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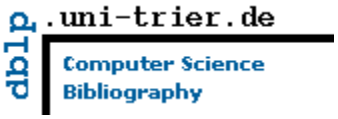

IJCSI Publicity Board 2010

EDITORIAL

In this third edition of 2010, we bring forward issues from various dynamic computer science areas ranging from system performance, computer vision, artificial intelligence, software engineering, multimedia , pattern recognition, information retrieval, databases, security and networking among others.

As always we thank all our reviewers for providing constructive comments on papers sent to them for review. This helps enormously in improving the quality of papers published in this issue.

IJCSI will maintain its policy of sending print copies of the journal to all corresponding authors worldwide free of charge. Apart from availability of the full-texts from the journal website, all published papers are deposited in open-access repositories to make access easier and ensure continuous availability of its proceedings.

The transition from the 2nd issue to the 3rd one has been marked with an agreement signed between **IJCSI** and **ProQuest** and **EBSCOHOST**, two leading directories to help in the dissemination of our published papers. We believe further indexing and more dissemination will definitely lead to further citations of our authors' articles.

We are pleased to present IJCSI Volume 7, Issue 3, May 2010, split in eleven numbers (IJCSI Vol. 7, Issue 3, No. 1). The acceptance rate for this issue is 37.88%.

We wish you a happy reading!

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Distributed Maximality based CTL Model Checking

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Abstract

In this paper we investigate an approach to perform a distributed CTL Model checker algorithm on a network of workstations using Kleen three value logic, the state spaces is partitioned among the network nodes, We represent the incomplete state spaces as a Maximality labeled Transition System MLTS which are able to express true concurrency. we execute in parallel the same algorithm in each node, for a certain property f on an incomplete MLTS , this last compute the set of states which satisfy f or which if they fail f are assigned the value $\perp$ .The third value $\perp$ mean unknown whether true or false because the partial state space lacks sufficient information needed for a precise answer concerning the complete state space .To solve this problem each node exchange the information needed to conclude the result about the complete state space. The experimental version of the algorithm is currently being implemented using the functional programming language Erlang.

Keywords: *Author Guide, Article, True concurrency semantics; State space explosion problem; Distributed model checking; three value logic.*

1. Introduction

Model checking is powerful technique for verifying reactive systems able to find subtle errors in real commercial designs, it is gaining wide industrial acceptance. Compared to other formal verification (e.g theorem proving) Model checking is largely automatic[1][2].In our approach the application to be verified is firstly specified by means of the formal description technique LOTOS[3][4] . This specification is translated, using the maximality based operational semantics, to a graph called Maximality-based Labeled Transition System (MLTS)[5] . This graph is used for the properties verification.

The main limiting factor of Model checking technique is the so called explosion problem where translation from the specification of the application to a state transition graph usually involves an exponential blow-up. State space does not fit into memory or state space fits in memory, but is too large for being explored entirely (e.g., access to hash table becomes slower as the number of states grows).

Three approaches has been proposed in the literature for tackling this problem, the first one uses some equivalence relation to reduce the number of states and transitions in the model (bisimulation relations, alpha reduction relation, partial order based relations, ...)[6][7][8]. The second approach consists of coding the model in an efficient representation like binary decision diagram (BDD) [9][10][11].

To overcome hardware limitations, a third approach is deeply investigated currently. This approach consists of using a cluster or a network of workstations. This last technique has showed its efficiency since it can preserve the result of the first and second approach with increasing performance[12][13] [14].

In this paper we continue our work for the parallelization of the model checking based on the maximality semantics the first step for the parallelization of the construction of the state space, which is modeled as Maximality Labeled Transition System has achieved with success, for more information we refer the reader to [14], in this paper we present the second step which is the parallelization of the Model checking verification algorithm discussed in [1].

First the state graph is partitioned among the network nodes, i.e. each network node owns a subset of the state space. Each node executes an instance of the parallel generation algorithm which computes partial MLTS[14].

Secondly we execute in parallel the same CTL Model checker algorithm in each node on these incomplete structure, this last use three value logic of Kleen [15][16] and return $\perp$ only when the partial state space lacks information needed for a defined answer about the complete state space. The algorithm exchange information about Border States which is not present in

the node to conclude the result about the complete state space; if an arbitrary node has new information he need to make a re-computation.To the best of our knowledge our Algorithm of verification is the first fix point algorithm of model checker which can be executed in parallel on Maximality Labeled Transition System.

2. Maximality Semantics

We assume that the reader is familiar with behavioural part of LOTOS and its interleaving semantics.

2.1 Maximality based Labeled Transition System

M being a countable set of events names, a maximality-based labeled transition system of support M is a quintuplet $(\Omega, A, \mu, \xi, \psi)$ with :

$\Omega = (S, T, \alpha, \beta)$ is a transition system such that :

S : the countable set of states in which the system can be.

T : the countable set of transitions indicating the change of system states.

α and β are two functions from T to S such that : for any transition $t \in T$; $\alpha(t)$ denotes the origin of the transition and $\beta(t)$ its goal.

(Ω, A) is a transition system labeled by an alphabet A.

$\psi : S \to 2^m$: is a function which associates to every state a finite set of maximal event names present at this state.

$\mu : T \to 2^m$:is a function which associates to every transition a finite set of event names corresponding to actions that have start their execution such that their terminations allow the start of this transition.

$\xi : T \to M$: is a function which associates to its transition an event name identifying its occurrence. Such that for any transition $t \in T$, $\mu(t) \in \psi(\alpha(t))$, $\xi(t) \notin \psi(\alpha(t)) - \mu(t)$ and $\psi(\beta(t)) = (\psi(\alpha(t)) - \mu(t)) \cup \{\xi(t)\}$.

2.2 The intuition behind the Maximality semantics

The semantics of a concurrent system can be characterized by the set of states of the system and transitions by which the system passes a state to another. In the approach based on the maximality, transitions are events that only represent the beginning of the execution of actions. Consequently, the concurrent execution of several actions becomes possible; hence we can distinguish sequential executions and parallel executions of actions. Being given that several actions have the same name can be executed in parallel (auto concurrency), we associate, to distinguish the executions of each action, an identifier to every beginning of the execution of that action. In a state, an event is said maximal if it corresponds to the beginning of the execution of an action that can be possibly always executing in this state. In order to illustrate this semantics let us consider the following example :

F = a; b ; stop [] b; a ;stop E = a ; stop ||| b ; stop

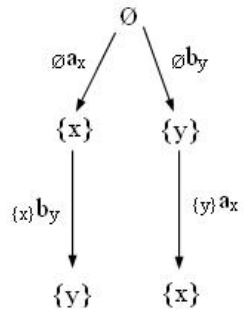

Fig.1 F = a; b ; stop [] b; a ;stop.

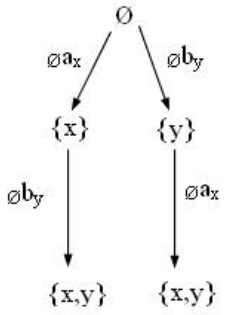

Fig.2 E = a ; stop ||| b ; stop

Fig.1 represents the MLTS of the LOTOS behavioral expression F and Fig.2 represents the MLTS of the LOTOS behavioral expression E. It is clear that in states 2 and 4 of Fig.2 actions a and b are currently executed in parallel this fact is represented by the presence of the two event names x and y in each states . However, in states 2 and 4 of Fig.1, only one action may be in execution, this fact is captured by the presence of one event name in each state. A detailed presentation of the maximality semantics can be found in .

The maximality based operational semantics of LOTOS is defined on configurations associated to behavior expressions. For illustration, let us reconsider the

behavioral expressions E and F . In the initial state, no action has been executed again, therefore the sets of maximal event names associated to the initial states are empty, hence the initial configurations associated to the behavior expressions E and F are ${}_{\varnothing}[E]$ and ${}_{\varnothing}[F]$. So *a configuration represents a state.* When applying the maximality base operational semantics, the following derivations are possible :

$${}_{\varnothing}[E] \overset{\varnothing\, a_x}{\bullet}_m \qquad {}_x[stop] \,|||_{\varnothing}\, [b;stop] \qquad \overset{\varnothing\, b_y}{\bullet}_m \qquad {}_x[stop] \,|||_y\, [stop] \quad (1)$$

x (respectively y) being the name of the event identifying the beginning of the action "a" (respectively "b""). Note that nothing can be concluded on the termination of the two actions a and b in the configuration :

$${}_x[stop] \,|||_y\, [stop] \quad (2)$$

x and y are said maximal in this configuration. Let's note that x is also maximal in the intermediate state represented by the configuration:

$${}_x[stop] \,|||_{\varnothing}\, [b;stop] \quad (3)$$

For the implementation we can implement events as integer.

Definition 1 . A Kripke structure M is a tuple (S, L, R, I) , where S is a finite set of states, $L : S \times AP \to \{true, false\}$ is an interpretation that associates a truth value in $\{true, false\}$ with each atomic proposition $P \in AP$ the set of all atomic proposition, for each state in S , $R \subseteq S \times S$ is a transition relation on S , and $I \subseteq S$ is a set of initial states.

3. Maximality Labeled Transition System as Kripke Structure

let M=($\Omega, A, \mu, \xi, \psi$) be an MLTS such that $\Omega = (S, T, \alpha, \beta)$ and let K= (S, L, R, I) be a kripke structure, it is clear to see that if we take from M the maximal events as atomic proposition we can consider M as a kripke structure defined by : (S, ψ, T, I).

Example 1. : we take the example of the MLTS in Fig.2 this MLTS can be seen as kripke structure like this :

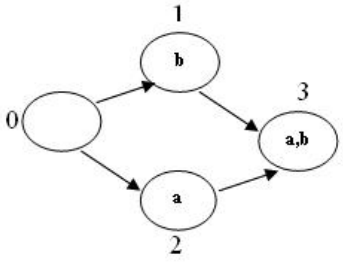

Fig .3 The MLTS of E = a ; stop ||| b ; stop as Kripke structure

The atomic propositions are based on the content of states, since we can define each state as a function:

This function answer the question: "is the arbitrary action "a" currently executed in the state i?" to make an idea let consider the MLTS of Fig 2:

$$state_2(a) = True; state_2(b) = True$$

Whereas:

$$state_1(a) = True; state_1(b) = False$$

for example if "a" = A-InCriticalSection and "b" = B-InCriticalSection we can see that the state 2 violate the principle of mutual exclusion (safety property : some thing bad never happen) . We make the remark that the model of MLTS is very rich of information and also can be used for the scheduling in multiprocessor platform, since it represent also the dependence between action. The main advantage is that this graph can be generated automatically by a compiler. Our use of MLTS here as logical Model for verification is very simple than scheduling since we don't need all the information contained in it.

Definition 2 . Let $M = (S, L, R, I)$ a Kripke structure, the set of border states in M is $border(M) = \{s \in S \mid \neg \exists s'.(s, s') \in R\}$.[19]

Definition 3 . Let $M = (S, L, R, I)$ be a Kripke structure, $T \subseteq S$. We define the partial kirpke structure $\Phi_M(T) = (S_T, L_T, R_T, I_T)$ as follows:

$$S_T = \{s \mid s \in T or \exists s' \in T : (s', s) \in R\}$$
$$R_T = \{(s_1, s_2) \in R \mid s_1 \in T, s_2 \in S_T\}$$
$$I_T = \{s \in S_T \mid s \in I\}$$
$$L_T : S_T \times P \to \{false, \perp, true\}$$

We call the partial Kripke structure $\Phi_M(T)$ a *fragment* of M, the states in the set T are all present in the Node and $S_T - T$ is the set of border states of $\Phi_M(T)$ i.e $border(\Phi_M(T))$. From the definition of R_T we can see that the fragment $\Phi_M(T)$ know all the *immediate successors* of the states present in the node i.e in T [19]. The truth function L_T for the fragment of M and a CTL formula φ is a total function

$L_T : S \times \varphi \to \{True, \perp, False\}$.

$L_T(s,\varphi) = True$ iff $M, s \Box \varphi$ and $L_T(s,\varphi) = False$ iff $M, s \not\Box \varphi$ we use $L_T(s,\varphi) = \perp$ if we don't know the truth value at certain stage of computation of the truth function for example in the start of computation of the truth on border states.

The truth function on the complete Kripke structure M is a total function $L : S \times \varphi \to \{True, False\}$. since all the information for the computation needed are available we don't need the third value unknown represented by $\perp$.

Definitions .4 Let $M = (S, L, R, I)$ be a Kripke structure,and $\Phi_M(Z)$ a fragment of M we define :

$T(p) = \{s \in S \mid L(s,p) = true\}$
$U(p) = \{s \in S \mid L(s,p) = \perp\}$
$F(p) = \{s \in S \mid L(s,p) = false\}$

for $s \in T, inT(s) = (1,s)$
for $s \in U, inU(s) = (\perp, s)$
for $s \in F, inF(s) = (o,s)$

$T^+(p) = \{inT(s) \mid \forall s \in T(p)\}$
$U^+(p) = \{inU(s) \mid \forall s \in U(p)\}$
$F^+(p) = \{inF(s) \mid \forall s \in F(p)\}$
$S^+(p) = T^+(p) \cup U^+(p) \cup F^+(p)$
$\forall e_1, e_2 \in S^+$ we have $e_1 B e_2$ iff $snd(e_1) = snd(e_2)$

We Interpret the logical operators $\wedge$ and $\vee$ on partial kripke structure using Kleene's three value logic . An accurate and compatible interpretation of Kleene's connectives was given by Korner [15].Korner defined the notion of an inexact class of a given non-empty domain A generated by a partial definition D(P) of a property P of elements of A as a three-valued ``characteristic function'

$X_p : A \to \{-1, 0, 1\}$

$$X_p(a) = \begin{cases} -1 & when\ P(a)\ according\ to\ D(P)\ is\ false, \\ 0 & when\ P(a)\ is\ D(P) - undecidable, \\ 1 & when\ P(a)\ according\ to\ D(P)\ is\ true. \end{cases}$$

Any family of inexact classes of a given domain *A* is a de Morgan lattice, the algebraic operations $\cup, \cap$ and $-$:

$(X \cup Y)(a) = max\{X(a), Y(a)\}$
$(X \cap Y)(a) = min\{X(a), Y(a)\}$
$(-X)(a) = -X(a)$

being counterparts of the Kleene connectives[15]. We now consider our theory based on the theory mentioned above :

Let $B_\perp = \{false, \perp, true\}$.
Let $(B_\perp, <)$ be a total order such that :

$false < \perp < true$

$\forall e_1, e_2 \in S^+$ in the case when $e_1 B e_2$ we have :

$e_1 \wedge e_2 = (min(fst\ e_1, fst\ e_2), snd\ e_1)$
$e_1 \vee e_2 = (max(fst\ e_1, fst\ e_2), snd\ e_1)$
Let $S \subseteq S^+$ and $G \subseteq S^+$ we define :

$S \lceil G = \{e_1 \wedge e_2 \mid \forall e_1 \in S, \forall e_2 \in G\ such\ that\ e_1 B e_2\}$
$S \lfloor G = \{e_1 \mid \forall e_1 \in S\ and\ \nexists e_2 \in G\ such\ that\ e_1 B e_2\}$
$\cup \quad \{e_2 \mid \forall e_2 \in G\ and\ \nexists e_1 \in S\ such\ that\ e_1 B e_2\} \quad \cup$
$\{e_1 \vee e_2 \mid \forall e_1 \in S, \exists e_2 \in G\ such\ that\ e_1 B e_2\}$

Let $succ$ be a function defined as follow :

succ : $S^+ \to 2^{S^+}$
$succ(e) = \{e'^+ \mid (snd(e), snd(e')) \in R\}$

4. CTL model checking on fragments

Theorem.1 Given $M = (S, L, R, I)$ a fragment of Kripke structure and a CTL formula, the following recursive algorithm compute the set of states $H(f) \subseteq S$ which satisfy f or it may satisfy f and exclude all states which not satisfy f.

• $H(p) = T^{+}(p) \cup U^{+}(p)$ such that p is an atomic proposition

• $H(\neg f) = \{inT(s) \mid s \in (S - map(snd, H(f))\} \cup U^{+}(f)$

• $H(f \wedge g) = H(f) \sqcap H(g)$

• $H(f \vee g) = H(f) \sqcup H(g)$

•

$H(AXf) =$

$(\{InT(snd(e)) \mid \forall e \in S^{+}(f).succ(e) \subseteq T^{+}(f) \subseteq H(f)\}$

$\cup \{inU(snd(e)) \mid \forall e \in S^{+}(f).succ(e) \subseteq (T^{+}(f) \cup U^{+}(f))$

$and\ \exists e' \in succ(e)\ such\ that\ e'^{+}(f)\}) \sqcup$

$\{inU(s) \mid s \in border(M)\}$

•

$H(EXf) = (\{InT(snd(e)) \mid \forall e \in S^{+}(f).\exists e' \in succ(e)\ and\ e'^{+}(f)\}$

$\cup$

$\{inU(snd(e)) \mid \forall e \in S^{+}(f).succ(e) \subseteq U^{+}(f) \subseteq H(f)\})$

$\sqcup$

$\{inU(s) \mid s \in border(M)\}$

• $H(AGf) = \upsilon Z.(H(f) \sqcap AXZ)$

• $H(AFf) = \mu Z.(H(f) \sqcup AXZ)$

• $H(A(fUG)) = \mu Z.(H(g) \sqcup (H(f) \sqcap AXZ))$

After the application of the above recursive algorithm we have $\forall s \notin H(f) \Rightarrow L(s, f) = false$. The other operators like EG can be all deduced from the operators cited above, for example $H(EGf) = H(\neg(AF\neg f))$ for more information we refer the reader to [2].

proof

• For the atomic proposition we can see that $H(p)$ is the set of states where the formula hold or where the formula may hold i.e where we are not sure that the formula is false

• For the case of $H(AXf)$: The set $(\{InT(snd(e)) \mid \forall e \in S^{+}(f).succ(e) \subseteq T^{+}(f) \subseteq H(f)\}$ represent the set of states where all of there successors are states where the formula f holds, and the set $\{inU(snd(e)) \mid \forall e \in S^{+}(f).succ(e) \subseteq (T^{+}(f) \cup U^{+}(f))\ and \exists e' \in succ(e)\ such\ that\ e'^{+}(f)\}$ represent the set of states where there successors may satisfy f, hence this set is the set of states where $H(AXf)$ may be satisfied. Furthermore because we don't know the successors of the border states we add this sates to the result of computation $\{inU(s) \mid s \in border(M)\}$ because this states may satisfy the formula $H(AXf)$.

• We will prove the fix point characterization of the operators AGf, the fix point characterization for the remaining CTL operators can be established in similar manner. The set 2^{S} of all subset of S form a lattice under the set inclusion ordering. Each element s' of the lattice can also be thought of as a predicate on S where the predicate is viewed as being true or may be true $\perp$ for exactly the states in s'. The least element in the lattice is the empty set, which we also refer to as False , and the greatest element in the lattice is the whole set S, which we sometimes write as True. A function that maps 2^{S} to 2^{S} will be called a predicate transformer. We follow the same manner as in [2] first we can see that $\tau(Z) = H(f) \sqcap AXZ$ is monotonic, and $\sqcap$-continuous by the theorem of Tarski and Knaster we can conclude that AGf is the great fix point of. $\tau(Z) = H(f) \sqcap AXZ$

proposition 1:The predicate transformer $\tau(Z) = H(f) \sqcap AXZ$ is monotonic

proof

let $P_1 \subseteq P_2$ To show that $\tau(P_1) \subseteq \tau(P_2)$, consider an arbitrary sate $s \in \tau(P_1)$.Then s satisfy f or it may satisfy f. $i.e(L(s, f) = true\ or\ L(s, f) = \perp)$ and for all states s' such that $(s, s') \in R$ and $s' \in P_1$. Because $P_1 \subseteq P_2$, $s' \in P_2$ as well thus $s' \in \tau(P_2)$

proposition 2:The predicate transformer $\tau(Z) = H(f) \sqcap AXZ$ is $\sqcap$-continuous

proof

We want to proof that $\tau(\sqcap_i P_i) = \sqcap_i \tau(P_i)$.

first we can see that $(P_1 \sqcap P_2) \subseteq P_1$ because τ is monotonic we have $\tau(P_1 \sqcap P_2) \subseteq \tau(P_1)$ the same for $\tau(P_1 \sqcap P_2) \subseteq \tau(P_2)$ which mean that $\tau(P_1 \sqcap P_2) \subseteq (\tau(P_1) \sqcap \tau(P_1))$ more generale we have $\tau(\sqcap_i P_i) \subseteq \sqcap_i \tau(P_i)$. Furthermore we have for an arbitrary state $s \in (\tau(P_1) \sqcap \tau(P_2) \sqcap ... \tau(P_n))$ this mean that : [illegible] and $s \in \tau(P_2)$ ... $s \in \tau(P_n)$ this mean that: $(s \in \tau(P_1) \Leftrightarrow s \Box_{may} f$ and $\forall s'$ such that

$(s,s') \in R$ implies that $s' \in P_1)$ and ... $(s \in \tau(P_n) \Leftrightarrow s \Box_{may} f$ and $\forall s'$ such that $(s,s') \in R$ implies that $s' \in P_n)$.

Hence $s \in \tau(P_2) ... s \in \tau(P_n)$ implies $s \Box_{may} f$ and $s' \in (P_1 \cap P_2 ... \cap P_n)$ which mean that $s \in \tau(\cap_i P_i)$ i.e $\cap_i \tau(P_i) \subseteq \tau(\cap_i P_i)$ Ω

With an informal way we can see that at the first iteration we have all the state which satisfy f or it may satisfy f, lets said that this set is Z_1, at the second iteration we compute the set of states which is in Z_1 and there successor satisfied f or it may satisfied f i.e there successor is in Z_1, we forward the computation on the successors until we reach a fix point. Hence we understand that we have giving to the operators AGf the semantics, that we look for the states s, which has the property that all the states of the paths stemming from s satisfy f or it may satisfy f. Ω

Example 2 lets take the fragment of the Kripke Structure M shown on Figure 8 in node 1, and the property to be checked on this fragment is $AG(a \vee c)$:

$H(a) = T^+(a) \cup U^+(a)$, $T^+(a) = \{(1,2)\}$,
$U^+(a) = \{(\perp,3),(\perp,4)\}$
$H(a) = \{(1,2),(\perp,3),(\perp,4)\}$
$H(c) = \{(\perp,3),(\perp,4)\}$, $H(a \vee c) = H(a) \cap H(c)$
$H(a \vee c) = \{(1,2)\} \cup \{(\perp,3) \vee (\perp,3),(\perp,4) \vee (\perp,4)\}$
$H(a \vee c) = \{(1,2),(\perp,3),(\perp,4)\}$
$H(AG(a \vee c)) = \upsilon Z.(\{(1,2),(\perp,3),(\perp,4)\} \cap AXZ)$
$Z_0 = \{(1,1),(1,2),(1,3),(1,4)\}$
$AXZ_0 = \{(1,1),(1,2),(1,3),(1,4)\} \cap \{(\perp,3),(\perp,4)\}$
$AXZ_0 = \{(1,1),(1,2),(1,3),(1,4)\}$
$Z_1 = \{(1,2),(\perp,3),(\perp,4)\} \cap AXZ_0$
$Z_1 = \{(1,2),(\perp,3),(\perp,4)\}$
$AXZ_1 = \{(1,1),(\perp,2)\} \cap \{(\perp,3),(\perp,4)\}$
$AXZ_1 = \{(1,1),(\perp,2),(\perp,3),(\perp,4)\}$
$Z_2 = \{(1,2)(\perp,3),(\perp,4)\} \cap AXZ_1 = \{(\perp,2),(\perp,3),(\perp,4)\}$
$Z_3 = \{(\perp,2),(\perp,3),(\perp,4)\}$
$Z_3 = Z_2$

Fix point reached, the algorithm stop the computation, from the precedent theorem. we conclude that, $L(1, AG(a \vee c)) = false$ so the final result of computation on the fragment in node 1 is :

$\{(0,1),(\perp,2),(\perp,3),(\perp,4)\}$

5. Distributed CTL Model checking

The main idea of the distributed verification algorithm is that if we want to check some formula φ in some state s see figure 4, it is clear that the truth of formula depend on the truth of this formula in s' which is in node II. Hence we start the computation in node I with $L(s', \varphi) = \perp$, i.e we consider that the formula ϕ may hold in s'. when the node II finish the computation, if the formula hold in s', the node number I make a recomputation and found that the formula hold in s for example in the case of $\varphi \in \{EGf, AGf, AFf, EFf, A(fUg), E(fUg)\}$ and the result of the first computation in node I is $\perp$. If the formula don't hold in s' and the result of the first computation in node I is $\perp$ this mean that the formula don't hold in s. The main difference between the reasoning algorithm on fragments and the distributed Algorithm is that in the case of $\varphi \in \{EGf, AGf, AFf, EFf, A(fUg), E(fUg)\}$ we consider in the fragments algorithm that f may hold in border states, but in the distributed version we consider the whole formula φ not only f may hold in border states and the truth on border states is parameter passed to the predicate transformer as follow :

- $AFp = \lambda Y.\mu Z.(p \vee Y \vee AXZ)$
- $EFp = \lambda Y.\mu Z.(p \vee Y \vee EXZ)$
- $AGp = \lambda Y.\upsilon Z.(p \vee Y \wedge AXZ)$
- $EGp = \lambda Y.\upsilon Z.(p \vee Y \wedge EXZ)$

- $A(p \cup q) = \lambda Y.\mu Z.(q \vee Y \vee (p \wedge AXZ))$
- $E(p \cup q) = \lambda Y.\mu Z.(q \vee Y \vee (p \wedge EXZ))$

where

$Y = \{s \in border(M) \mid L(s,\varphi) = True \text{ or } L(s,\varphi) = \perp\}$

and φ is an arbitrary formula represented by one of the six operator described above respectively, here Y represent the missing part of information in border sates ,if some one give us the set of border sates where the formula to be verified is valid we can conclude the truth of the formula on the whole Kripke structure, this fact can be represented as the application of model checking function to the given information.

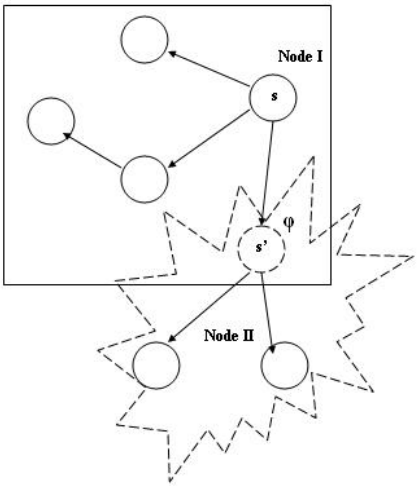

Fig .4

Theorem .2 Given $M = (S, L, R, I)$ a fragment of Kripke structure , a CTL formula $\varphi(f)$ and $Y = H_b\varphi(f)$ the set $s \in border(M)$ which satisfy $\varphi(f)$ or it may satisfy $\varphi(f)$, the following recursive algorithm compute the set of states $H(\varphi(f)) \subseteq S$ which satisfy $\varphi(f)$ or it may satisfy $\varphi(f)$ and exclude all states which not satisfy $\varphi(f)$.

- $H(p) = \lambda Y.T^+(p) \cup U^+(p)$ such that p is an atomic proposition
- $H(\neg f) = \lambda Y.\{inT(s) \mid s \in (S - map(snd, H(f))\} \cup U^+(f)$
- $H(f \wedge g) = \lambda Y.H(f) \sqcap H(g)$
- $H(f \vee g) = \lambda Y.H(f) \sqcup H(g)$
- $H(AXf) = \lambda Y.(\{InT(snd(e)) \mid \forall e \in S^+(f).succ(e) \subseteq T^+(f) \subseteq H(f)\} \cup \{inU(snd(e)) \mid \forall e \in S^+(f).succ(e) \subseteq (T^+(f) \cup U^+(f)) \text{ and } \exists e' \in succ(e) \text{ such that } e' \in^+(f)\}) \sqcup \{inU(s) \mid s \in border(M)\}$
- $H(EXf) = \lambda Y.(\{InT(snd(e)) \mid \forall e \in S^+(f).\exists e' \in succ(e) \text{ and } e' \in^+(f)\} \cup \{inU(snd(e)) \mid \forall e \in S^+(f).succ(e) \subseteq U^+(f) \subseteq H(f)\}) \sqcup \{inU(s) \mid s \in border(M)\}$
- $H(AGf) = \lambda Y.\upsilon Z.((H_p(f) \sqcup Y) \sqcap AXZ)$
- $H(AFf) = \lambda Y.\mu Z.((H_p(f) \sqcup Y) \sqcup AXZ)$
- $H(A(fUG)) = \lambda Y.\mu Z.((H_p(g) \sqcup Y) \sqcup (H_p(f) \sqcap AXZ))$

Note : $H(f) = H_p(f) \sqcup Y$ where $H_p(f)$ is the set of state $s \notin border(M)$ which satisfy f or it may satisfy f Ω

Lemma .1

The result of the above recursive algorithm can be influenced only by the truth value of formula to be verified on border states thus we need a recomputation only when the truth value on border states change.

proof

The proof is easy, we can see that the model checking algorithm is a function depend only on Y the truth value of the formula to be checked on border states. Ω

Lemma .2

The distributed termination is reached when no change of the information on all border states.

proof

using lemma.1 we can see that if there is no change in all border states, each instance of the distributed algorithm don't need to make a new computation , a hence the distributed algorithm reach a fix point and terminate. Ω

Lemma .3

When the termination is detected and still some value has undefined truth on some sates s i.e $L(s, f) = \perp$, example in the case of cycle, this implies that :

1. In the case of $f = AG\phi$, $L(s, f) = true$
2. In the case of $f = AF\phi$, $L(s, f) = false$

3. In the case of $f = A(\phi_1 U \phi_2)$, $L(s, f) = false$

proof

The proof is easy, we can see that the transition relation is a partial order, in the example of figure 5 we have $1 \prec 2 \prec 3 \prec 1$ i.e that the truth of the formula in state 1 depend on the truth of the formula in sate 2 and so on, since we know the truth of the immediate component of our formula (in the example is just atomic proposition P) in the state present in the node, which must be true for arriving to this situation, we conclude the result about the whole Kripke. Ω

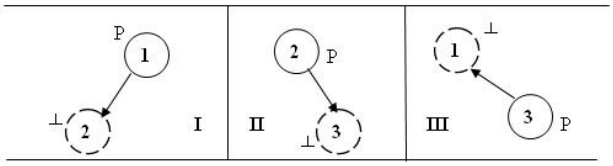

Fig .5 The Fragments of M distributed over Nodes

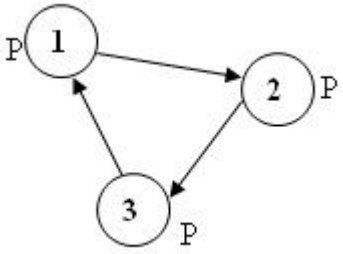

Fig .6 The Kripke structure M with cycle

Example 3.

Structure M shown in Figure 7, property to be checked on M is $AG(a \vee c)$:

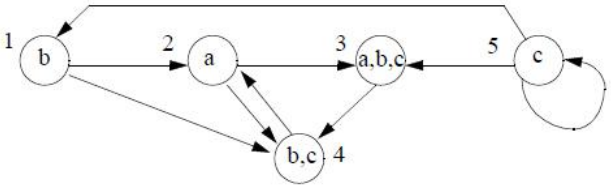

Fig .7The Kripke structure M

$S = \{1,2,3,4,5\}, AP = \{a,b,c\},$

$R = \{(1,2),(2,3),(3,5),(5,5),(5,1),(2,4),(4,2),(1,4),(3,4)\}$

, $L(1) = \{b\}, L(2) = \{a\}, L(3) = \{a,b,c\}, L(4) = \{b,c\}, L(5) = \{c\}$

The partitioning of the system on three network nodes using the following partition function h is shown in figure 8 :

$h : \{s_1, s_2, s_3, s_4, s_5\} \rightarrow \{node_1, node_2, node_3\}$

$h(1) = h(2) = 1, h(4) = 2, h(3) = h(5) = 3$

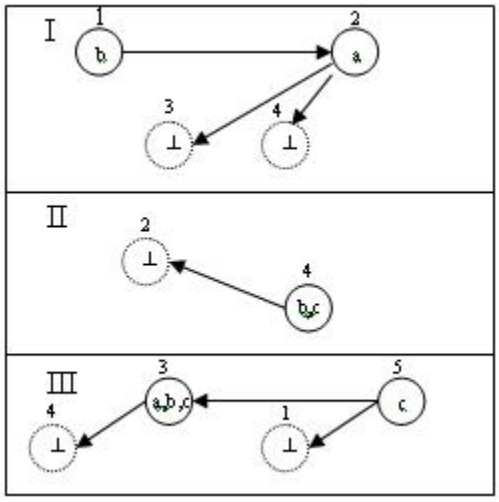

Fig .8 The Fragments of M distributed over Nodes

The application of the Algorithm on the complete M give the same result as in [2], $H(AG\, a \vee c) = \{2,3,4\}$, since all the information needed for the computation is available. We make the remark that in the case of the application of the algorithm in the complete Kripke, our Algorithm can be simplified to the Algorithm in [1], because $Y = \{\}$ and the operations $\lceil, \lfloor$ will be $\cap, \cup$ respectively .

iteration 1:

Node I :

$H_p(a) = \{(1,2)\}$

$H_p(c) = \{\}$

$H_p(a \vee c) = \{(1,2)\}$

$Y = H_B(AG(a \vee c)) = \{(\perp,3),(\perp,4)\}$

$H(a \vee c) = Y \lfloor H_p(a \vee c) = \{(1,2),(\perp,3),(\perp,4)\}$

$H(AG(a \vee c)) = \upsilon Z.(\{(1,2),(\perp,3),(\perp,4)\} \lceil AXZ)$

$Z_0 = \{(1,1),(1,2),(1,3),(1,4)\}$

$AXZ_0 = \{(1,1),(1,2),(1,3),(1,4)\} \lfloor \{(\perp,3),(\perp,4)\}$

$AXZ_0 = \{(1,1),(1,2),(1,3),(1,4)\}$

$Z_1 = \{(1,2),(\perp,3),(\perp,4)\} \lceil AXZ_0$

$Z_1 = \{(1,2),(\perp,3),(\perp,4)\}$

$AXZ_1 = \{(1,1),(\perp,2)\} \lfloor \{(\perp,3),(\perp,4)\}$

$AXZ_1 = \{(1,1),(\perp,2),(\perp,3),(\perp,4)\}$

$Z_2 = \{(1,2),(\perp,3),(\perp,4)\} \lceil AXZ_1 = \{(\perp,2),(\perp,3),(\perp,4)\}$

$Z_3 = \{(\perp,2),(\perp,3),(\perp,4)\}$

$Z_3 = Z_2$

Fix point reached, the algorithm stop the computation and wait new information, if possible, about his border states, from the theorem 2. we conclude that, $L(1, AG(a \vee c)) = false$ so the final result of computation on the iteration 1 in node 1 is :

$$\{(0,1),(\perp,2),(\perp,3),(\perp,4)\}$$

Node II :

$H_p(a \vee c) = \{(1,4)\}$

$Y = H_B(AG(a \vee c)) = \{(\perp,2)\}$

$H(a \vee c) = Y \cup H_p(a \vee c) = \{(\perp,2),(1,4)\}$

$H(AG(a \vee c)) = \upsilon Z.(\{(\perp,2),(1,4)\} \cap AXZ)$

$Z_0 = \{(1,2),(1,4)\}$

$AXZ_0 = \{(\perp,2),(\perp,4)\}$

$Z_1 = \{(\perp,2),(\perp,4)\}$

$AXZ_1 = \{(\perp,2),(\perp,4)\}$

$Z_2 = \{(\perp,2),(\perp,4)\}$

$Z_3 = Z_2$

Node III :

$H_p(a \vee c) = \{(1,3),(1,5)\}$

$Y = H_B(AG(a \vee c)) = \{(\perp,1),(\perp,4)\}$

$H(a \vee c) = Y \cup H_p(a \vee c) = \{(1,3),(1,5),(\perp,1),(\perp,4)\}$

$H(AG(a \vee c)) = \upsilon Z.(\{(1,3),(1,5),(\perp,1),(\perp,4)\} \cap AXZ)$

$Z_0 = \{(1,1),(1,3),(1,4),(1,5)\}$

$AXZ_0 = \{(1,1),(1,3),(1,4),(1,5)\}$

$Z_1 = \{(\perp,1),(1,3),(\perp,4),(\perp,5)\}$

$AXZ_1 = \{(\perp,3),(\perp,5)\} \cup \{(\perp,1),(\perp,4)\}$

$AXZ_1 = \{(\perp,1),(\perp,3),(\perp,4),(\perp,5)\}$

$Z_2 = \{(\perp,1),(\perp,3),(\perp,4),(\perp,5)\}$

$Z_3 = \{(\perp,1),(\perp,3),(\perp,4),(\perp,5)\}$

$Z_3 = Z_2$ Fix point reached .

iteration 2:

Node III : we can make recomputing only in node III since from Lemma 1. only in node 3 we have a change in the truth of border states, because the truth value in sate 1 is changed:

$H(a \vee c) = \{(1,3),(1,5),(\perp,4)\}$

$Z_0 = \{(1,1),(1,3),(1,4),(1,5)\}$

$AXZ_0 = \{(1,1),(1,3),(1,4),(1,5)\}$

$Z_1 = \{(1,3),(\perp,4),(1,5)\}$

$AXZ_1 = \{(\perp,3),(\perp,4),(\perp,1)\}$

$Z_2 = \{(\perp,3),(\perp,4)\}$

$Z_3 = Z_2 = \{(\perp,3),(\perp,4)\}$

from theorem 2. we conclude that

$L(5, AG(a \vee c)) = false$ so the final result is in node III : $\{(\perp,3),(\perp,4),(0,5)\}$

using Lemma 2. because no change will happen in border states, the computation terminate , and the distributed algorithm halt in the iteration number 2.

using Lemma 3 . we conclude that :

$L(2, AG(a \vee c)) = true$, $L(3, AG(a \vee c)) = true$, $L(4, AG(a \vee c)) = true$. The final result of the whole computation on the three node is : $\{(1,2),(1,3),(1,4)\}$

6. Conclusions and related work

We have developing a theory of reasoning on fragments of MLTS using a three value logic as a base for a parallel model checker and presenting a natural approach for distributed model checking on MLTS, to the best of our knowledge, our algorithm is the first algorithm that use fix point model checking with three value logic on maximality labeled transition system. Closest to our work is the work of [19].In fact, the main problem of the distributed verification discussed here has been treated in their work, using the notion of Assumption, which is not a natural and easy approach for treating the problem , since they present there idea using an imperative paradigm which make the proof difficult . Furthermore they don't show how to get fragments of the system to be verified, for that reason I think it is not easy to apply their result directly to the industry. Our approach has several advantages, First we have showing how to get the fragments from a standard language and with a semantic model which allow the design of systems by action refinement, second we have making a little change to the approach of verification, all this make our idea easy to apply it for industry. Another work similar to our work in the principle of using three value logic of Kleen on partial Kripke structure was introduced by [16] but our algorithm is different from their Algorithm since they use a two pass , the first one is optimistic which consider the $\perp$ as true, the second pessimistic which consider the $\perp$ as false, hence the result of the Algorithm have four results (false, false) <(true, false) < (false, true) < (true, true), for that reason we think that our approach is the best since it is easy to adapt it for distributed Model checking. another

interesting work is the work of [20] which define a multi valued model checking , which is more general than our work, this work miss an application, our work can be considered as an application with special case using three value logic.

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References

[1] E.M. Clarke, E. A. Emerson, and A.P. Sistla. Automatic Verification of finite state concurrent systems using temporal logic Specifications. ACM transactions on Programming Languages And Systems, 8(2):244-263 (April1986).
[2] Edmund M Clarke,Orna Grumberg and al : Model check-ing MIT press ,2000 .
[3] T. Bolognesi and E. Brinksma, " Introduction to the ISO Specification Language LOTOS", volume 14, Computer Networks and ISDN Systems, 1987.
[4] ISO8807. LOTOS, a formal description technique based on the ordering of observation behaviour. ISO (November 1988).
[5] J. P. Courtiat and D. E. Saidouni. Relating maximality-based semantics to action refinement in process algebras. In "D. Hogrefe and S. Leue, Editors, IFIP TC/WG6.1, 7th Int. Cof of Formal Description Techniques(FORTE'94)", pages 293- 308. Chapman Hall (1995).
[6] Milner. "Communication and Concurrency". Prentice Hall (1989).
[7] D. E. Saidouni and A.Benamira Considiration of the cov-ering steps in The Maximality-based labled transitions systems in Proceedings of acit 2006.
[8] P. GodeFroid, " Using Partial Orders to Improve Auto-matic Verification Methods", in Proceedings of CAV'90, volume 3, pages321-340, ACM, DIMACS, 1990.
[9] R.E. Bryant, Graph-based algorithme for boolean func-tion Manipulation. IEEE Transactions on Computer Science, 37: 77-121, 1986.
[10] D.-E.Saidouni,O. Labbani Maximality-based symbolic model checking in ACS/IEEE International Conference July 2003.
[11]A. Layeb - D.E. Saidouni Quantum Differential Evolu-tion Algorithm for Variable Ordering Problem of Binary Decision Diagram in 13th International CSI Computer Conference 2008.
[12]F. Lerda and R. Sisto Distributed-Memory Model Check-ing with SPIN in Proceedings of the 5th and 6th Inter-national SPIN Workshops on Theoretical and Practical Aspects of SPIN Model Checking,1999.
[13] H. Garavel, R. Mateescu, and I. Smarandache. Parallel state space Construction for model-checking. In Proc. 8th Inter. SPIN Workshop, volume LNCS 2057, pages 217-234. Springer, 2001. Revised version available as INRIA Research Report RR-4241, Dec. 2001.
[14] Z. El Abidine Bouneb, D. E. Saidouni : Parallel state space construction for a model checking based on max-imality semantics - CISA 2009
[15] The Handbook of the History of Logic volume 8 : The Many valued and nonmonotonic turn in Logic ISBN: 978-0-444-51623-7, 2007.
[16] G.Bruns and P.Godefroid Model Checking Partial State Spaces with 3-valued Temporal logics in CAV Interna-tional Conference 1999.
[17] L. Lamport. What good is temporal logic ? Information processing, 83:657-668, 1983.
[18] ftp://ftp.rfc-editor.org/in-notes/rfc1321.txt
[19] Lubos Brim, Karen Yorav, Jitka Zidkova : Assumption-based distribution of CTL model checking, Springer-Verlag 2004
[20] Marsha Chechik, Steve M. Easterbrook, Benet Devereux: Model Checking with Multi-Valued Temporal Logics.

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Different Forms of Software Testing Techniques for Finding Errors

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Abstract

Software testing is an activity which is aimed for evaluating an attribute or capability of a program and ensures that it meets the required result. There are many approaches to software testing, but effective testing of complex product is essentially a process of investigation, not merely a matter of creating and following route procedure. It is often impossible to find all the errors in the program. This fundamental problem in testing thus throws open question, as to what would be the strategy that we should adopt for testing. Thus, the selection of right strategy at the right time will make the software testing efficient and effective. In this paper I have described software testing techniques which are classified by purpose.

Keywords: *Correctness Testing, Performance Testing, Reliability Testing, Security Testing*

1. Introduction

Software testing is a set of activities conducted with the intent of finding errors in software. It also verifies and validate whether the program is working correctly with no bugs or not. It analyzes the software for finding bugs. Software testing is not just used for finding and fixing of bugs but it also ensures that the system is working according to the specifications. Software testing is a series of process which is designed to make sure that the computer code does what it was designed to do. Software testing is a destructive process of trying to find the errors. The main purpose of testing can be quality assurance, reliability estimation, validation or verification. The other objectives or software testing includes. [6][7][8]

- The better it works the more efficiently it can be tested.
- Better the software can be controlled more the testing can be automated and optimized.
- The fewer the changes, the fewer the disruption to testing.
- A successful test is the one that uncovers an undiscovered error.
- Testing is a process to identify the correctness and completeness of the software.
- The general objective of software testing is to affirm the quality of software system by systematically exercising the software in carefully controlled circumstances.

Classified by purpose software testing can be divided into [4]

1. Correctness Testing
2. Performance Testing
3. Reliability Testing
4. Security Testing

2. Software Testing Techniques

Software testing is a process which is used to measure the quality of software developed. It is also a process of uncovering errors in a program and makes it a feasible task. It is useful process of executing program with the intent of finding bugs. The diagram below represents some of the most prevalent techniques of software testing which are classified by purpose. [4]

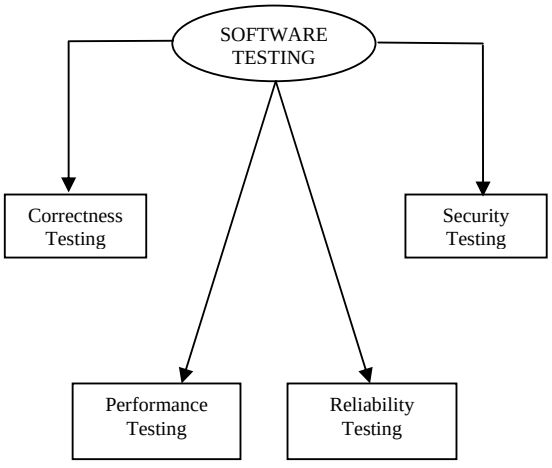

Fig. 1 Represent different software testing techniques which are classified by purpose

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2.1 Correctness Testing

The most essential purpose of testing is correctness which is also the minimum requirement of software. Correctness testing tells the right behavior of system from the wrong one for which it will need some type of Oracle. Either a white box point of view or black box point of view can be taken in testing software as a tester may or may not know the inside detail of the software module under test. For e.g. Data flow, Control flow etc. The ideas of white box, black box or grey box testing are not limited to correctness testing only. [4]

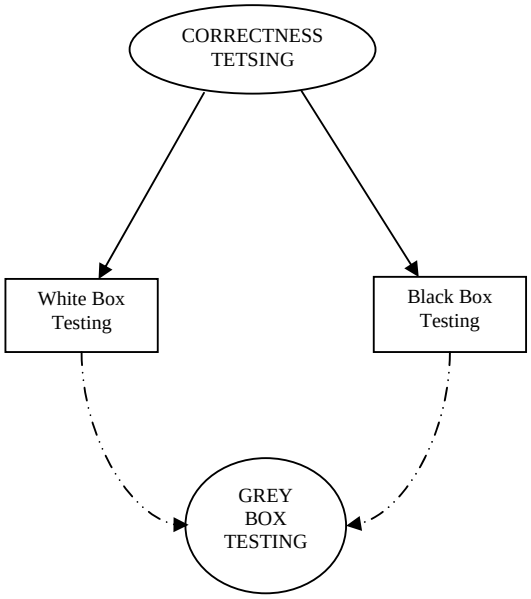

Fig. 2 Represent various form of correctness testing

2.1.1 White Box Testing

White box testing based on an analysis of internal working and structure of a piece of software. White box testing is the process of giving the input to the system and checking how the system processes that input to generate the required output. It is necessary for a tester to have the full knowledge of the source code. White box testing is applicable at integration, unit and system levels of the software testing process. In white box testing one can be sure that all parts through the test objects are properly executed. [2][10]

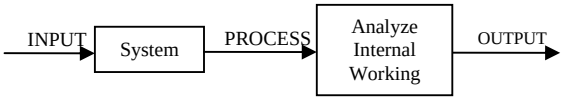

Fig. 3 Represent working process of White Box Testing

Some synonyms of white box testing are [5]

- Logic Driven Testing
- Design Based Testing
- Open Box Testing
- Transparent Box Testing
- Clear Box Testing
- Glass Box Testing
- Structural Testing

Some important types of white box testing techniques are:

1. Control Flow Testing
2. Branch Testing
3. Path Testing
4. Data flow Testing
5. Loop Testing

There are some pros & cons of white box testing-

Pros-

1. Side effects are beneficial.
2. Errors in hidden codes are revealed.
3. Approximate the partitioning done by execution equivalence.
4. Developer carefully gives reason about implementation.

Cons-

1. It is very expensive.
2. Missed out the cases omitted in the code.

2.1.2 Black Box Testing

Basically Black box testing is an integral part of 'Correctness testing' but its ideas are not limited to correctness testing only. Correctness testing is a method which is classified by purpose in software testing.

Black box testing is based on the analysis of the specifications of a piece of software without reference to its internal working. The goal is to test how well the component conforms to the published requirement for the component. Black box testing have little or no regard to the internal logical structure of the system, it only examines the fundamental aspect of the system. It makes sure that input is properly accepted and output is correctly produced. In black box testing, the integrity of external information is maintained. The black box testing methods in which user involvement is not required are functional testing, stress testing, load testing, ad-hoc testing, exploratory testing, usability testing, smoke testing, recovery testing and volume testing, and the black box testing techniques where user involvement is required are user acceptance testing,

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alpha testing and beta testing. Other types of Black box testing methods includes graph based testing method, equivalence partitioning, boundary value analysis, comparison testing, orthogonal array testing, specialized testing, fuzz testing, and traceability metrics. [2]

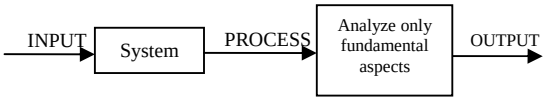

Fig. 4 Represent working process of Black Box Testing

There are various pros and cons of black box testing- [5]

Pros-

1. Black box tester has no "bond" with the code.
2. Tester perception is very simple.
3. Programmer and tester both are independent of each other.
4. More effective on larger units of code than clear box testing.

Cons-

1. Test cases are hard to design without clear specifications.
2. Only small numbers of possible input can actually be tested.
3. Some parts of the back end are not tested at all.

2.1.3 Grey Box Testing

Grey box testing techniques combined the testing methodology of white box and black box. Grey box testing technique is used for testing a piece of software against its specifications but using some knowledge of its internal working as well. [2]

Grey box testing may also include reverse engineering to determine, for instance, boundary values or error messages. Grey box testing is a process which involves testing software while already having some knowledge of its underline code or logic. The understanding of internals of the program in grey box testing is more than black box testing, but less than clear box testing. [11]

2.2 Performance Testing

'Performance Testing' involve all the phases as the mainstream testing life cycle as an independent discipline which involve strategy such as plan, design, execution, analysis and reporting. This testing is conducted to evaluate the compliance of a system or component with specified performance requirement. [2] Evaluation of a performance of any software system includes resource usage, throughput and stimulus response time.

By performance testing we can measure the characteristics of performance of any applications. One of the most important objectives of performance testing is to maintain a low latency of a website, high throughput and low utilization. [5]

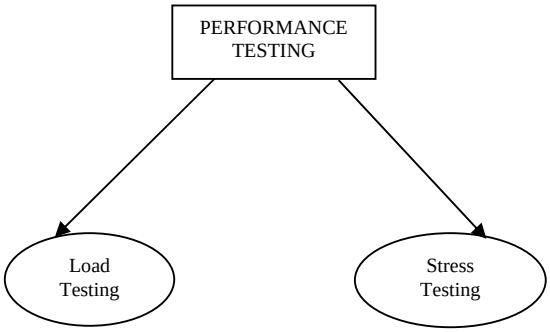

Fig. 5 Represent two types of performance testing

Some of the main goals of performance testing are: [5]

- Measuring response time of end to end transactions.
- Measurement of the delay of network between client and server.
- Monitoring of system resources which are under various loads.

Some of the common mistakes which happen during performance testing are: [5]

- Ignoring of errors in input.
- Analysis is too complex.
- Erroneous analysis.
- Level of details is inappropriate.
- Ignore significant factors.
- Incorrect Performance matrix.
- Important parameter is overlooked.
- Approach is not systematic.

There are seven different phases in performance testing process: [5]

- ✓ Phase 1 – Requirement Study
- ✓ Phase 2 – Test plan
- ✓ Phase 3 – Test Design
- ✓ Phase 4 – Scripting
- ✓ Phase 5 – Test Execution
- ✓ Phase 6 – Test Analysis

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✓ Phase 7 – Preparation of Report

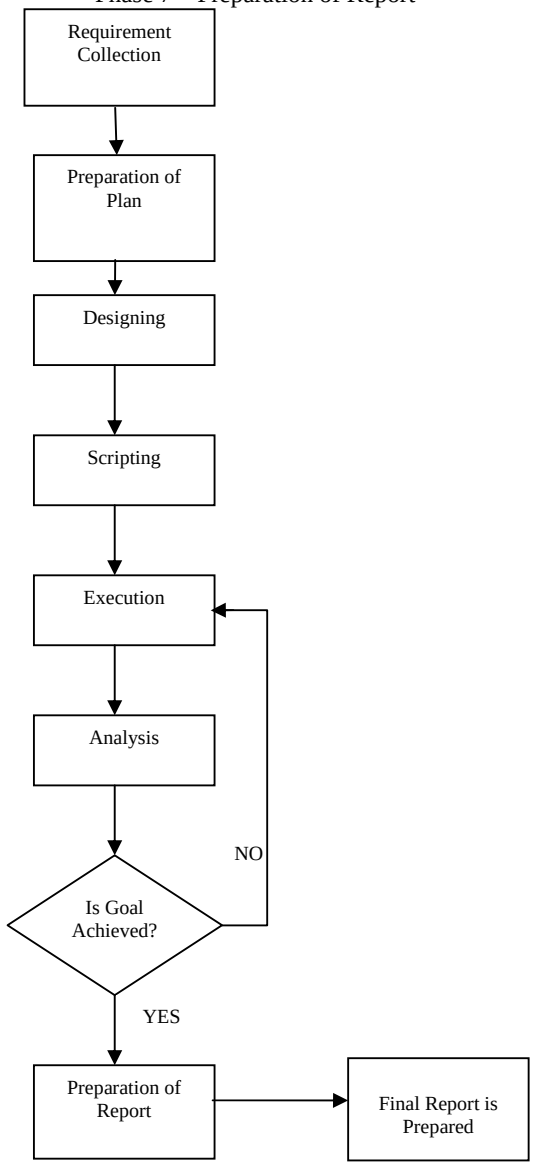

Fig. 6 Represent Performance Testing Process

Typically to debug applications, developers would execute their applications using different execution stream. Which are completely exercised the applications in an attempt to find errors. Performance testing is secondary issue when looking for errors in the applications but, however, it is still an issue.

There are two kinds of performance testing:

2.2.1 Load Testing

Load Testing is an industry term for the effort of performance testing. The main feature of the load testing is to determine whether the given system is able to handle the anticipated no. of users or not. This can be done by making the virtual user to exhibit as real user so that it will be easy to perform load testing. It is carried only to check whether the system is performing well or not. The main objective of load testing is to check whether the system can perform well for specified user or not. Load testing increases the up time for critical web applications by helping us to spot the bottle necks in the system which is under large user stress.

Load testing is also used for checking an application against heavy load or inputs such as testing of website in order to find out at what point the website or applications fails or at what point its performance degrades. [2][5]

Two ways for implementing load testing are

1. Manual Testing: It is not a very practical option as it is very iterative in nature and it involves [5]
   - Measure response time
   - Compare results

2. Automated Testing: As compared to manual load testing the automated load testing tools provide more efficient and cost effective solutions. Because with automated load testing, tools test can easily be rerun any number of times and decreases the chances of human error during testing. [5]

2.2.2 Stress Testing

We can define stress testing as performing random operational sequence, at larger than normal volume, at faster than normal speed and for longer than normal periods of time, as a method to accelerate the rate of finding defects and verify the robustness of our product, or we can say stress testing is a testing, which is conducted to evaluate a system or component at or beyond the limits of its specified requirements to determine the load under which it fails and how. Stress testing also determines the behaviour of the system as user base increases. In stress testing the application is tested against heavy loads such as large no. of inputs, large no. of queries, etc. [2] [5]

There are some weak and strong points of stress testing.

Weak Points

1. Not able to test the correctness of a system.
2. Defects are reproducible.
3. Not representing real world situation.

Strong Points

1. No other type of test can find defect as stress testing.
2. Robustness of application is tested.

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3. Very helpful in finding deadlocks.

2.3 Reliability Testing

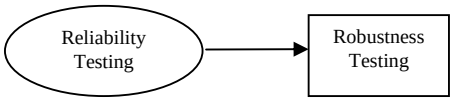

Fig. 7 Represent Reliability testing

'Reliability Testing' is very important, as it discover all the failures of a system and removes them before the system is deployed. Reliability testing is related to many aspects of software in which testing process is included; this testing process is an effective sampling method to measure software reliability. Estimation model is prepared in reliability testing which is used to analyze the data to estimate the present and predict future reliability of software. [4][2]

Depending on that estimation, the developers can decide whether to release the software or not and the end user will decide whether to adopt that software or not.

Based on reliability information, the risk of using software can also be assessed. Robustness testing and stress testing are the variances of reliability testing. By Robustness we mean how software component works under stressful environmental conditions. Robustness testing only watches the robustness problem such as machine crashes, abnormal terminations etc. Robustness testing is very portable and scalable. [4]

2.4 Security Testing

Security Testing: 'Security testing' makes sure that only the authorized personnel can access the program and only the authorized personnel can access the functions available to their security level. Security testing of any developed system or (system under development) is all about finding the major loopholes and weaknesses of a system which can cause major harm to the system by an authorized user. [1][2]

Security testing is very helpful for the tester for finding and fixing of problems. It ensures that the system will run for a ling time without any major problem. It also ensures that the systems used by any organization are secured from any unauthorized attack. In this way, security testing is beneficial for the organization in all aspects. [1][2]

Five major concepts which are covered by security testing are

- Confidentiality: By security testing, we will ensure the confidentiality of the system i.e. no disclosure of the information to the unknown party other than intended recipient.

- Integrity: By security testing, we will maintain the integrity of the system by allowing the receiver to determine that the information which he is getting is correct.

- Authentication: Security testing maintains the authentications of the system and WPA, WPA2, WEP are several forms of authentication.

- Availability: Information is always kept available for the authorized personnel whenever they needed and assures that information services will be ready for use whenever expected.

- Authorization: Security testing ensures that only the authorized user can access the information or particular service. Access control is an example of authorization.

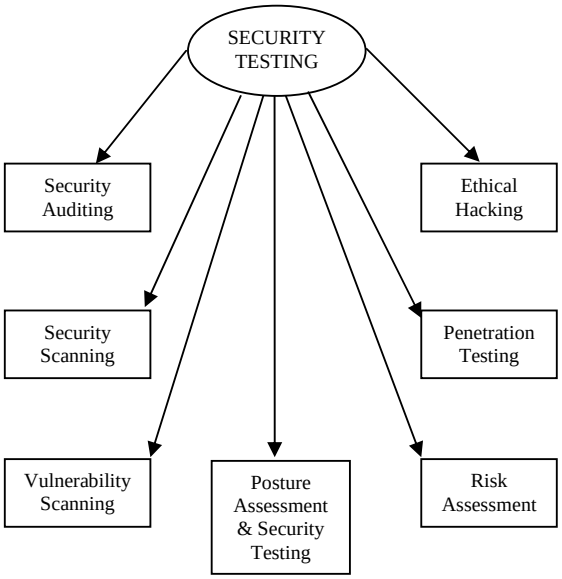

Fig. 8 Represent various type of security testing

Different types of security testing in any organization are as follows: [3]

1. Security Auditing and Scanning: Security Auditing includes direct inspection of the operating system and of the system on which it is developed. In Security Scanning the auditor scan the operating system and then tries to find out the weaknesses in the operating and network.

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2. Vulnerability Scanning: Various vulnerability scanning software performs Vulnerability Scanning, which involves the scanning of the program for all known vulnerability.

3. Risk Assessment: Risk Assessment is a method in which the auditors analyze the risk involved with any system and all the probability of loss which occurs because of that risk. It is analyzed through interviews, discussions, etc.

4. Posture Assessment and Security Testing: Posture Assessment and Security Testing help the organization to know where it stands in context of security by combining the features of security scanning, risk assessment and ethical hacking.

5. Penetration Testing: Penetration Testing is an effective way to find out the potential loopholes in system and it is done by a tester which forcibly enters into the application under test. A tester enters into the system with the help of combination of loopholes that the application has kept open unknowingly.

6. Ethical Hacking: Ethical Hacking involves large no. of penetration test on a system under test. To stop the forced entry of any external elements into a system which is under security testing.

3. Conclusion

Software testing is an important technique for the improvement and measurement of a software system quality. But it is really not possible to find out all the errors in the program. So, the fundamental question arises, which strategy we would adopt to test. In my paper, I have described some of the most prevalent and commonly used strategies of software testing which are classified by purpose and they are classified into [5]

1. Correctness testing, which is used to test the right behavior of the system and it is further divided into black box, white box and grey box testing techniques (combines the features of black box and white box testing).

2. Performance testing, which is an independent discipline and involves all the phases as the main stream testing life cycle i.e. strategy, plan, design, execution, analysis and reporting. Performance testing is further divided into load testing and stress testing.

3. Reliability testing, which discovers all the failure of the system and removes them before the system deployed.

4. Security testing makes sure that only the authorized personnel can access the system and is further divided into Security Auditing and Scanning, Vulnerability Scanning, Risk Assessment, Posture Assessment and Security Testing, Penetration Testing and Ethical Hacking.

The successful use of these techniques in industrial software development will validate the results of the research and drive future research. [8]

References:

[1] Software testing-Brief introduction to security testing by Nilesh Parekh published on 14-07-2006 available at http://www.buzzle.com/editorial/7-14-2006-102344.asp
[2] Software testing glossary available at http://www.aptest.com/glossary.html#performance testing
[3] Open source security testing methodology manual of PETE HERZOG and the institute for security and open methodology-ISECOM.
[4] Software testing by Jiantao Pan available at http://www.ece.cmu.edu/~roopman/des-899/sw_testing/
[5] Software Testing by Cognizant Technology Solution.
[6] Introduction to software testing available at http://www.onestoptetsing.com/introduction/
[7] Software testing techniques available at http://pesona.mmu.edu.my/~wruslan/SE3/Readings/GB1/pdf/ch14-GB1
[8] Paper by Lu Luo available at http://www.cs.cmu.edu/~luluo/Courses/17939Report.pdf
[9] Security testing-wikipedia the free encyclopedia available at http://en.wikipedia.org/wiki/security-tetsing.
[10] White box testing from wikipedia, the free encyclopedia.
[11] Software testing for wikipedia available at http://en.wikipedia.org/wiki/grey_box_testing#grey_box_tetsing

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I completed my B.Sc in 1997 and M.C.A. in 2001 from Aligarh Muslim University, Aligarh, India, and pursuing Ph.D (Computer Science) from Singhania University, Jhunjhunu, India. I have worked as a lecturer at Aligarh College Engineering & Management, Aligarh, India from 1999 to 2003. From 2003 to 2005 worked as a lecturer at Institute of Foreign Trade & Management, Moradabad, India. From 2006 to present working as a lecturer in the Department of Information Technology, Al Musanna College of Technology, Ministry of Manpower, Sultanate of Oman. I am recipient of PG Merit Scholarship in MCA. My research area is software engineering with special interest in driving and monitoring program executions to find bugs, using various software testing techniques.

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Study of Airport Self-service Technology within Experimental Research of Check-in Techniques
Case Study and Concept

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Abstract

This intensive and extensive study as the relevance and impact of self-service technology to consumers in general and especially to passengers since they have many uses in international airports, Therefore I have prepared a model that includes all applications of self-service technology in all international airports and specifically focused on the Common Use self-service technology (CUSS) and compared with a corresponding system in the function is called Common User Terminal Equipment (CUTE) This comparison shows the difference between them and proves that self-service technology help to raise the efficiency and performance of airports and airlines. Also this technology help to reduce costs in terms of staff and the provision of time and effort, etc., as well as the study shows the feasibility of replacing the CUTE system with the CUSS system or not in the near future, this has already been used in some international airports and I hope to apply it in Cairo International Airport and all this supported the output of the case study that I made this research and the output will be the beginning of the development or to change the current model of the traditional check-in and this is the objective of the research, when completed, namely, re-engineering or restructuring of the traditional check-in model which uses the CUTE system and so by replacing this system with CUSS system.

Keywords: *Self Service and CUSS Kiosk.*

1. Introduction

Self-service in general is most definitely "in". From supermarket checkout to airline check-in kiosks, self service is proven to be a very large benefit to business, and more importantly their customers. These days the question is not whether we should, but more "when will we". [1]

The use of self-service is not a new concept; banks have been using it for a long time now. The banking industry adopted the ATM concept for reducing costs and providing better services for the customers. The first ATM was installed in the early 1967 by Barclays Bank in London, UK The banks started installing ATM machines in the bank buildings first and where a cash dispensing machine was not linked to the account directly. With the spread of internet connectivity the ATM machines have become a part of the urban landscape and available at parks, shopping malls or airports with many more services on offer than just cash dispensing. The adoption of self-service is gaining importance in other industries for two main reasons, increased efficiency and reduced costs and labor. Self-service puts control into hands of the customers. It has been observed that customers are now more open to experiment with kiosks [2]. Other industries like retail, finance, hotels, etc. are considering using of self-service kiosks. Even libraries are trying out self-service technologies to issue books. The customers are now ready to make bigger transactions with kiosks and many models for self-service have been put to the test [3] After all this we have a new technology called self service Technology (SST). A self service Technology (SST) is an object which allows customers to interact with self service software (SSS). Such kiosks can be found in a variety of locations, and they typically include a computer loaded with the software and housed inside a protective case, although a self service kiosk (SSK) can also consist of a computer placed at a table or desk in an accessible area for customers to use. An internet-based self-service access must meet specific requirements of information technology as well as general requirements of the access system architecture. Only the integration of different functions, e.g. electronic payment, digital signature etc., can enable electronic transactions which allow 'one-, stop-non-stop-services'. [4]. Customers can opt to use a self service kiosk to meet a need, rather than interacting with an employee of a company, and in some cases, customers may be required to use the kiosk.

Fig.1 The Classification of Self-Service Technology

From the consumer angle, time and cost savings is use of self-service technology biggest benefit, reduce waiting time, more efficient, flexible and convenient to use, make consumers to customize the customization - more high-level [5], in addition, the convenient of location, and the use of IT services feelings of the Fun [6], and even some scholars have pointed

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out: when consumers used self-service transaction process, they can feel spontaneous delight of spontaneous. However, another group of consumers, the service technology transfer process has brought their anxiety and not the smooth operation of doubts; so that consumers will consider the cost size of use new technologies, whether it is worthwhile to transfer or not [7]. There are many studies of self-service technology [2], mostly focused on self-service technology attributes of the service quality performance, the impact of service providers, and the perspective is service a supplier to discuss impact factors of Self-Service Technologies (SSTs) performance. This study is based on the consumer s point of view, and analysis services innovative model of self-service technology attitudes impact factors. The result will provide the best service and business in the industry. The purpose of this study was to discuss service innovation to Self-Service Technologies attitude impact factors. The purpose of the study is to establish the key parameters that affect the self-service and traditional check-in process and the factors that influence them, All these factors will comes to live case study from experimental research at Cairo International Airport, to develop generic model which could be used to determine the efficiency and estimate the resources, to develop a simulation model with the understanding gained for estimating resources for the whole check-in system for any airport ,The model should be simple enough to understand and should use commonly available software, so that it is accessible to all and to add value to the industry understanding of the self-service and traditional check-in process in a tangible way for future use.

In recent years the airlines have started using innovative Check-in technologies. The dedicated Self-service Check-in kiosks are now an integral part of the airport facility and the new e-ticket also allows the use of the internet for check-in. These processes enable airlines to reduce the time and number of staff required, thus saving substantial costs in operations. These changes in the process have allowed airports to handle more passengers in the same space [8] by reducing queues. Further to this, IATA is advocating CUSS- Common Use Self Service, similar to standardized ATMs- Automated Trailer Machines at banks. New CUSS standards will allow the sharing of kiosks among airlines similar to CUTE- Common User Terminal Equipment, and also give access to the technology for the smaller airlines. The advantages of adopting CUSS have been discussed in many papers and conferences alike and will be discussed later in detail. The impacts these new check-in technologies have the design and operation of the airports and how far it has been successful in reducing queues is not quite evident. There is a need to understand the process and its implication on the effects that it will have on operations and implementation. Also it is essential to study what kind of changes will be required for moving from one technology to another. Also, there are no set standards for installing the system at the airports. Because technology is new, IATA does not have any standard procedures or thumb rules to estimate the requirements. There are many sophisticated simulation tools available that need a lot of inputs and are costly for an airport to acquire.

In this section, describes the passenger check-in at the airport. This includes conventional check-in and self-service check-in, the history of self service technology, the importance of the self-service technology and the workforce is reviewed. In section 2, I collected all types of self –service kiosks at international airports as a model; I focused on the steps of CUSS Kiosk. In section 3 comparisons between the traditional check-in (CUTE System) & self-service check-in (CUSS Kiosk) and the best practices of CUSS kiosk in the International Airports. Section 4, will provide the analysis of Egypt Air self-service check-in process at Cairo International Airport. This analysis is based on observational studies conducted during 2009 to 2010; additionally this section focuses on the acceptance of the technology by both the workers and the passengers. Data collected from passenger and agent surveys is provided, summarizes the findings from an in-depth station case study. I was deducing the generic model from the result of the survey of case study, The purpose of this case study was to raise performance and to help airlines to reduce their costs in employee staff, time and to identify best practices both operationally and organizationally in the eService process in an attempt to gain operational efficiency across the Egypt Air network.

In section 5, I was presented the case studies about all types of the airport kiosk in the international Airports with in the common factor of them. In section 6, describes the future work about using the generic model to make simulation model within the result of the survey of Cairo International Airport.

2.Overview Of Airport SST

All previous studies focused only on one type of these kiosks and this is why we can deduce a general model for all the kiosks at the airports “Fig.5” also attached to this framework a comprehensive study of all types of kiosks not only at airports but also in life in Section 5. Airport kiosk is a standalone desk or an interactive computer terminal that provides information, goods, or services (Information Kiosk). In many airports, individuals can purchase tickets, check baggage, and monitor the status of arriving and departing flights at a specific airline's computerized kiosks (Ticketing Kiosk). Several airlines rely on kiosks to ease congestion and prevent long lines at check-in counters (CUSS KIOSK). An airport kiosk may also be a booth where people can purchase food, magazines, or souvenirs from a salesperson before or after a flight (Retail Kiosk).

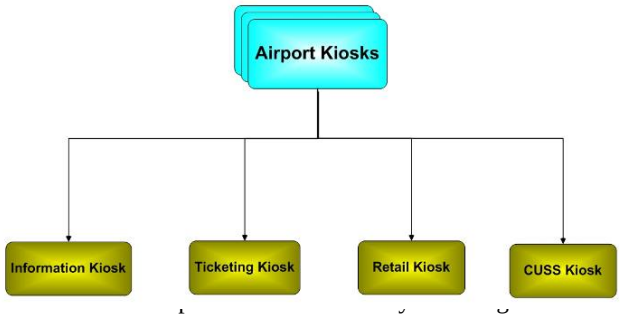

Fig.2 Classification for all kiosks of International Airport

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customers and airline employees. Computerized terminals allow customers to avoid long lines at ticket counters and check in for their flights at their own convenience. Customer service agents are relieved of the burden of manually entering information and checking in large numbers of passengers before flights. Instead, they are able to help people who have difficulties with kiosks and those who need to discuss special accommodations. The self-service model reduces or in some instances eliminates the requirement for airline personnel to "interface" for passengers, repetitively performing tasks that passengers often are willing and able to do for themselves. At least half-dozen vendors provide kiosk products to the air-travel industry. Many airlines are challenged in keeping a large force of ticket agents on standby 24/7 to handle surges in passenger traffic, whereas almost any airline can maintain dozens or even hundreds of kiosks at the ready to issue tickets, baggage tags, seat assignments, and boarding passes. Adopters of the technology assert that kiosks eliminate tedious repetitive work and free airline agents to deliver "real customer service."

2.1 Information Kiosk

The Info Kiosk provides passengers with information on Airport facilities a number of information kiosks will be planned. Information Kiosks will consist of freestanding column-type, or wall mounted, workstations consisting of an industrial PC with touch screen interface. The kiosks will have an easy graphical interface with multilingual support (Arabic, English and other languages as required) and provides the traveling public with information on airport facilities (restaurants, shops, lounge, flight details, etc.). Moreover, the kiosks can be used by the passengers and airport operator to provide (sponsored) information on hotels, car rentals, tours and other services that might be of interest to the public.

2.2 Ticketing Kiosk

Automated ticketing kiosks (frequently called self-service kiosks) are a subset of the more encompassing category of information technology known as Interactive Transaction Machines (ITMs). Automated teller machines (ATMs), patented in 1973 and extensively adopted by commercial banking in the mid-1980s, now number over 350 thousand in the U.S. alone and are one of the most widely used forms of ITM technology. Unlike some forms of ITMs, however, kiosks employed by the banking and airline industries do not function as standalone devices (such as self-service gas pumps). Rather, teller and ticketing machines are networked peripheral IT devices whose interfaces give consumers direct access to companies' centralized customer-service systems. Computerized, self-service kiosks are found near the check-in counters for many large airlines. At these terminals, individuals can review prices and flight times, and either purchase or confirm reservations. A self-service kiosk is able to confirm a traveler's identity by prompting him or her to input a confirmation number and insert the credit card used to purchase tickets. The kiosk has access to an airline's information database, and is able to immediately access profiles and payment information. If the terminal is unable to confirm a purchase or a customer does not have his or her credit card handy, the screen usually directs the traveler to a manned ticked counter so that he or she can speak with a customer service agent; the features and benefits as follows:

- Self-service kiosks reduce costs by lowering employee headcount.
- Improves customer retention rate.
- Reduced costs for basic service levels.
- Reduces waiting in line by customer.
- Virtual sales assistant increases sales. [9,10,11,12]

2.3 Retail Kiosk

The Retail kiosks contain the largest segment of deployed kiosk applications. Analysts estimate that retail kiosks comprise at least 30% of the entire self-service kiosk market. Locations include Department Stores, Grocery Stores, Big Box Specialty Retailers and Convenience Stores. Retail kiosks provide convenient services to customers such as bridal and gift registry, non-stock product ordering, way finding directories, employment, product lookup, company information and targeted offers. These services increase consumer awareness and offer new channels for retailers to grow their business. That Includes loyalty, product information, store directory and many more Studies show an average of 7% increase in incremental sales when kiosks are added. More compelling investment returns are as follows:

- Loyalty cards reward frequent customers, increasing brand loyalty.
- Self-service kiosks reduce costs by lowering employee headcount.
- Reduction in inventory overhead and warehousing costs.
- Increased customer satisfaction = increased sales. [13]

2.4 CUSS Kiosk

This evolving pattern will enable passengers to obtain boarding passes, check baggage, and conduct other transactions at times and places of their convenience. Passenger check in procedures will gradually shift from check in procedures performed at check in counters, to check in procedures performed at home from the internet, by mobile phone, or through self service check in facilities at the airport such as CUSS. The trend is towards common use equipment which may consist of free standing column type or counter type workstations with built-in Automated Ticket and Boarding pass (ATB) printer. The CUSS will provide ticketed passengers the ability to perform many tasks, not limited to, check-in for flights, select or change a seat assignment, and obtain a boarding pass for their departures. The CUSS will be used by self-service passengers to check-in, seat allocation, boarding pass printing, and baggage check-in in a common use environment. Self-service is becoming the common check-in mechanism in Europe, US and in many airports. In the MEA-

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Middle East Area region it started as a dedicated self-service and the first CUSS kiosks have been installed at Cairo International Airport TB3. The CUSS will be designed for the use of different types of passengers with or without luggage where passengers with luggage could use the new use facility of the Common Use Baggage System-described in the above Industry Development section. The CUSS platform software will be responsible for managing the entire Kiosks System, The final configuration of the CUSS kiosk will very much depend on airport operational and security requirements. The equipment required for CUSS consists of two redundant servers (usually the same servers used for CUTE system), located in the main equipment room MER – Main Equipment Room and self service kiosks.

The stand alone kiosks are placed in a group of 10 kiosks and the location of kiosks is horizontal to its success. With so many kiosk types available and with the changing requirements the configuration of the check-in kiosks depends on a large number of factors. The main aspects to be considered in the placement of kiosks are:

- Visibility.
- Accessibility and movement of passenger traffic.
- Comfort and privacy of the passenger.[14]

Fig.3 CUSS Kiosk Machine

There are many possible solutions for the layout of kiosks and it has been observed that for the efficient use of kiosks it is essential to have some roving agents to help the customers increase their transaction speed .These are steps the procedures of travel using self-service technology at international airports, The new concept of self-service kiosks has divided the check-in process in two parts:

- Getting the boarding pass.
- Getting the bag-tag to dropping the bags at bag drop-off .

The passenger arrives at the airport and proceeds to the kiosk, which issues the boarding pass based on the information provided by the passenger .The passenger then proceeds to the fast baggage drop-off if he/she has any baggage otherwise can move to the security check .The main steps in the check-in process through kiosk are shown in “Fig. 3”.

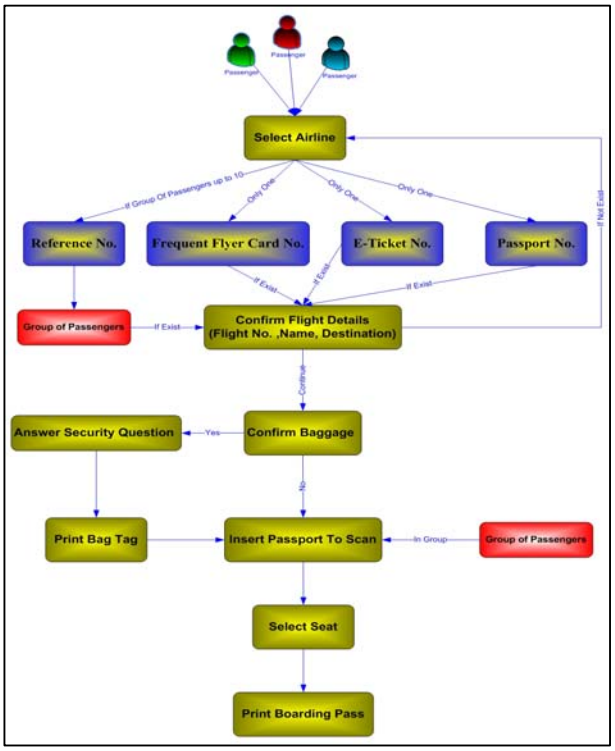

Fig.4 How to make check-In procedures through common use self-service

It is easy to follow the instructions on the kiosk and very direct in most of the cases. The speed of checking in depends on the familiarity of the passenger with the kiosks and on the speed of the machine itself in processing the request. The kiosks are also equipped with the passport reader to enable international passenger check-in.

All this will take us to make a survey to compare between the CUTE System and CUSS Kiosk in (dis/advantage, benefits) depend on the common factor between them.

3.CUTE Vs. CUSS

In the Conventional type of check-in environment, the overall throughput of the system can be constrained by a number of factors. The most likely causes of throughput limitation are the productivity of the ticket agents, the staffing levels established by the airline management, or the total ticket counter positions available to the airline. [15]

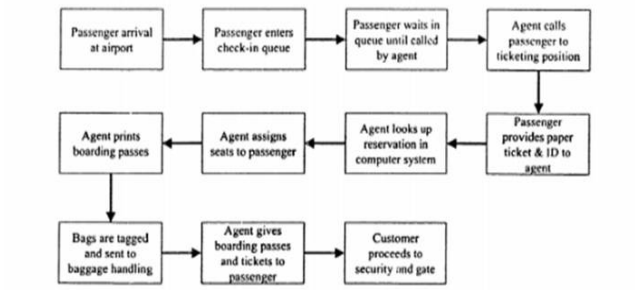

Fig.5 The Conventional Check-In Process

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CUTE- Common User Terminal Equipment, the facilities at the airports are shared between the airlines to reduce the space and resources required. CUTE was first implemented in 1984 for the Los Angeles Summer Olympic Games. It was at this point that IATA first created the recommended practice (RP) 1797 defining CUTE. It should be noted that ATA does not have a similar standard for common use. From 1984 until the present, approximately 400 airports worldwide have installed some level of CUTE. CUTE systems allow an airport to make gates and ticket counters common use. These systems are known as "agent- facing" systems, because they are used by the airline agents to manage the passenger check-in and boarding process. Whenever an airline agent logs onto the CUTE system, the terminal is reconfigured and connected to the airline's host system. From an agent's point of view, the agent is now working within his or her airline's information technology (IT) network.

In the Recent Model of check-in the airport passenger processing is a systematic process and the airport capacity is as good as the weakest link .The traditional passenger processing is shown in the" Fig. 4" in yellow .The passenger arrives at the airport and approaches the check-in counter .The check-in process is a one-step process where he/she can interact with the check-in agent and decide on seats and drop bags .After check-in, the passenger proceeds to the security check where the hand baggage and personal belongings are scanned .The check-in baggage in most of the European airports is scanned in-line unlike the new security requirement at US airports and Cairo International Airport where the bags need to be scanned before taking them to check-in .Passengers are now in secured area and can shop and relax .Prior to boarding the aircraft they queue up in boarding lounge where the identity of the person is verified once again .If the flight is international, passengers will have to go through the Immigration process.In that case, the passenger without baggage can directly move to the security check and board the aircraft without any hassles at the airports .The passengers with baggage can drop the bags at the baggage drop-off and proceed to the security check; this is represented in "Fig. 5" .CUSS Kiosk Check-in has seen a rise in passenger acceptance as it gives them a higher comfort level. It is believed that both the CUSS Kiosk check-in will cater for most of the passengers in the near future.

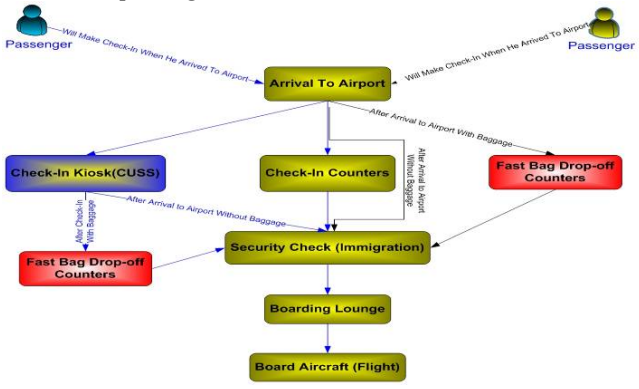

Fig.6 The Proposed Model for Recent Check-In Process Flow

CUSS- Common Use Self-service kiosks were first introduced by Continental Airlines in 1995 at US airports [15] . Since then the CUSS has become an integral part of providing services for passengers .Most schedule airlines now provide the option for Common Use self-service kiosk check-in at major airports .The cost of check-in through kiosks is just $0.16 as against $3.68 with normal check-in with an agent [8]. There are only 8% airports planning to deploy dedicated kiosks as against 60% to implement CUSS. The airports and airlines have understood the importance of the shared facilities [16]. I was converted the interactive map in the IATA website to the statistics more easily to read (The airports have realized the benefits of the kiosks and IATA is now promoting the installation of CUSS instead of dedicated check-in at all International Airports In The world.) [17]

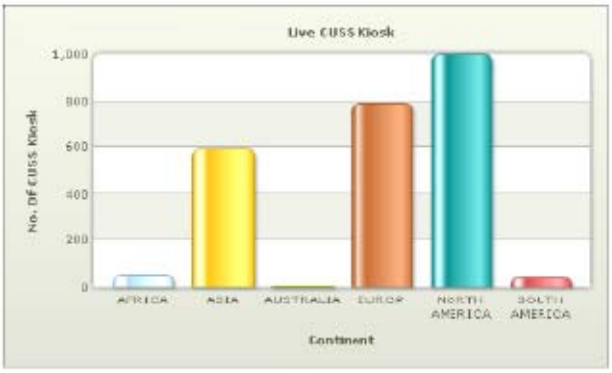

Fig.7 This statistics shows the current numbers Of CUSS Kiosk around the world

Fig.8 This statistics shows the current numbers of CUSS in future Kiosk around the world

4.Reasearch Validation

In order to achieve the stated objectives (discussed at section 3.0), I conducted case studies at Cairo International Airport to understand the process and also collect the primary data to be used in the simulation model. The purpose of visiting Cairo International Airport is to understand the variations in the process that exist at Cairo International Airport, gather as much data as possible and to appear the advantage of using self-service kiosks is that the check-in process can be divided in two steps and it can process 40 to 50 passengers per

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hour. The location of kiosks decides the passenger flow pattern and convenience. The two steps include printing a boarding pass and dropping the bags along with bag tags at baggage drop off. The baggage drop off are manned and the agents print the tag and attach it to bags. This is more convenient as the passengers tend to make errors in attaching tags, which might prove costly in overall operations. This system has a larger throughput as the passengers without bags can be filtered and need less processing time.

The method of data collection will basically include observing the passenger in the process and other key issues at Cairo International Airport. The data collected will be analyzed to understand the differences and various factors that might affect the check-in process at Cairo International Airport. The collected data will also help in establishing key parameters for the simulation model.

For the research in Cairo International Airport TB3, this was useful for the exploration of attitudes and experiences with check-in technologies as the technique "uncovers specific events and behaviors that underlie service encounter dis/satisfaction" [18].

While following the questionnaire crafted below, good use of the technique requires that I adjust, modify and adapt the tool as the need arises in order to elicit the most data rich conversations [19]. The criteria of inclusion mean require respondents were selected on based on their familiarity [20] with self service check-in technologies.

Following [19] an incident will be required to meet the following 4 criteria:

1. Involve technology-customer interaction.
2. Be very satisfying or dissatisfying from the passenger's point of view.
3. Be a specific and preferably recent episode
4. Have sufficient detail to be visualized by the interviewer.

I had the opportunity to witness the use of traditional check in as well as those who used or attempted to use the kiosks. Also, there may be some opportunity to glean the response of various parties to the presentation of a boarding pass printed at home after checking in on-line. Formally, I followed noted the observation data sought by [15] in his airport SST research:

- Agents per position (Queue Manager, Station Manager, Bag Handler).
- Passenger in line.
- Passenger arrivals per 3 minute interval.

4.1 Expermint Description

The research was initiated with an understanding that there is a need for a tool to estimate the resources required to see can we convert from CUTE system to CUSS Kiosk System at Terminal Building 2 or not necessary .The CUSS kiosk are seen as a positive move and it has been believed that it improves the check-in process and reduces queues at airports.

In total 210 interviews. Before having the approval from Executive Director of Cairo International Airport efforts were made to connect with Cairo International Airport residents, away from the airport, who had previously used the kiosk.

Two passenger interview forms were created to address the variation between those checking in at the counter and those using CUSS kiosks and I did another interview forms with two manger (1st Executive Director of Cairo International Airport, 2nd Station Director of Egypt Air at Cairo International Airport) to know the importance scope of CUSS kiosk They were both translated into Arabic as an additional visual aid to facilitate the interview process. Keeping to the standards of case study, the sample size is limited at such point as there is significant redundancy in the amount of new information being collected [19,20]. The model is kept simple and users need to input all the parameters in the first sheet and can see various results like waiting times, processing times, usage of resources, etc.

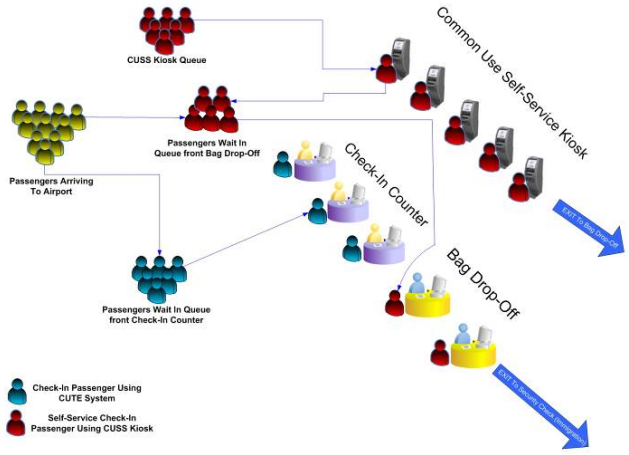

Fig.9 Description Model of Survey

Rush-hour passengers at the airport are determined and are the key input for the model. The passengers using each type of check-in technology are assumed and the appropriate type of passenger profile is selected. The passengers arrive at the airport. There are two different queues in the system. The model is developed with three different bank queues serving the multiple servers for check-in counters and bag drop-off. The passengers separated for each process join the required queue. The passenger has to wait in the queue till the server is available to process him/her. The different processing times are assigned to each check-in methods. Passengers from the self-service kiosks required to check baggage join the same bank queue for bag drop-off. After finishing the process the passenger leaves the system for a further process required to board the aircraft.

In experimental research validity I collected and compared additional sources of information, including the research study, "the main idea is to triangulate or establish convergence lines of evidence to make findings as robust as possible" [21]. Data Triangulation in this research is done using existing

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aeronautical manager's anticipation and SST Industry and Passenger impressions.

Before I begin this survey I'm doing a field study of all places of Check-In (CUSS, Counters), I had personal interviews with passengers in order to know what is being conducted at the airport to provide comfort and also I've done interviews with some airport leaders to know what they want to add Check-In systems at Cairo International Airport after all that I was able to draw these questions, which was as follows:

I've done passenger questions in a manner (closed-ended)
1 - because I do not know how their culture and level of education so that the questions must be simple and easy.
2 - most of the passengers be too hasty in ending the travel procedures because they came late to the airport.

I've done questions to the leadership at Cairo International Airport in a manner (open-ended)
1 - I expect they will speak about the Common Use Self Service system with other angle than passengers because the airport is renting premises and equipment of Counters of Check-In and Common Use self-service for airlines, and also has a supervisory role and work of periodic maintenance to each period.

I've done questions to leaders and workers of Egypt Air Company in a manner (open-ended)
1 - Because the CUSS system part of the tools that helps them in the procedures for passengers, one of the cores of their work.
2 - Provide all the amenities and improve services for passengers to improve the quality of Egypt Air because if the passengers did not feel the comfort and safety will change the airline.
3 - So Egypt Air sensed that they really care about the area of Common Use Self-Service because it provides them a lot of time, effort and staff, particularly after the recent global financial crisis.
4 - Egypt Air leaders have found of that the CUSS kiosk helps to reduce expenditures and to increase the income of the company.

In all, I conducted interviews, each with an average length of one hour. After framing the interview and clarifying process issues, core questions were focused on in these structured interviews and included:

- What are the benefit do kiosks, self-service check-in offer passengers?
- How does self-service check-in technology benefit the airlines and airports?
- What are the limitations of self-service check-in for passengers?
- What in Egyptian culture may make Egyptians passengers resistant to self-service check-in?
- What are the obstacles of CUSS Kiosk that perceived by passenger offer related to their experience with kiosks?
- What are the obstacles of counters of check-in Flights that perceived by passenger offer related to their experience with kiosks?
- How do we encourage travelers to use the CUSS kiosk?

4.2 Hypothesis and Expermint Variables

The research was initiated with an understanding that there is a need for a tool to estimate the resources required for the changing technology of counter or not. The passenger surveys showed some positive results and it was seen that self-service is a positive move by passengers. The passengers were ready to take control of the process and more than happy to check-in themselves. Most of the passengers also showed the inclination to use the self-service rather than normal check-in if both took the same time.

In order to change or redesign the check-in process at Cairo International Airport, an experiment or trial period of the new process needs to occur .This experiment is the first phase of the research effort .An experimental plan was designed to test a number of parameters of the new process. These included the impact of queue management agent presence on kiosk utilization, agent to machine ratio impact on system throughput, and queuing style impact on machine load balancing .The proposed timeframe to conduct these experiments was in November and December of 2009. The sections that follow will provide an analysis of the case study conducted.

Table 1: Independent and Dependent Variables.

Independent Variable	The System being used (CUTE System & CUSS Kiosk System)
Dependent Variables	1.Convenience of Usage 2.Change/Select seat at Flight 3. Processing Time 4. Queuing Time

4.3 Results

The interviews produced one set of rich data. This survey is being conducted in an effort to assess the overall satisfaction and /or concerns over the self-service kiosk and processes being deployed by Egypt Air Airlines. The results of the case study regarding the passenger satisfaction, processing times and queuing time were particularly interesting it is evident from the table that the total processing time for the kiosk plus bag drop is far more than the normal check-in process.

I will measure in this survey the passenger satisfaction, time processing and queuing time.

Table 2: All times are in Minutes per Passenger for Egypt Air Airlines, MSR

	Total No. of Passenger	Process Faster,Easy to understand					Change/Select Seat and/or Flight				
		Strongly Disagree 0% to 49%	Disagree 50% to 64%	Somewhat Natural 65% to 74%	Somewhat Agree 75% to 84%	Strongly Agree 85% to 99%	Strongly Disagree 0% to 49%	Disagree 50% to 64%	Somewhat Natural 65% to 74%	Somewhat Agree 75% to 84%	Strongly Agree 85% to 99%
CUTE	158	23.42%	18.99%	25.32%	21.52%	26.86%	0.00%	0.00%	0.00%	0.00%	0.00%
CUSS	50	0%	0%	8%	24%	68%	0.00%	0.00%	0.00%	8.00%	92%

	Average Time	Maximum Processing Time	Minimum	Standard Deviation	Maximum Queuing Time	Average Time	No. Of Pax
CUTE	3.470254777	6.15	0.58	1.792477895	7.34	1.74	158
CUSS	1.242244898	4.43	0.43	0.864619769	0	0	50

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customer. This human element causes significant variations in check-in times. Passengers without bags were processed faster and took 22 to 34 seconds to complete the transaction.

4.3.1 Convenience Of Usage

That is means the passenger satisfies with the process of self-service check-in using CUSS Kiosk, which is faster, accurate and easier to understand. As was mentioned at section 1, self-service puts control into the hands of the customer.In the airline industry, this control comes in the form of enabling the customer to select their own seat, request an upgrade, or change flights. As Table 2 shows, an overwhelming majority of the customers either strongly agreed or agreed with the statement.

4.3.2 Processing Time

These passengers using kiosks need to go to baggage drop-off if required to check in bags. The processing time for each process is shown in Table 2. The characteristics for each method are discussed in detail in this section. The average processing time per passenger at the kiosk was 2.24 minutes with a standard deviation of 1.31 minutes, while the average processing time at the bag drop-off was 2.23 minutes with a standard deviation of 1.11 minutes.

As seen from Table 2 the processing time for the kiosk is 1.24 minute with standard deviation of 0.86 minute per passenger against the belief that it takes less than a minute for the kiosk. Further to this, the following was observed at the airport

• The minimum time was 0.43 minutes and on average it took at least a minute to complete a transaction and print a boarding pass.

• The processing times for the passenger who had some experience of using a kiosk was significantly less than average.

• Most of the passengers needed assistance in completing the process and there were two roving agents helping passengers.

• The location of the kiosks made them very accessible and easily visible before the passengers could see the check-in counters.

It could be seen that the average processing time is smaller than kiosks but has a huge standard deviation. This is a result of the efficiency of the check-in agent .This human element causes significant variations in check-in times. Passengers without bags were processed faster and took 30 to 45 seconds to complete the transaction.

4.3.3 Queuing Time

The other important aspect that was observed in the process is the waiting times for each passenger. The maximum and average queuing times for each techniques of check-in are shown in Table 2.

The results of the observations are shown in Table 2. It was observed that there were no queues for the use of the kiosks on the day of the observation. There were some queues at the bag drop-off but not significantly long and the average wait time per passenger was 2.27 minutes, Further to this, the following was observed at the airport:

• It is quite evident from the comparisons that the kiosks though processing a greater number of passengers wait times are lower.

• The maximum number of passengers waiting for the services is 0 for kiosks against 5 in the case of check-in counters.

Thus, the passenger using both needs to spend more time in the system for two reasons: more processing time and more waiting time in the queues for two processes. To maintain passenger comfort it will be necessary to maintain lower wait times at both the services, implying the need for more resources.

From this survey I deduced the results of Usage of CUTE 75, 2%, Usage of CUSS 23, 8% and other 1.0% is shown in “Fig. 9”, doubtless contributing to the preference is that nearly 95% reported high to very high satisfaction about select or change a seat location with self-service kiosks. But 93% of those studies thought self-service kiosks would be faster, and would shorten lines. 60 % believed self-check-in would be more queues free. 52% liked the greater control of the process; about the same number liked the privacy. [7]

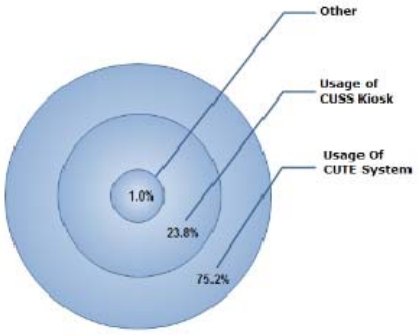

Fig.10 The Usage Of all check-In techniques at this case study in Cairo International Airport

5 . Related works

This Case Studies all Types of Self Service Kiosk at Airports: Vancouver Airport has increased throughput by 250% by installing CUSS. The airport has seen now employs 30% fewer check-in staff. Thus has been able to postpone the expansion plans until 2012 [16]. Another example is Las Vegas McCarran Airport, which has installed 100 CUSS kiosks at the airport and installed some off airport as well [8]. McCarran airport claims to be a 100% common use airport. It has invested $1-2 million in CUSS, which saves the airport from a building expansion of $20 million [16]. And this table which appears all advantages of different case studies of All Types of Self Service Kiosk at Airports. I had chosen these factors based on all types of kiosk are involved in all self-service technology and almost the differences between these systems and some very small.

All Factors of Kiosk Comparison:

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- Financial Cost
- Temporary Cost
- Increasing accuracy
- Return on Investment
- Easy To Manage
- Flexible payment options

This is due to business rules that are created from the design of the system which is compatible to work in different environments such as airports environment or stores or in banks or other environments that use various self-service technology.

Table 3: Sample of Self-Service Airport Kiosk

Area Of Research	Application Domain	Financial Cost	Temporary Cost	Increasing accuracy	Return on Investment	Easy To manage	Flexible payment options
SITA's Electronic Ticketing in Airlines Electronic [16]-ticketing can simplify internal procedures, offering further scope for the permanent removal of costs. alot of areas provide yet more opportunity for cuts in costs –and improvements to passenger service and these establish st Zurich Airport	1-Ticketing Kiosk	1-Reduction in Employees.	1-Reduction in transaction costs. 2-Self-service ticket purchases through kiosks during peak traffic activity reduces congestion in lines	Reduction in unauthorized access to confidential information and other protected Assets	Increased ticket sales	Convenience of self-service kiosks offer a competitive advantage over traditional manned ticket window or box office locations	Ticketing kiosks offer ticket dispensing, credit card & cash acceptance options for fast transactions
The re:vive system Automated-ordering systems "revive," an innovative dining program at JetBlue Airways' new Terminal 5 at JFK International Airport in New York City. • Passengers can order food, pay with a credit card and have it delivered to the gate area. •Touchscreen monitors display flight information and a food and beverage menu.	2-Retail Kiosks	1-Airline travelers can use the this system to order food or check flight information without leaving their seat at the gate. 2- Reduction in Employees	Reduction at waste time	There is no any confidential data	Studies show an average of 7% increase in incremental sales when kiosks are added	Easy to make order	
Friendly flights info terminals at CAI The passenger can find his flight details and other facilities such as restaurants, shops, lounge and etc. ove these terminals including location information, maps to look at, Data to printout and to request further information.	3-Information Kiosk	1-Reduction in employees. 2- Reduced costs for basic service levels 3-Reduces instances of error in approval process	Reduces waste of time if passenger want to go any place and he doesn't know any the ways of places	There is no any confidential data	Improves the ROI of the sponsors such as food and beverage company (Advertising) at CAI	The kiosks will have an easy graphical interface with multilingual support (Arabic, English and other languages as required)	
Vancouver Airport CUSS Check-in Kiosk The CUSS will be used by self-service passengers to check-in, seat allocation, boarding pass printing, and baggage check-in in a common use environment.	4 Check In Kiosk	Reduction in Employees.	1-Reduction in transaction costs. 2-Reduction in waiting queues by up to 30%	Carrera devices and scanners create digital records for accuracy and protects against fraud	Increased throughput by 250% by installing CUSS	Self-service passengers to check-in, seat allocation and boarding pass printing.	

6. Conclusion and future work

While the plans for this experiment have been outlined and passed on to Cairo International Airport for future implementation, it was agreed that another valuable research focus would be an in-depth station comparison. The intent of the station comparison would be to look at both operational and organizational metrics and determine what impacts if any of these have on the acceptance of self-service at the stations. This learning could then be combined with the, observations, surveys, and eventually the experiment to ensure that all aspects of the changing or re-engineering effort are in place to ensure success.

The research focused on the feedback from both Egypt Air agents and the passengers utilizing self-service. The survey results reviewed that the passengers are responding positively to self-service deployment and generally understand the process. However, the acceptance of this relatively new technology within Egypt Air's own workforce depends to a large extent on the type of station at which the employee works. Thus the sample size (210) of passengers observed was small and the results could not be accepted confidently, so in future I will present more credible result within a big number of passengers but I believe that the self-service will cater for most of the passengers in the near future; so the case studies show that there are significant variations in the results depending on the profile or operations of the airport. It can be observed that the queuing at the airport is affected by three aspects namely.

• Schedule of Flights (Departure)

• Processing Times

• Queuing Time

The key parameters will be used as inputs for the simulation model to be developed. The simulation model will be validated against the existing situation and industry standards wherever they exist. This validated simulation model can be used for various experiments to explain the behavior of the check-in system as a whole and provide the airport planners with a tool to estimate requirements for check-in systems.

7. Referances

[1] Kiosk Information System Inc., "http://www.kis-kiosk.com", accessed Septmeper 25, 2009.

[2] Murphy, Samantha. "Kiosk 411" Chain Store Age, January 2007: 68.

[3] Maras, Elliot. "Self-serve kiosks address a changing customer." Automatic Merchandiser, March 2006: 20

[4] Freimut Bodendorf," Self-Service e-Transactions for Citizens Concept and Case Study ", IEEE Computer Society, Third International Conference on Digital Society, 2009.

[5] Oliver,R.J.,(1997), Satisfaction: A Behavioral Perspective on the Customer, NY: McGraw-Hill.

[6] Gatingon, H. and Thomas S.R. (1991),"Innovative Decision Processes," in Handbook of Consumer Behavior, Thomas S.R. and Harold. H. Kassarjian.eds. Englewood Cliffs, NJ: Prentice Hall, 316-348.

[7] Jacob Bennett "Opportunities emerge for self-service in retail and hospitality," White Paper, published by NetWorld Alliance and sponsored by NCR Inc., © 2009.

[8] Weiss, David. "Analysis: Kiosk Uptime, Revenue." Airport Business, July 2006: 9-11.

[9] Dabholkar, P.A. (1994a), "Technology-based service delivery: a classification scheme for Developing marketing strategies", in Swartz, T.A., Bowen, D.E. and Brown, S.W. (Eds), Advances in Services Marketing and Management, 3: 241-27

[10] Dabholkar, P.A. (1996), "Consumer evaluations of new technology-based self-service Options: an investigation of alternative models of service quality", International Journal of Research in Marketing, 13(1): 29-51.

[11] Meuter, M.L., Ostrom, A. L., Roundtree, R.I. and Bitner, M.J. (2000), "Self-Service Technologies: Understanding Customer Satisfaction with Technology-Based Service Encounters. ", the Journal of Marketing, 64(3): 55-64.

[12] Anitsal, I. (2005), "Technology-Based Self-Service: From customer productivity toward Customer value", Doctoral dissertation, The University of Tennessee, Knoxville.

ISSN (Online): 1694-0784
ISSN (Print): 1694-0814

[13] Tricia Ellis-Christensen," What Is a Retail Kiosk?" White paper, Conjecture Corporation, 2003-2009.

[14] Tomber, Dave. "Check-in Evolution." Passenger Terminal World, June 2007: 52-56.

[15] Miller, Jared Keith. "Reducing the Air Travel Hassle Factor Through Self-Service Check- in Process Improvements." MSc Thesis, Massachusetts Institute of Technology, 2003.

[16] Conway, Peter. "Common vision." Airline Business, January 2006: 40-42

[17] IATA website," CUSS Airport Readiness Interactive Map" (http://www.iata.org/stb/maps/cuss.html)

[18] Bitner, M. J. "The service encounter: Diagnosing favorable and unfavorable Incidents". Journal of Marketing, P82, January 1990: 71-84.

[19] Butterfield, L. D., Borgen, W. A., Amundson, N. E., & Maglio, S. T. Fifty years of the critical incident technique 1954-2004 and beyond Qualitative Research, 5(4), 2005 : 475-497.

[20] Flanagan, J. C. The Critical indecent technique. Psychological Bulletin, 51(4), 1954:327-358.

[21] Matthing, J., Kristensson, P., Gustafsson, A., & Parasuraman, "A. Developing successful technology-based services": The issue of identifying and involving innovating users. Journal of Services Marketing, 20(5), 2006: 288-297.

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An Overview of Portable Distributed Techniques

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Abstract

In this paper, we reviewed of several portable parallel programming paradigms for use in a distributed programming environment. The Techniques reviewed here are portable. These are mainly distributing computing using MPI pure java based, MPI native java based (JNI) and PVM. We will discuss architecture and utilities of each technique based on our literature review. We explored these portable distributed techniques in four important characteristics scalability, fault tolerance, load balancing and performance. We have identified the various factors and issues for improving these four important characteristics.

Keywords: *Message Passing Interface (MPI), Java Native Interface (JNI), Parallel Virtual Machine (PVM), Component Object Model (COM), Distributed Component Object Model (DCOM).*

1. Introduction

Computing power of idle hosts is utilized by distributed computing. There are certain strong reasons that justify using distributed computing in comparison than mainframes. Distributed systems offer a better price and performance than mainframes. A distributed system has more total computing power than a mainframe. If one machine crashes, the system as a whole can still survive in distributed system. Thus distributed system provides better reliability. Computing power can be added in small increments in distributed systems. In this way Incremental growth can be achieved. Distributed systems allow many users to access a common database thus provides data sharing. It also allows many users to share expensive peripherals. It makes human-to-human communication easier. It has flexibility, because workload is spread over available machines in most cost effective way. On distributed computing, various heterogeneous devices communicate with each other with different ways.

One of the ways in which Distributing computing can be classified is based on portability; Portable Distributed Computing v/s Non-portable Distributed computing. Within each type, there may be several techniques considered. The basis of the selection a techniques in a group was that these techniques were most prevailing existing distributing computing technique. The other basis of choice for selecting a technique in each group was that these techniques individually represent their group having a distinguished feature. Various distributed computing techniques are:

(1) Distributed Computing through Message Passing without using Java: In this Plain MPI, PVM may be analyzed

(2) Distributed Computing Through Middleware such as COM-DCOM CORBA.

(3) Distributed Computing through .NET Remoting.

(4) JNI: Wrapper: C and C++ codes are interfaced with Java codes using MPI

(5) Pure Java using socket programming and RMI and using these techniques in MPI.

Among these distributing computing techniques, some are portable and some are not portable. In this paper, we have discussed portable techniques mainly distributed computing using pure java based MPI, native java based MPI and PVM.

2. Portable Distributed Techniques

A technique is portable if it applies to different versions of the same operating system (e.g., past and future versions of Operating System) and to different operating system

2.1 Distributed Computing using Pure Java Based MPI

The Message Passing Interface (MPI) provides a powerful programming paradigm for high performance computing. It is based on the interchange of messages

between processes. MPI can be implemented in any programming language because MPI is language independent. Earlier MPI was implemented in C and FORTAN. Performance of C and FORTAN based MPI is high but portability is major drawback. Researchers are devoting efforts to overcome the problem of portability. Portability problem is solved by implementing the MPI with a portable high level language like JAVA. MPI implementation in java has overcome the problem of portability but on the cost of performance [**1**]. For the last few years, both researchers and practitioners have been concerned with the improving the performance of java based MPI.

MPI can be implemented using java in two ways; pure java and impure java implementation. Researchers are trying to solve many issues related to pure java implementation of MPI. These issues are efficient and lightweight distributed computing implementation, design and development of user centric interface for administrator to configure environments, performance evaluation techniques, performance improvements, system interoperatability across a diverse range of devices, efficient implementation, flexibility, fault-tolerance, scalability, transparency, performance with portability, efficient access control, easy to access, high degree of abstraction to ease the programming , load balancing, heterogeneity, malleability(the capability to handle changes in the resources used during a computation) etc[2].

Java is object oriented language with an attractive feature of portability. Hence practitioners are trying to implement a high performance implementation of MPI with different approaches based on MPI standard. In order to implement MPI using java, MPJ is developed. MPJ is a MPI specification for java. It works with impure as well as with pure java [**3**]. Pure java implementations of MPI are two types, Socket based and RMI based. Socket based are flexible but its programming is complex. Programming with RMI is very easy and efficient. Programmers with RMI can make easily distributed application as compared with socket. Another problem with socket is errors. Distributed programming using socket is very difficult as compare to RMI. Hence programming with socket is tough. Programmer can not make distributed system easily with socket [4].

Performance is measured through latency, bandwidth, and total processing time mainly. Performance can further be improved. In our literature we find several java based MPI with specific shortcoming, but no one can full fill all basic requirements. Researchers are also trying to implement “one size fit all”. Reason for “one size fit all” is that for some main concern could be portability while for other high bandwidth or low latency. Portability and high performance are contradictory requirements. There is much scope to manage these contradictory requirements. There have been various efforts made by researchers to improve the performance of pure java based MPI, and maintaining the portability. Some researchers implemented MPJ with layered architecture. In this layered architecture java, java new I/O (NIO) based device, a shared memory device are implemented. It brings ability to swap devices at run time and thus manage the contradictory requirements [5].In this layered architecture, one of layer is of native MPI so it adds overheads and the performance improvement is not so significant. There is a strong need to identify the factors affecting performance and explore the ways to improve the performance of pure java based MPI.

JMPI is designed with remote method invocation with object serialization. JMPI is written purely in java. JMPI can be run on any host where java virtual machine (jvm) is available. As compare to mpiJava it is more stable and reliable. Performance is very low as compare to Sun’s RMI or KaRMI [6]. It has a good interface tool which can further be improved. Time to time researcher evaluate the performance of all main techniques of distributed paradigm. In their evaluation they found that the Java RMI has higher round trip latency, when compared with MPI and PVM. The reason for higher latency is, in JavaRMI communication is done in terms of objects. When communication is done over the network using Java RMI, the objects are converted into bytes and then these bytes are transmitted over the network. The conversion of objects into bytes is a time consuming job. For this reason, the Java RMI has the highest latency among all paradigms. Java RMI gives the least performance with respect to bandwidth [***7***]. There is a lot of scope to identify the factors, to improve the performance. There is a strong need to make a framework of these critical factors. This framework can provide a better understanding to developers, designers and programmer managers to design and develop the high performance portable distributed system using pure java. Researcher designed JMPI using both RMI and socket [4]. There are further research areas to implement multiple process of an MPI application on same machine as a separate thread which can improve the performance. Best performance is obtained by increasing the number of computers. However latency is not measured for JMPI which can be a research problem for our research work.

2.2 Distributed Computing using Impure Java Implementation of MPI

Java native interface implementation of MPI is basically wrapping existing native MPI libraries with the Java. Java Native Interface (JNI) specifies the transition between java code running within the java virtual machine

(JVM) and native, system-dependent C or FORTRAN code. One of the first attempts was Bryan Carpenter's mpiJava. mpiJava is an essentially a collection of JNI wrappers to a local C MPI library[**8**]. It is a hybrid implementation with limited portability. It has to be recompiled against the specific MPI library being used. Researcher developed HPJava to overcome the problem of compiling again [9].

The major research problem is efficient cooperation between java and native codes [**10**]. JNI also introduce a time overhead and affect the performance. Researcher devoted to measure the time overhead. The overall native method invocation overhead turned out to be about 3-5 times bigger than for ordinary methods [**11**]. Researcher also worked for a better understanding of JNI-related performance issues that might help developers to make more informed decisions during the software design phase. Still there is much scope to work in same.

JNI performs poorly because most of the data transferred between the virtual machine and the native space must be copied [**12**]. Researcher avoided the JNI overhead by tightly integrating mpiJava with a version of Hyperion[**13**].Some researcher suggested direct buffering mechanism to improve the overhead of copying the data[**14**][**15**].Still performance of native java interface is an issue that need a systematic investigation. There is a need to design a better understanding of all techniques to overcome the shortcomings like performance, limited portability, efficient and effective coordination among native and java codes.

Beside these issues, the mpiJava library is not thread-safe partly because it depends on an underlying native MPI library. Even if the native MPI library was thread-safe, some additional work would be needed to make the mpiJava wrappers thread-safe. There is a tremendous scope to address various issues related with JNI to improve the performance, fault-tolerance, scalability, transparency, load balancing, resource tracking etc. javaMpi is another wrapper around C MPI Library. JNI has another problem of limited portability [**3**].

With our literature survey we find some key areas related to java native interface. These key areas are distribution of load over different computers, managing resources and scheduling user jobs, fault tolerance techniques improvements, dynamic load balancing **[**17].There is a tremendous scope to identify the factor and their improvement in stated above.

2.3 Distributed Computing using PVM

PVM system is a distributed programming environment. PVM support heterogeneous distributed computing. PVM is a portable distributed computing. It supports certain forms of error detection and recovery. The PVM (Parallel Virtual Machine) provides a unified framework .Large systems can be developed in a straightforward and efficient manner. PVM permit a collection of heterogeneous machines on a network to be viewed as a general purpose concurrent computation resource [18]. With our literature survey we found that there are several areas of PVM in which substantial efforts have been done by various researchers. These areas are better technique for dividing and distributing the big task, performance measurement, performance improvement, analysis, load balancing, dynamic resource allocation and utilization, support for the automatic compilation of different object modules for different architectures, fault detection and tolerance, data access, develop software environments that will automatically find a near-optimal mapping for an high computing(HC) program expressed in a machine-independent high-level language.

With PVM, There is a need to divide and distribute a complex big task among various computers. To address this issue, researcher suggested the heterogeneous network computing environment (HeNCE) as a tool. This tool decomposes their application into subtasks. HeNCE also distribute these subtasks to the machines currently available in the HC system [16]. HeNCE allows the programmer to explicitly specify the parallelism for an application by creating a directed graph. HeNCE also has four types of control constructs: conditional, looping, fan out, and pipelining [19].However there is still need for improvement in dynamic environment for task divide and allocation. There is a strong need for dynamic self-adjustment of task deployment and other aspects of self-management. Still there is need to investigate systematically.

From time to time, researchers have been devoted efforts to measure the performance of PVM and compare it with others techniques of distributed computing. PVM has high latency. It is due to daemon. In case of PVM, the daemon is responsible for all communications. It provides flexibility but it eats up the processing power of the machine. Due to this reason the PVM and Java RMI take more time to pass the message (high latency). PVM performance is 2 to 3 times slower than RPC [7]. There is research scope to work to investigate the critical factors and their improvements with respect to performance of PVM.

Researcher also compares PVM with MPI. The total time of execution of the PVM version is about 20% longer than the MPI implementation of the algorithm. PVM environment is built on the concept of virtual machine, which secures three levels of heterogeneity. First, the network level: different networks can create common virtual machine. Second, the machine level: computers with different architecture, operating systems and data formats can create

virtual machine. Third, the application level: the architecture of the virtual machine can be matched to the form of a subtask [25]. The PVM environment was created with heterogeneity over performance, while the principal idea of MPI standard is performance and portability over flexibility. There is much scope to explore the ways to make PVM for data parallel application and to improve the performance of PVM.

Performance improvement can also be achieved by reducing the message transmission time. There is much scope to investigate the reasons and factor to reduce message transmission time. Another reason for performance degradation is buffer access time. There is a strong need to make more effort to reduce PVM based memory allocation time, and improve access protocols to reduce overall message buffering time.

PVM does not offer some functionality such as thread safety, multiple communication end-points per task, and default-case direct message routing. In order to solve these issue researchers developed JPVM.JPVM is a java implementation of PVM [26]. JPVM uses direct task-to-task message delivery instead of daemon-to-daemon routed communications. JPVM is based on TCP. However UDP/IP implementation is yet to be suggested and implemented. When performance of PVM, JPVM is compared, we found that performance become worst and bandwidth is also lost [27].There is much scope to address these issues such as thread safety, multiple communication end-points per task, and default-case direct message routing differently rather than implementing in java.

Performance is measured by simulation elapsed time, speedup and bandwidth [7]. Performance may be different for light and heavy traffic. There is much scope to identify the main causes and relationship between load amounts with performance. Researchers have evaluated the significance of reducing buffer access time and message transit time in order to improve the runtime performance. There is a common belief that to reduce the elapsed time of a parallel program, the workload distribution among the processors must be balanced [20]. So there is a research scope in load balancing and distribution among the various computers connected in a distributed network. Many researchers observed that other factors such as inter-processor communication overheads may also cause poor performance. So there is a scope to improve the interprocess communication to improve performance.

By load balancing, performance of PVM can be improved significantly. PVM round robin load balancing is not the correct approach in a heterogeneous industrial environment where different machines have dissimilar performance. As a result, the Applied Research and Technology Lab has developed a new load balancing sub system ,which has the ability to manage PVM spawn taking into account both current CPU load and CPU performance altogether. Tests have been conducted on the new load balance subsystem which results in an increase of PVM performances in a heavy heterogeneous (in terms of workload/performances) environment [21].Results stated there is improvement in performance but there is a need for reasonable improvements. Hence there is a lot of scope to correct the load balancing. There is also need to distribute the load among various machines in order to maximize the usage of machine and minimize the task execution. There is a still need of “intelligent distribution of load”.

The main reason for low performance of PVM is daemon thread. It provides the flexibility but eats up all resources. Researcher are also trying to use one of the new general purpose transport protocol called SCTP (Stream Control Transmission Protocol) for direct communications among the tasks [22]. SCTP has been recently standardized by the IETF (Internet Engineering Task Force) and, compared it with TCP (Transmission Control Protocol). It has new interesting characteristics that could be more suitable for parallel applications. Hence there is a lot of scope to explore the ways for this [23].

Fault-tolerance becomes an important requirement in distributed systems. Many researchers are devoting their efforts in development of a fault-tolerant PVM. Researcher presents a transparent, non-blocking check pointing protocol to support fault-tolerance for PVM applications. Even if the applications have dynamic number of processes, the protocol can be implemented as a user-level library and, therefore, the changes in PVM library and operating system is not necessary[24].However due to check point, an overhead is introduced that could make it unsuitable for many application. So there is a need for a low overhead fault-tolerance technique for PVM.

From our extensive literature survey, there is a lot of research scope in improving the overall utilization of resource. It will consequences improvements in performance of PVM.

3. Conclusions

Based on our discussion in section two, we derive the several findings about the portable distributed techniques. Performance of java based MPI is low as compared to plain MPI on cost of portability. Portability and performance are contradictory requirement. Performance can be further improved by improving the factors affecting the performance. Conversion of byte codes to machine codes adds an extra overhead on the performance. In case of JNI, by improving the coordination between the java to native code and vice-versa performance can be improved. Daemon eats up all processing power of computing nodes in PVM. Thus by use of the new general purpose protocol,

performance of PVM can improved. More adaptive improved and fuzzy algorithm is required to make load balancing more efficient.

References

[1] V. Getov, S. Flynn-Hummel and S. Mintchev., "High-Performance parallel programming in Java: Exploiting native libraries," In ACM 1998 Workshop on Java for High Performance Network Computing, Palo Alto, February 1998, Concurrency: Practice and Experience, 1998.

[2] G. F. Jordi, "Performance Improvement of Multithreaded Java Applications Execution on Multiprocessor Systems," Computer Architecture Department (DAC), Technical University of Catalonia (UPC), Barcelona (Spain), July 2005.

[3] G. Vladimir, L. Quanming, a M. Thomas and M. Williams, "Message-Passing Computing with Java: Performance Evaluation and Comparisons," 1066-6192/01$10.000, 2001 *IEEE*, pp. 173-177.

[4] B. SeungJun and A. JinHo, "Implementation and Performance Evaluation of Socket and RMI based Java Message Passing Systems," 0-7695-2867-8/07 $25.00, 2007, IEEE, DOI 10.1109/SERA.2007.60, pp. 153-159.

[5] B. Mark, C. Bryan and S. Aamir, "MPJ: Enabling Parallel Simulations in Java," www/acet.reading.ac.uk/projects/mpj/docs/res/DSGTR19062005 .

[6] M. Steven, K. Israel and C. Mani Krishna "JMPI: Implementing the Message Passing Standard in Java," www.ecs.umass.edu/ece/realtime/publications/morin02.pdf.

[7] Q. Kalim and R. Haroon "A Performance Evaluation of Rpc, Java Rmi, Mpi And Pvm," Malaysian Journal of Computer Science, Vol. 18 No. 2, December 2005, pp. 38-44.

[8] M. Baker, B. Carpenter, G. Fox, S. Ko and S. Lim "mpiJava: An Object-Oriented java Interface to MPI," Lecture Notes In Computer Science; Vol.1586, proceedings of the 11 IPPS/SPDP'99 Workshops held in conjunction with the 13th International Parallel Processing Symposium and 10th Symposium on Parallel and Distributed Processing, pp.748-762 ,Year of Publication: 1999, ISBN:3-540-65831-9.

[9] C. Bryan and F. Geoffrey "Hpjava: A Data Parallel Programming Alternative," 1521-9615/03/$17.00, 2003, IEEE.

[10] K. Dawid and S. Vaidy, "Efficient Cooperation between Java and Native Codes - JNI Performance Benchmark," Emory University, Dept of Math and Computer Science.

[11] Z. Bao-Yin, Y. Ze, Y. Guang-Wen and Wei-Min Zheng, "Dynamic Load-Balancing and High Performance Communication in Jcluster," 1-4244-0910-1/07/$20.00 c_2007 IEEE.

[12] B. Pugh and J. Spacco, "MPJava: High-Performance Message Passing in Java using Java.nio," In Proc. 16th Intl. Workshop on Languages and Compilers for Parallel Computing (LCPC'03), LNCS vol. 295*8*, pp. 323-339, College Station, TX, USA, 2003.

[13] H. Philip and R. Mathew "Cluster computing With Java," Computing in Science and Engineering**,** Volume 7, Issue 2 (March 2009), pp. 34-39, Year of Publication: 2009, ISSN: 1521-9615, 1521-9615/05/$20.00 © 2005 IEEE.

[14] B. Mark, C. Bryan and S. Aamir, "MPJ Express: Towards Thread Safe Java HPC," Cluster Computing, 2006, IEEE International Conference CLUSTER 2006, pp. 1-10.

[15] M.A. Baker, B. Carpenter, and A. Shafi, "MPJ Express: Towards Thread Safe Java HPC," Proceedings of the IEEE International Conference on Cluster Computing (Cluster 2006), Barcelona, Spain, September, 2006, ISSN: 1552-5244.

[16] A. Beguelin, J. Dongarra, A. Geist, R.Manchek and K. Moore, "HeNCE: A Heterogeneous Network Computing Environment," Tech. Rep. CS-93-205 (August 1993), University of Tennessee.

[17] A. Jameela, M. Nader, J. Hong and S. David, "An Agent-Based Infrastructure for Parallel Java on Heterogeneous Clusters," Proceedings of the IEEE International Conference on Cluster Computing (CLUSTER'02) 0-7695-1745-5/02 $17.00 © 2002 IEEE.

[18] V. S. Sunderam, ''PVM: A Framework for Parallel Distributed Computing,'' Concurrency: Practice and Experience, vol. 2, no. 4, pp. 315-339, December 1990.

[19] M. Muthucumaru, D. B. Tracy, and S. Howard Jay , "Heterogeneous Distributed Computing: Encyclopedia of Electrical and Electronics Engineering," J. G. Webster, editor, John Wiley & Sons, New York, NY, 1999,Vol. 8, pp. 679-690.

[20] P. Kovendhan and D. Janakiram, "The Edge Node File System: A Distributed File System for High Performance Computing," Scalable Computing: Practice and Experience, Vol. 10, Number 1, pp. 115–130, http://www.scpe.org.

[21] D. B. Christian, P. Guido , P. Emiliano De, G. Riccardo and G. Francesco, "PVM Advanced Load Balancing in industrial environment," Proceedings of the 14th Euromicro International Conference on Parallel, Distributed and Network-Based Processing (PDP'06), 1066-6192/06 $20.00 © 2006 IEEE.

[22] R. R. Stewart and Q. Xie, "Stream Control Transmission Protocol (SCTP)," A Reference Guide, Addison-Wesley, 2002.

[23] M. Petrone and R. Zarrelli, "Enabling PVM to build Parallel Multidomain Virtual Machines," Proceedings of the 14th Euromicro International Conference on Parallel, Distributed and Network-Based Processing (PDP'06), 1066-6192/06 $20.00 © 2006 IEEE.

[24] N. Thoai and D. V. Hung, "Checkpoint and Recovery for Parallel Applications with Dynamic Number of Processes," Sixth International Symposium on Parallel and Distributed Computing (ISPDC'07), 0-7695-2936-4/07 $20.00 © 2007.

[25] B. Butrylo , F. Musy , L. Nicolas , R. Scorretti and C. Vollaire, "New Trends in Parallel Electromagnetic Fields Computation," Proceedings of the International Conference on Parallel Computing in Electrical Engineering (PARELEC'02), 0-7695-1730-7/02 $17.00 © 2002 IEEE.

[26] D. Thurman, "JavaPVM," available from http://www. isye.gatech.edu/chmsr/JavaPVM/.

[27] K. Dincer, "jmpi and a Performance Instrumentation Analysis and Visualization Tool for jmpi," First UK Workshop, Java for High Performance Network Computing at EuroPar 1998, September 1998, http://www.cs.cf.ac.uk/hpjworkshop/.

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Towards Corrosion Detection System

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Abstract

Corrosion is a natural process that seeks to reduce the binding energy in metals. The end result of corrosion involves a metal atom being oxidized. Surface corrosion on aluminum aircraft skins, near joints and around fasteners, is often an indicator of buried structural corrosion and cracking In this paper we proposed a new method on which we are moving towards designing a method to detect the corrosion within the metals, the new method has defined texture analysis as the main method for this approach, the proposed enhancement shows less false positive and less false negative. The main functions used in this approach beside texture analysis are Edge detection, structure element and image dilation. The new approach has designed to detect a part of the image that has been affected by the corrosion, the tested images has showed a good result lying on detecting the corrosion part from the image.

Keyword - Corrosion, Object Detection, Texture Analysis, Edge Detection

1. Introduction

Corrosion is a physicochemical interaction between a metal and its environment which results in changes in the properties of the metal and which may often lead to impairment of the function of the metal, the environment [12], [5], [4]. The corrosion resistance of metals and alloys is a basic property related to the easiness with which these materials react with a given environment. Today, aircraft paints are routinely removed to reveal corrosion on metal surfaces, and the aircraft must be repainted following repairs. Both expensive and time-consuming, that process can also generate air pollution and waste resources. A method is therefore needed to detect the early onset of corrosion on metal substrates covered by protective coatings, so that aircraft primers and need not be stripped [13]. Concrete and structural steel. Both materials decay in predictable ways, and bridges and over- passes made from them deteriorate to a level where the structures must be rehabilitated or replaced the cost of rehabilitating these bridges or replacing them with new ones is staggering, approximately $90 billion a year. Texture analysis is important in many applications of computer image analysis for classification [7], [8].

In new simple methodology for the assessment of the crown corrosion in concrete sewer pipes was developed based upon the principle that the surface roughness increases when concrete corrodes [9]. The roughness was quantified by correlating the depths of the surface pits to the lengths of shadows produced in a single source of incident light. A computer program was used to reconstruct a pseudo three-dimensional concrete exterior and obtain the averaged corrosion rate [2]. In this paper that the use of non-parametric classifiers based on learning algorithm enables the proposed approach to be used in small robots and portable devices for corrosion diagnosis. As the neural network classifiers store the knowledge in the neurons weights, there is no need to store all data as in the parametric methods

2. Why Texture Analysis

Texture analysis methods have been utilized in a variety of application domains. In some of the mature domains (such as remote sensing) texture already has played a major role, while in other disciplines (such as surface inspection) new applications of texture are being found [14].Texture analysis will play an important role in detecting this isolated data and reducing the error and improving the

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classification results [1]. Segmentation can be done by finding the pixels that lie on a region boundary. These pixels, called edges, can be found by looking at neighbouring pixels. Since edge pixels are on the boundary and regions on either side of the boundary may have different gray values, a region boundary may be found by measuring the difference between neighbouring pixels. Most of edge detectors (local operators) use only intensity characteristics as the basis for edge detection. Such methods take advantage of gray level discontinuities that are considered relevant features of the image [6].
And thus texture analysis with edge detection may use to retrivel the objects that have a different texture characteristic from the image. In this paper we are moving towerds implemnting an accurate method to detect the corrosion, in fact, edge detection, texture analysis and other factors has been embeded on this paper for the purpose of tuning the system to have better result.

3. Methodology

In this approach we will design and implement a method to detect the corrosion within the metals, the new method will define texture analysis as the main method for this approach, texture analysis normally implement to segment a special objects, however texture analysis can not stand alone without enhancing the images, whereby, the object will be easy to detect. The main assistance functions will be edge detection, create structure elements and finally dilate the edge of the structured objects. The expected result will be a system can detect the corrosion.. This texture filter has been invented originally to calculate the local range of an image. These statistics can characterize the texture of an image because they provide information about the local variability of the intensity values of pixels in an image. For example, in areas with smooth texture, the range of values in the neighborhood around a pixel will be a small value; in areas of rough texture, the range will be larger, The stdfilt and entropyfilt functions operate similarly, defining a neighborhood around the pixel of interest and calculating the statistic for the neighborhood to determine the pixel value in the output image. The stdfilt function calculates the standard deviation of all the values in the neighborhood. The entropyfilt function calculates the entropy of the neighborhood and assigns that value to the output pixel. Note that, by default, the entropyfilt function defines a 9-by-9 neighborhood around the pixel of interest. To calculate the entropy of an entire image, use the entropy function.
Edge detection is the process of finding sharp contrasts in intensities in an image [10]. This process significantly reduces the amount of data in the image, while preserving the most important structural features of that image. Canny edge detection operator was developed by John F. Canny in 1986 and uses a multi-stage algorithm to detect a wide range of edges in images, Edge detection methods such as the canny detector [3] were widely applied for this task. Edge detection methods utilize intensity gradients to detect the boundaries of objects [11].

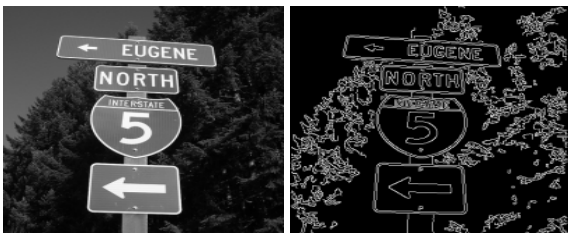

Figure 1. Example of Canny Edge Detection.

4. Testing Result

Below the output figures include a tables, these table has five fields, sequentially, a, b, c, d and e, where (a) is the original image, (b) is the gray level image, (c) is the texture filter, (d) is the Edge detection, and finally (e) is the final enhanced image.
Other test in figure 2 shows more complex corrosion, in figure 2. The caption was for image that has two parts, one part affected by corrosion and other part was not.
The output shows a good accuracy of using the new approach to detect the corrosion on the image

a	
b	

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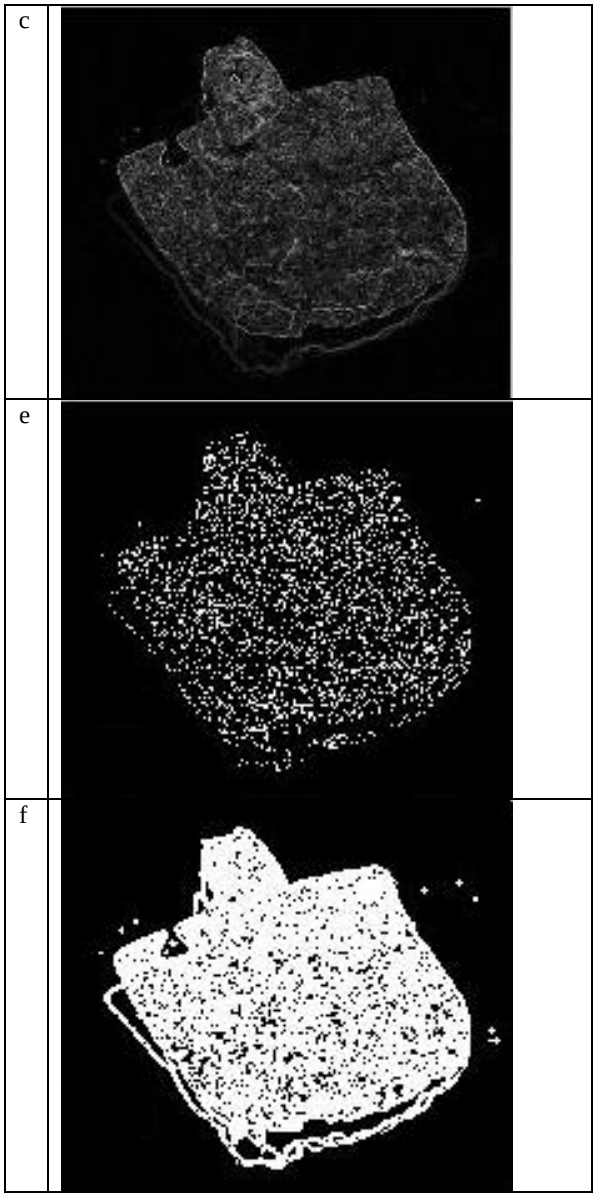

Figure 2. Other Corrosion Detect by the System

5. Conclusions

Texture segmentation is a significant and primary issue in texture analysis. It is concerned with automatically determining the boundaries between various textured regions in an image detection approaches has been widely used in the image processing. It has represented less time consuming and inexpensive alternative. Many techniques and functions were involve on the image processing to achieve an accurate methods on detect, recognize and classify the target, the most popular methods on these area are, texture analysis, image segmentation and many other functions. Texture analysis is one of the most important characteristics in the image processing; in this paper texture analysis through stdfilt filter has been proposed to detect the corrosion within the plates. The proposed solution has focused on the rough texture of the corrosion areas, and identifies the simple texture as non-corrosion area. The test has shows a good result in term of detecting visible corrosion, as well, we assumed the new approach may do the job successfully with the under-paint corrosion.

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REFERENCES

[1] Alhaddad, B. I. Z., M. C. Burns, et al. (2007). Texture Analysis for Correcting and Detecting Classification Structures in Urban Land Uses. Urban Remote Sensing Joint Event. Spain.

[2] Bento, M. P., F. N. S. de Medeiros, et al. (2009). Image Processing Techniques applied for Corrosion Damage Analysis.

[3] Canny, J. (1987). "A computational approach to edge detection." Readings in computer vision: issues, problems, principles, and paradigms: 184.

[4] Demadis, K. D. (2007).,"ALKALINE EARTH METAL PHOSPHONATES: FROM SYNTHETIC CURIOSITIES TO N ANOTECHNOLOG Y APPLICATIONS." Solid State Chemistry Research Trends: 109.

[5] Demadis, K. D., C. Mantzaridis, et al. (2006). "Effects of Structural Differences on Metallic Corrosion Inhibition by Metal- Polyphosphonate Thin Films." Ind. Eng. Chem. Res 45(23): 7795-7800.

[6] Di Ruberto, C., G. Rodriguez, et al. (1999). Image segmentation by texture analysis.

[7] Dunker, K. F. and B. G. Rabbatt (1993). "Why America's bridges are crumbling." Scientific American 268(3): 18-24.

[8] Ehlen, M. A. (1997). "Life-cycle costs of new construction materials." Journal of Infrastructure Systems 3(4): 129-133.

[9] Gutierrez-Padilla, M., D. Guadalupe, et al. (2009). "Simple scanner-based image analysis for corrosion testing: Concrete application." Journal of Materials Processing Technology 209(1): 51-57.

[10] Hamid, A. M., M. L. M. Kiah, et al. (2009). "Novel Approach for High Secure and High Rate Data Hidden in the Image Using Image Texture Analysis." International Journal of Engineering and Technology (IJET): 0975-4042.

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[11] Haralick, R. M. (1979). "Statistical and structural approaches to texture." Proceedings of the IEEE 67(5): 786-804.

[12] Javaherdashti, R. (2000). "How corrosion affects industry and life." Anti-Corrosion Methods and Materials 47(1): 30-34.

[13] Lipkin, B. S. and A. Rosenfeld (1970). Picture processing and psychopictorics, Academic Press, Inc. Orlando, FL, USA.

[14] Tuceryan, M. and A. K. Jain (1993). "Texture analysis." Handbook of pattern recognition and computer vision 276.

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A Situational Approach for Web Applications Design

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Abstract

The paper introduces a situational approach for Web applications design. We, first, define development situations and identify their specific characteristics through situational factors in projects. Using these situational factors, the most appropriate design process-model is selected. A meta-modeling technique is proposed that integrates the Map formalism for modeling existing design process-models.

Based on COMET meta-model we have redefined most proven existing web applications development methods into method components that we have stored in a components base to be selected. Finally, a new method of useful method fragments is assembled.

The approach provides three types of guidance: (1) guidance in the selection of the most appropriate design process-model, (2) guidance in the selection of the most appropriate method components and (3) guidance in the application of selected method components. The method developed was validated in a case study and proposed tool was validated empirically.

Keywords*: web application, web development method, method engineering, situational method, web-oriented situational method.*

1. Introduction

The Web has very rapidly evolved into a global environment for delivering different kinds of applications ranging from small-scale to large scale applications. However, most applications often fail since their development is often on an ad-hoc basis, without the support of appropriate methodologies able to manage the high complexity of information. Consequently, considerable attention has been given to Web engineering. This discipline is concerned with the establishment and the use of engineering and management principles and disciplined and systematic approaches to the successful development, deployment and maintenance of high quality web-based applications.

In order to manage the overall complexity of development, several methodologies and approaches have been proposed.

They should provide guidelines for performing activities and suitable models for expressing the results.

The development of a web application should not be an event, but a process. This process will consist of a set of manageable activities. In fact, it is important to be guided by a sequence of steps to be performed, to know how the different steps co-operate and how they fit into the development process as a whole. Each design activity should address different concerns at the proper stage and at the proper level of abstraction.

However, we have concluded that there are a number of gaps in existing modeling approaches, particular with regard to the level of guidance provided. Some approaches do not provide real guidance during design. In this context, some do not consider one or more basic dimensions of web design. We mention, for instance, the method proposed by [28] for the web information systems development which does not include presentation design in its life cycle, in spite of, the importance of aesthetic aspect in web design. For those which do, they do not explain steps to achieve them, as in the case of RMM [12] that includes a requirements analysis phase in its life cycle without explaining how a designer should do to achieve this activity.

However, as stressed above, some engineering activities should be carefully guided in order to maximize quality of result. The second issue addressed in this work is the need for better web design approaches being more specific to particular kinds of web applications. Most of proposed approaches consider design in the same way for all web applications. They propose only one process that should be followed during design of all applications. However, some particularities in term of complexity of the application, potential users and others should be considered.

More specifically, the work in this paper is partially motivated by conclusions derived in both Method Engineering discipline and Web Engineering discipline [4]. It was observed that there is no existing full-featured approach that one can use to develop different kinds of applications with different requirements. Consequently, if one wants to develop more than one application, he might need to use more than one methodology.

In this research, we propose an approach that covers existing methodologies transparently. It takes as input the application requirements and decides which process to follow. It provides web designer with the ability to move

through the basic design steps. We have adopted the meta-model MAP as modeling formalism, offering different ways to guide achievement of design activities. The MAP provides guidance to a lower level abstraction through associated guidelines.
Before advancing in the description of the approach, we judge important to define the notion of method since it will be frequently used throughout this paper. One of the results obtained by the meta-modeling community is the definition of any method as composed of a product model and a process model [21]. A product model defines a set of concepts, their properties and relationships that are needed to express the outcome of a process. A process model comprises a set of goals, activities and guidelines to support the process goal achievement and the action execution. Therefore, method construction following the meta-modeling technique is centered on the definition of these two models.

The remainder of the paper is organized as follow. We present, first, motivation and our contribution. Second, we give an overview of the proposed approach. Finally, we describe how the approach provides guidance in (1) selection of the most appropriate design process-model, (2) selection of the most appropriate method components and (3) application of selected method components.

2. Motivation and Contribution

To understand deeply the discipline of Web engineering, we have established a Web Engineering Framework. To outline limits of existing methods we have proceeded to the evaluation of seven methods among the most referenced ones in literature RMM [6], UWE [16], WSDM [5], OOHDM [11], Takahashi Method [28], WebML [2] and HFPM [20] according to the different views of the framework. This evaluation revealed three limits in particular.

- Informational aspect dominates the process design. We have noticed that the majority of methods do not consider all aspects having to be considered during design process. Let us mention, for instance, the method proposed by Takahashi [28] and WSDM method for the design of respectively web information systems and kiosk applications. Both approaches do not include a presentation design step in their life cycle, despite the importance of aesthetic aspects in web development.

- All existing methods are prescriptive (except HFPM). In fact, they prescribe a list of tasks to be done without considering (n) either the development situation at hand (n) or designer experience.

- Some methods are lack of guidance. They prescribe phases in their life cycle without describing how to achieve them. This is the case of RMM method, which includes both requirements analysis and User-interface screen design phases without explaining what a designer should do to achieve these activities.

Considering all these issues, we propose to relax the prescription of web design process model and cover all aspects that should be considered during web applications design. Situational Method Engineering responds to this need by offering techniques to construct methods by assembling reusable method components stored in a method repository. Brinkkemper [1] has defined the Situational Method Engineering as "the discipline to build project-specific methods, called situational methods, from parts of existing methods, called methods fragments".
We talk, henceforth, about Web oriented Situational Method Engineering that proposes to support construction of web development methods based on a reuse strategy. By assembling reusable method components originating from different web development methods, a new method can be tailored to the project situation at hand. New methods can, thus, be constructed by selecting the most appropriate components to a given situation from the method repository. Web oriented Situational Methods discipline favors the construction of modular web development methods that can be modified and augmented to meet the requirements of a given situation.

3. Overview of the Approach

When the web designer, who is the end user of our approach, decides to begin the design of a web application, he/she is invited to characterize the current situation of its web application to be developed by a set of situational factors. Based on introduced situational factors, the most appropriate design process-model is selected at different levels of abstraction.
The selected process-model comprises several steps delivering each of which delivers a particular product model. In fact, we have adopted this principle conformingly to existing methodologies which often advocate a model-driven approach, inspired by the separation-of-concerns principle. In order to tackle the complexity of the problem, each model in the system focuses on a different aspect of the design and often also a different level of abstraction.
The different steps which constitute the selected process-model are achieved by method components. The latter are defined accordingly to the meta-model for modular methods [22] and stored in a method repository in order to be selected.
To be able to select the most appropriate method components, we have fixed a set of selection criteria for each product model involved. We have used the multi-criteria analysis approach to select the most appropriate method components.

Selected components are, then, assembled and transformations from instances of one model into instances of the next model are taken place to, ultimately, reaching the final result in the form of a Web situational method.
In this sense, our solution is based on the following aspects which were be further detailed in this paper: (1) a list of classified product models [26], (2) a set of situational factors characterizing the current situation, (3) a web applications design process model providing required guidance during design [26], (4) a set of selection criteria for each product model and (5) a tool supporting the proposed approach.
We propose a multi-process approach offering panoply of web applications design process-models. We adopted the meta-modeling technique for abstracting all these process-models in a common process meta-model which is based on a set of product models each concerning a particular aspect of design.
To achieve this task, we need to adopt process model formalism. As our solution provides many alternatives and paths, strategic oriented process models seem to be the solution. In particular, the MAP formalism belonging to this class can be employed to model the design process as we intend to do; that is why we keep it for our solution.
In the following, we present first, a list of classified product models. Second, we describe the different situational factors characterizing the current situation of development we give a brief description of the MAP formalism.

3.1 The Typical Phases of Web Applications Design and their classification

Existing Web development methods consider the design phase as a phase of product models delivery, addressing each one a particular concern of design. A typical web application development method has the following phases [7] [9]:

- Conceptual design: describes the organization of the information managed by the application, in terms of pieces of content that constitute its information base and their semantic relationships. Modeling aims to construct a conceptual domain model without commitment to any specific detail for navigation paths, presentation and interaction aspects.

- Navigation design: concerns the facilities for accessing information and for moving across the application content. The navigation structure should be carefully designed through a navigation model by providing the web designer with the comfortable navigation spaces.

- Presentation design: affects the way in which the application content and the navigation commands are presented to the user. This is described in a presentation model.

- Requirements analysis: gathering and forming the specification of users and/or stakeholder requirements. This step delivers a requirements analysis model.

- Adaptation modeling: the success of web applications is largely dependent on user satisfaction which is achieved by, for example, easy-to-use interface and well structured navigational architectures. The most effective technique to leverage these features is adaptation. It consists on delivering them to the right user at the right time in the right format. This phase presents the objects that participate in the adaptive functionality and describes how this adaptation is performed [16]. It aims to construct an adaptation model which is based on a user model.

- User modeling: aims to construct a user model which contains information that represents the view the system has of the knowledge, goals and/or individual features of user.

- Business process modeling: apart from simple web sites, web applications are derived from conventional transaction processing systems. These applications support critical business processes and workflows that are important part of the organization's core business model. These business functions must be supported and consequently web design methods need to provide the ability to represent these functions and their related design artifacts. It is an important activity in particular for the e-business applications design.

- Business modeling: deals with identifying and understanding the relevant elements in a specific domain and their relationships [29]. An important part of enterprise business modeling is the creation of a high-level domain model that depicts the main business entities and their relationships that are of interest to an organization. This model does not need to be very detailed. It provides a basis from which to begin more detailed modeling efforts.

The first four phases could be supported during the design of any web application. However, others are specific to some web applications types. In fact, adaptation modeling and user modeling phases are both performed when designing adaptive applications. User modeling phase can be also performed when designing a user-model based application. Web designer, in such case, intends to adopt a user-centered approach focusing on user requirements and characteristics. This has the advantage to solve disorientation and cognitive overload problems.

Although existing web development methods recommend achievement of the aforementioned phases and

consequently to deliver associated product models, we have noted that they do not consider them with the same degree of importance. In fact, they focus on the informational aspect by delivering: conceptual model, navigation model and presentation model. This is can be justified by two reasons: (1) at the early beginning of the web, web applications have primarily the role of disseminating information to users. This made methods privilege information dimension and derived aspects such as navigation and presentation; (2) informational dimension is recognized as fundamental in the design of any web application type [7] [13].

However, web applications are evolving from simple web sites to more and more complex and sophisticated applications. Consequently, others aspects besides the informational dimension should be considered during their design.
Based on this analysis, we have classified these models in two classes: Common models class and Features models class. The first class comprises conceptual model, navigation model and presentation model. The second class contains requirements analysis model, adaptation model, user model, business model and business process model.

As the proposed approach proposes panoply of web design process models, we have adopted the MAP as modeling formalism. In the following, we present an overview of the MAP and its associated guidelines.

3.2 The MAP Formalism

A MAP is a process model which allows designing several processes under a single representation. It is a labeled directed graph with intentions as nodes and strategies as edges between intentions [24]. The directed nature of the graph shows which intentions can follow which ones.
According to the meta-model illustrated in Figure 1, a MAP is composed of one or more sections. A section is a triplet <source intention I, target intention J, strategy Sij> that captures the specific manner to achieve the intention J starting from the intention I with the strategy Sij.

Error! Re ference source not found. An intention is expressed in natural language and is composed of a verb followed by parameters. Each MAP has two special intentions "Start" and "Stop" to begin and end the navigation in the MAP. Each intention can only appear once in a given MAP. For more details see [24].

4. Guidance in the Selection of the Most Appropriate Design Process Model

The process meta-model for the web applications design formalized using MAP is shown in

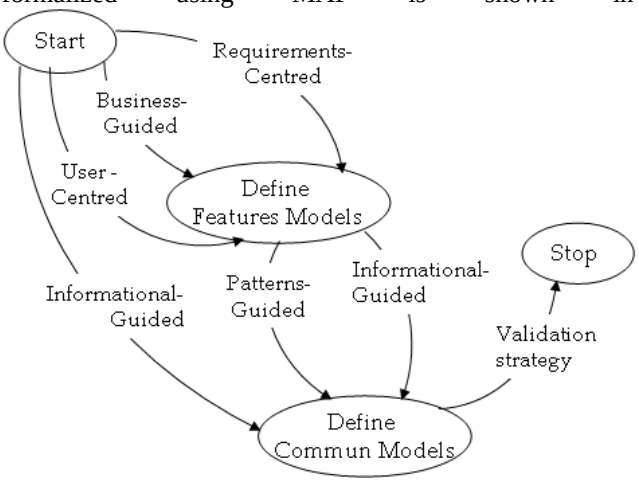


Fig 1. It contains two core intentions "Define Common models" and "Define Features models" in addition to "Start" and "Stop" intentions.
To allow designer going through the different intentions of the MAP, the approach provides a set of factors called Situational Factors. They guide designer during navigation in the design process model. The next subsection describes the proposed situational factors.

4.1 Situational Factors

The first step in the approach is to analyze the projects, categorize them in situations, and identify their specific requirements. The categorization of situations is based on their distinguishing characteristics. According to [1] and [17] stressed the importance of distinguishing development situations.
Karlsson [15] defines a characteristic of a development situation as: «a delimited part of a development situation, focusing on a certain problem or aspect which the method configuration aims to solve or handle». To achieve this purpose, we have proposed a list of situational factors characterizing current development situation. They help designer to choose the appropriate strategy among those presented in the MAP.

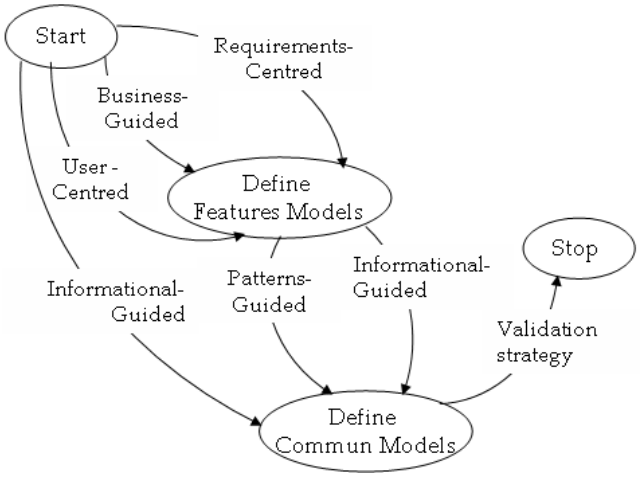


Fig 1. The Web Design Process Model

We have identified the following factors [27]:

- *Application type*: {kiosk application, Web Information System, Adaptive application, e-commerce application}.

All aforementioned types are obviously web applications; however they are different in term of deliverable models during design process.

- *Service complexity*: {Low, Medium, High}

Application complexity is measured through the complexity of services offered by application. Being more complex than kiosk applications, Web Information Systems should be designed differently, by giving more attention to services modeling dimension.

- *Similarity with others applications*: {Low, Medium, High}

The similarity with others applications factor specifies if the designer has already participated in the development of similar applications belonging to the same domain. It is to notice that web applications belonging to a same domain have similar structures and provide similar services. Thus, during design process, proposed approach considers designer profile by offering to him the possibility to reuse their past experiences.

- *User-application adaptation*: {Low, Medium, High}

This factor determines the adaptation degree of the application to users. A user-application adaptation having a high degree is specific to adaptive applications. When designer consider user aspect during design process a user-centered approach, this factor will take Medium value. In other cases, this factor will be of a low degree

- *Problem clarification*: {Low, Medium, High}

This factor reveals either the problem description of the current project is well defined and clarified or not.

- *Designer Experience*: {Low, Medium, High}

The approach considers the different profiles of designers such those having long experiences. In fact, they can exploit the different design patterns collected and stored to be employed.

Situational factors guide designer during the navigation in the design process model. We show, in the following section, how the proposed approach employs these aforementioned factors during the design process.

4.2 Selection of the Most Appropriate Web Design Process-Model

The choice of a particular path among those of the Map presented in

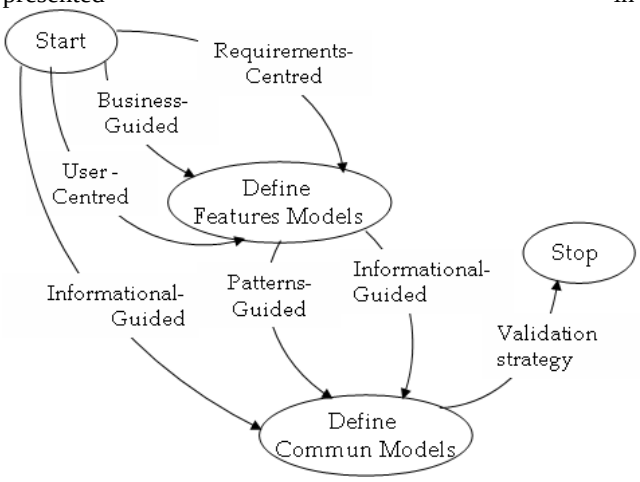


Fig **1** depends largely on purpose of designer in terms of web application type to be designed. A more in- depth analysis of the process MAP shows that designer is guided deeply and in flexible ways. Associated sections are refined to a lower level of abstraction proposing various techniques available to achieve the corresponding intentions.

From the "Start" intention, the designer is faced to a choice of two alternatives. He can either progress to achieve the "Define Features Model" intention or the "Define Common Model" intention.

When designing a simple web site (kiosk application) which problem description is well identified and requirements are well defined, designer should progress to "Define Common Model" intention. In others cases, designer should progress to "Define Features Model" intention.

When progressing to "Define Common Model" intention, designer can perform only one strategy named Informational-guided strategy. However, if he/she intends to progress to "Define Features Model" intention, he/she is faced to three alternatives. These strategies can be performed in parallel or alternatively depending on given situation:

- Business-guided strategy is followed when designer intends to develop an e-commerce application. In this case, he/she needs to conceptualize both Business Model and Business Process Model. Also, it is followed when

current application is a Web Information System (WIS) which is characterized by a high complexity of service. In such case, we provide designer with the ability to design a Business Process Model.
This strategy will be refined with a strategic guideline: a MAP at a lower level of abstraction. This latter contains two intentions: "Define Business Model" and "Define Services Model".

- User-centered strategy can be performed when designing an adaptive application. In this case, designer needs to consider users aspects and/or adaptation techniques through a user model and/or an adaptation model.

- Requirements-centered strategy helps to gather and form specification of users and stakeholder requirements.

All aforementioned guidelines associated to these strategies are refined through a MAP at lower level of abstraction. We have to stress that these three strategies can be performed alternatively or together. Let's take the example of an e-commerce application where requirements are all the time different and several. In fact, such application is characterized by both a high complexity of services and heterogeneity of clients. Consequently, all strategies Requirements-centered, User-centered and Business-guided strategy must be followed and achieved in this case.
Once "Define Features Model" intention is achieved, designer should progress to the "Define Common Model" intention either following informational-guided strategy or patterns-based strategy. We should recall that he/she can design a kiosk application and in this case, he/she follows also informational-guided strategy from "Start" intention. Being in one or other situation and at a lower level of granularity, refinement of this strategy is done through a MAP providing panoply of paths and strategies from "Start" and "Stop" intentions. It contains three core intentions: "Define Conceptual Model", "Define Navigation Model" and "Define Presentation Model" as it is shown by

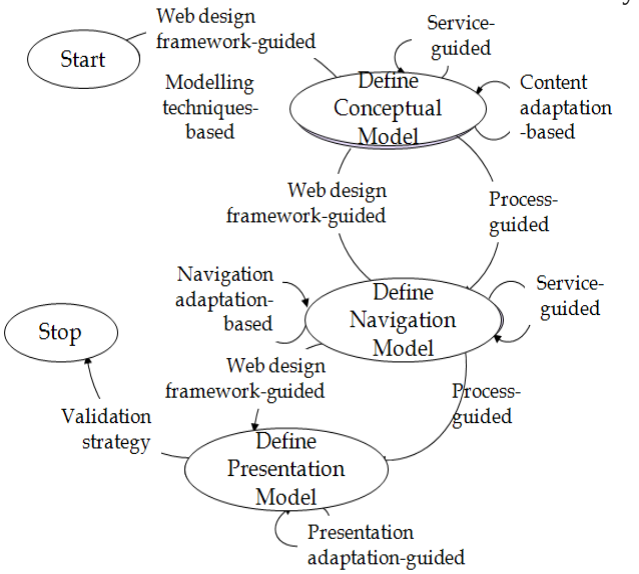


Fig 2.

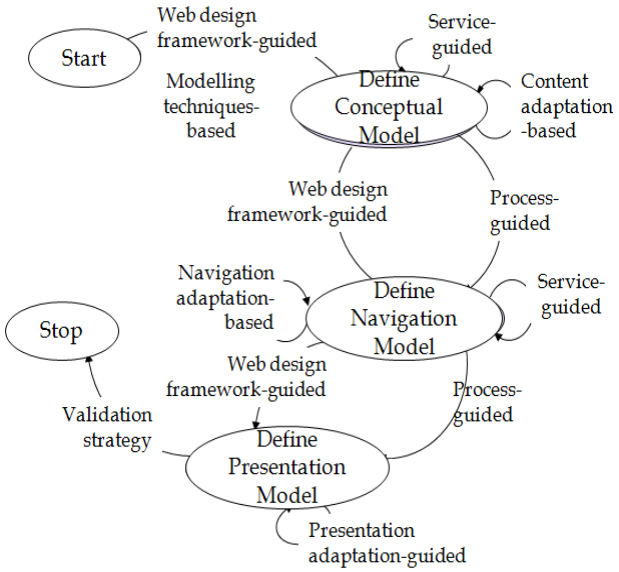


Fig 2. Refinement of the Informational-Guided Section at a lower level of abstraction.

Beginning from the "Start" intention, designer is faced to two strategies to achieve "Define Conceptual Model" intention. The modeling techniques-based strategy is applied when designer decides to start from scratch and to adopt a well known conceptual data-model like ER model or any Object-Oriented technique to define conceptual model.
By applying web design framework-guided strategy, designer has experience in current domain and has, already, designed similar applications in similar domain. Designer can reuse conceptual schemas already elaborated during

similar past projects. He should only personalize and adapt hot-spots according to specificities of the project at hand.
While defining the conceptual model, Service-guided strategy and/or Content adaptation-based strategy can be followed respectively when designer intends to enrich model with concepts associated to business process modeling and/or application being designed is an adaptive one.
Once the "Define Conceptual model" intention is achieved, designer progresses to achieve "Define navigation model" intention either by following web design framework-guided strategy or process-guided strategy. The process-guided strategy allows to be guided by a particular method selected as the most appropriate one from method components repository. The same strategies are, also, proposed to achieve "Define Presentation Model" intention oriented, here, presentation dimension. Navigation in the MAP is stopped by the validation strategy aiming to validate the different product models defined.
Once the most appropriate design process-model is selected, we proceed to the selection of method components which are stored in a method repository. The selection process is based on a list of criteria employed by a multi-criteria method.

5. Guidance in Method Components Selection

We describe in this section how the approach allows selection of the most appropriate method components given a selected design process. The selection step is realized based on a set of selection criteria associated to each defined product model. Designer is invited to attribute values to these criteria every time process-guided strategy is selected.

5.1 The Proposed Selection Criteria

We have fixed a set of selection criteria characterizing the following product models: user model, adaptation model, navigation model and presentation model.

a) The selection criteria of user model

Based on literature study [14] [16] [19] [30], we have listed the following criteria (Table 1):

- Granularity describes the level at which users are represented.

- Acquisition Technique expresses how users' information are collected.

- Characteristics specific to domain indicates if domain specific knowledge of users is modeled in the user model or not.

- Characteristics independent from domain indicates if other knowledge of users are modeled in the user model.

- Preference indicates if user can express his preference at a content dimension, navigation dimension and presentation dimension.

Table 1. User Model Criteria and their Values

Criteria	Possible Values
Granularity	Group, User, Group/User
Acquisition Technique	Explicit, Implicit, Explicit/Implicit
Characteristics	
Domain Specific	Yes, Partially, No
Domain Independent	Yes, Partially, No
Preferences	
Content	Yes, Partially, No
Navigation	Yes, Partially, No
Presentation	Yes, Partially, No

b) The selection criteria of Adaptation Model

Web applications should henceforth satisfy various requirements such as the need to be accessible from everywhere, at every time and from every platform. This leads to characterize an application by ubiquitous [3]. In order to cover all these aspects, we have identified a set of criteria [18] [13] [16] [30] [8] which their possible values are presented in Table 2:

- Adaptation Dimensions indicates dimensions of the application that are object of adaptation: Content, Navigation, Presentation, Functionalities.

- Adaptation Degree that are expected from the web application. It can take one of the following values: Minimal, Adaptive and Adaptable.

- Environment Context determines if the web application can be adapted according to these attributes: Location, Time, Device and Network.

Table 2. Adaptation Model Crteria and their Values

Criteria	Possible Values
Adaptation Dimensions	
Content (DC)	Yes, Partially, No
Navigation (DN)	Yes, Partially, No
Presentation (DP)	Yes, Partially, No
Functionalities (DF)	Yes, Partially, No
Adaptation Capabilities	
Minimal (CMin)	Yes, Partially, No
Adaptativity (CAdav)	Yes, Partially, No
Adaptability (CAdab)	Yes, Partially, No

Context related to Environment	
Location (C.L.Location)	Yes, Partially, No
Time (C.L.Time)	Yes, Partially, No
Material (C.L.Material)	Yes, Partially, No
Network(C.L.Network)	Yes, Partially, No

c) The selection criteria of Navigation Model

As for navigation model we have identified the following selection criteria. Table 3 presents possible values of these criteria.

- Notation (NOT) indicates the standardization degree of the notation.

- Implicated Dimensions (DIM) indicates dimensions considered during design.

- Adopted approach (APP) to define the navigation model can be either Bottom-up or Top-down or Mixed.

- Access Structures (StrAc) are additional navigation nodes allowing access to navigation objects.

Table 3. Navigation Model Criteria and their Values

Criteria	Possible Values
Notation (NOT)	Standard, Mixed, Proper
Implicated Dimensions (DIM)	Static, Dynamic, Static/ Dynamic
Access Structures (StrAc)	Yes, Partially, No
Adopted approach (APP)	Bottom-up , Top-down, Mixed

d) The selection criteria of Presentation Model

We have identified the following selection criteria for the presentation model which their possible values are presented in Table 4:
- Notation indicates with which notation presentation model will be defined.

- Implicated Dimensions: this attribute indicates dimensions considered during design.

- Multimedia Support determines if method takes in consideration multimedia dimension.

- Synchronization of interface objects indicates if method describes temporal relations between different Medias in particular when dynamic media such as video and audio are implicated.

Table 4. Presentation Model Criteria and their Values

Criteria	Possible Values
Notation	Standard, Mixed, Proper
Implicated Dimensions	Static, Dynamic, Static/ Dynamic
MultiMedia Support	Yes, Partially, No
Synchronization of interface objects	Bottom-up, Top-down, Mixed

Once the most appropriate design process is selected, we proceed to the selection of method components based on aforementioned criteria by employing the AHP multi-criteria method.

5.2 The Analytic Hierarchy Process Method

To achieve selection of most appropriate components we propose to employ a multi-criteria method such as the Analytic Hierarchy Process (AHP) method [25].
AHP allows both quantitative and qualitative criteria to be compared using informed judgments to derive weights and priorities.
The first step of AHP consists in determining analysis criteria, in our case, selection criteria associated to product models. Next step aims to elaborate binary comparison, in order, in one hand, to identify importance of one criterion relatively to others, and in the other hand, evaluate method components relatively to every criterion. Introduced values during evaluation should be conformed to the AHP table [25].

5.3 The Components Selection Process

To achieve intentions included in the selected design process, designer is invited to introduce his preferences by giving priorities between selection criteria as illustrated in

$$MC = \begin{pmatrix} & \text{NOT} & \text{DIM} & \text{StrAc} & \text{APP} \\ \text{NOT} & 1/1 & 3/1 & 3/1 & 7/1 \\ \text{DIM} & 1/3 & 1/1 & 5/1 & 5/1 \\ \text{StrAc} & 1/3 & 1/5 & 1/1 & 3/1 \\ \text{APP} & 1/7 & 1/5 & 1/3 & 1/1 \end{pmatrix} V_{PC} = \begin{pmatrix} 0.5111 \\ 0.3154 \\ 0.1198 \\ 0.0535 \end{pmatrix}$$

Fig 3.

$$MC = \begin{pmatrix} & \text{NOT} & \text{DIM} & \text{StrAc} & \text{APP} \\ \text{NOT} & 1/1 & 3/1 & 3/1 & 7/1 \\ \text{DIM} & 1/3 & 1/1 & 5/1 & 5/1 \\ \text{StrAc} & 1/3 & 1/5 & 1/1 & 3/1 \\ \text{APP} & 1/7 & 1/5 & 1/3 & 1/1 \end{pmatrix} V_{PC} = \begin{pmatrix} 0.5111 \\ 0.3154 \\ 0.1198 \\ 0.0535 \end{pmatrix}$$

Fig 3. Evaluation Matrix of selection criteria corresponding to Navigation Model and its eigen vector

For instance, the value 7/1 evaluated between notation (NOT) and Adopted Approach (APP) indicates that designer judges that the first criterion (NOT) is much more important than the second criterion (APP).
In another side, methods such as OOHDM, WebML, WSDM and UWE, examples of web development methods allowing the production of navigation model are evaluated in method repository.

The method expert has the responsibility to compare methods according to every criterion of all product models as illustrated by Fig 4.

$$MM1 = \begin{pmatrix} & \text{OOHDM} & \text{WSDM} & \text{UWE} & \text{WebML} \\ \text{OOHDM} & 1/1 & 5/1 & 1/5 & 2/1 \\ \text{WSDM} & 1/5 & 1/1 & 1/7 & 1/3 \\ \text{UWE} & 5/1 & 7/1 & 1/1 & 7/1 \\ \text{WebML} & 1/2 & 3/1 & 1/7 & 1/1 \end{pmatrix}$$

$$V_{PM1} = \begin{pmatrix} 0.2057 \\ 0.0718 \\ 0.5791 \\ 0.1109 \end{pmatrix}$$

Fig 4. Methods Evaluation matrix / Notation (NOT) Criteriom and its eigen vector

Recall that existing methods do not support product models definition with the same degree of importance. For employed notation, most of methods except UWE method based on UML standard employ mix notation. OOHDM, for example, combines OO technique with its proper notation (context, etc.) and WebML integrates content units with XML. Evaluation matrix and associated eigen vector are shown in Fig 4. For instance, the value 7/1 between UWE and WSDM means that the component of UWE method associated to the navigation model definition is much more important that WSDM component relatively to Notation criterion. This is due to the fact that UWE is entirely based on the standard UML language.

$$\left(\begin{pmatrix} \text{V}_{\text{PM1}} \\ 0.2057 \\ 0.0718 \\ 0.5791 \\ 0.1109 \end{pmatrix} \begin{pmatrix} \text{V}_{\text{PM2}} \\ 0.4646 \\ 0.0611 \\ 0.3313 \\ 0.0659 \end{pmatrix} \begin{pmatrix} \text{V}_{\text{PM3}} \\ 0.22 \\ 0.1641 \\ 0.3098 \\ 0.1633 \end{pmatrix} \begin{pmatrix} \text{V}_{\text{PM4}} \\ 0.0769 \\ 0.0769 \\ 0.0769 \\ 0.0769 \end{pmatrix} \right) \times \begin{pmatrix} \text{V}_{\text{PC}} \\ 0.4837 \\ 0.3582 \\ 0.1174 \\ 0.0406 \end{pmatrix} = \begin{pmatrix} \text{V}_{\text{AHP}} \\ 0.2947 \\ 0.0788 \\ \mathbf{0.4381} \\ 0.0995 \end{pmatrix}$$

Fig 5. The most appropriate method calculated by AHP vector

The same principle of evaluation is taken for all criteria of a particular product model. All eigen vectors obtained from evaluation matrix (in this case 4 vectors) form a matrix which will be multiplied by the eigen vector obtained from designer comparison matrix. As shown in Fig **5**, the highest value in the AHP vector corresponds to the most adequate method that is UWE in this example.

At this level, proposed approach continues to guide designer during application and employment of the selected components as they are stored in a method repository and redefined according to NATURE [10].

6. Guidance in Method Component Application

We propose to still continue guiding designer in the application of selected method components. Consequently, designer is not obliged to look for published documentation about the selected method to achieve his goal. It deals with formalizing the method process model through a set of different steps and activities to execute.

The Method Base stores the components of the methods. The base is organized in two levels: method knowledge level and method meta-knowledge level [22]. Method knowledge level stores the content of the method components, which are the components themselves, whereas the meta-knowledge level describes the reuse context of every component in its descriptor. Therefore, every method component in the method base has a descriptor represented in the meta-knowledge level.

Our approach for assembly-based Situational Method Engineering aims at constructing a method in order to match as well as possible the situation of the project at hand. It consists in the selection of method components from existing methods that satisfy some situational requirements and their assembly. Our approach is requirements-driven, meaning that user must start by eliciting requirements for the method. Next, the method components matching these requirements can be retrieved from the method base. And finally, the selected components are assembled in order to compose a new method or to enhance an existing one.

A method is a set of coupled method components expressed at different levels of granularity. A method component is autonomous and coherent method part supporting the realization of some specific activities. This view permits to reuse components of a given method in the construction of new ones.

Based on the observation that any method has two interrelated aspects, product and process, we integrate these two aspects in the same module [22].

In our approach, the selected component represents the step of a product model definition [27].

The interface of the method component captures the reuse context in which the method component can be applied. It is formalized by a couple <situation, intention>, which characterizes the situation that is the input of the component process and the intention that the component achieves.

Besides, a descriptor is associated to every method component. It defines the context in which the component can be reused.

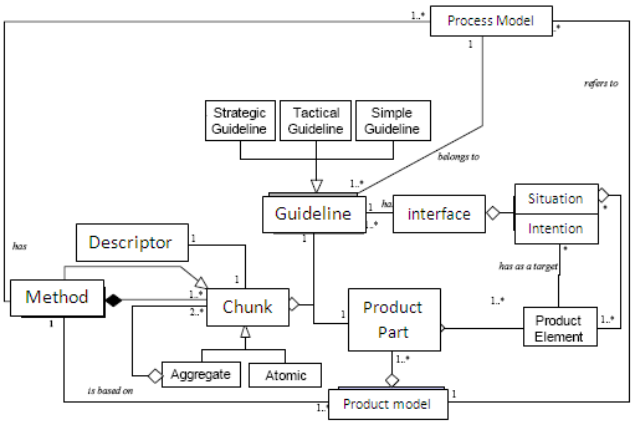


Fig 6. The Meta-Model for Modular Methods

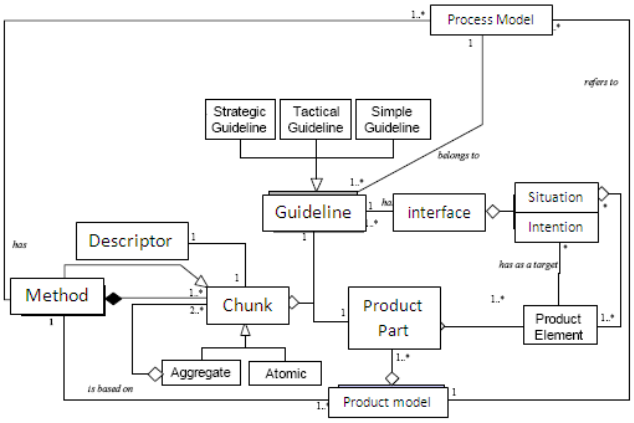


Fig 6 shows the meta-model for modular methods. According to this meta-model, a method is also viewed as a method component of a highest level of granularity. The body of the method component captured a part of method process model called guideline that can be considered as reusable and a part of its product model needed to perform the process encapsulated in this guideline. A guideline embodies the method knowledge to guide the user in achieving an intention in a given situation. Three types of guideline are distinguished: simple, tactical and strategic.

- A simple guideline may have an informal content describing the manner to proceed to handle the situation in a narrative form. It can be an executable plan of actions leading to some transformations of product under construction.

- A tactical guideline is a complex guideline which uses a tree structure to relate its sub-guidelines with others. This guideline follows the NATURE process modeling formalism [10].

- A strategic guideline is a MAP [24].

We have chosen to conform to the component structure proposed by [22] for the advantage to combine at the same time strategic and contextual approaches (NATURE) [10].

When a method provides different manners and alternatives to achieve the set of activities of its process model and they can be refined at a lower level of abstraction by another type of guideline, we should formalize process model through the strategic guideline. In other case, it is possible to use NATURE formalism.

The study of the state of the art that we have conducted on web development methods has revealed that methods are prescriptive. They propose a set of sequential steps delivering each one a specific product model. The next step is based on the product model delivered in the previous step. From the linear aspect characterizing web applications development methods, we have represented them through a tactical guideline.

7. The Proposed Tool: WISDAp

WISDAp tool is developed to support web design phases as suggested by our approach. It consists of three subsystems: (1) guidance in the selection of the most appropriate web design process-model, (2) guidance in the selection of the most appropriate method components and (3) guidance in the application of selected method components. The overall architecture of WISDAp tool is depicted in

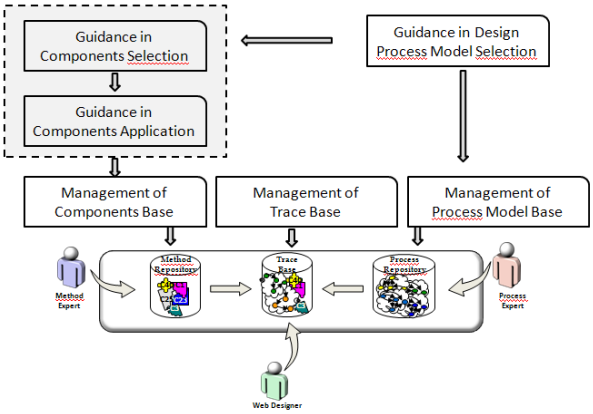


Fig 7.

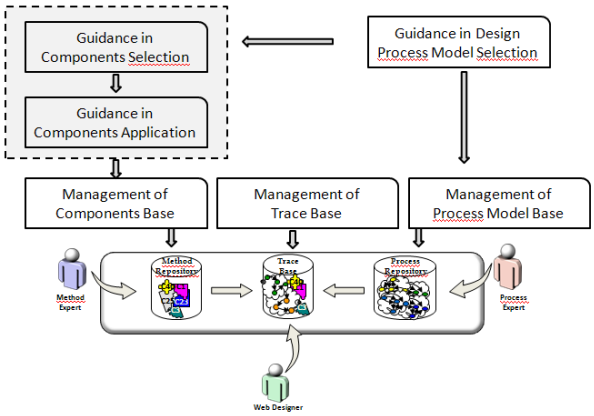


Fig 7. Architecture of WISDAp tool.

7.1 Architecture of WISDAp

To ensure success of use of our developed tool, main actors implied are:

- Administrator is charged with the administration of the environment. It is responsible for the attribution of the passwords and logins to the other users. Indeed, method engineer and design engineer cannot respectively handle the base of methods and the base of design process models that afterwards being authenticated.

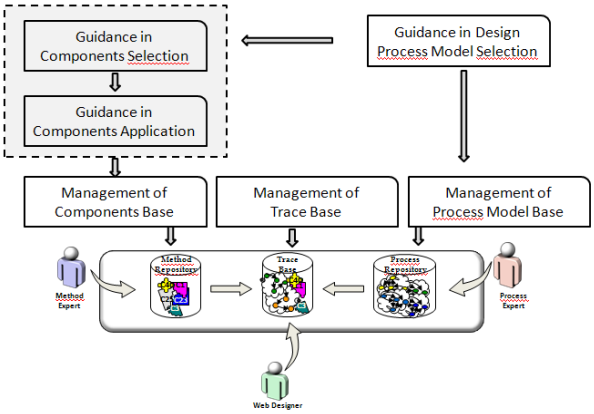
- Design engineer can add new process models of design with all the details associated in the base process models.

- Method engineer can, for example, add new methods in the base of methods and/or proceed to comparisons of one method to the others.

- Web designer is the end user of the web design environment. At the time of its first access, he/she is invited to register to be able to authenticate later on. The web designer starts by defining a new project while specifying the name of its project and a description. Thereafter, he/she will be guided during the stages process while starting by allotting values to the list situational factors allowing characterizing the current situation.

The web designer can, also, consult the base of methods to be informed about the list of the stored components.

To achieve aims of our approach, we have created the three following databases (see Fig 7):



- Base of process models containing all possible paths and alternatives to guide web designer in to the choice to most appropriate web design process model.

- Base of method components storing the set of method components. It permits the selection of the most appropriate component in each web design step.

- Base of Trace which stores the different projects previously achieved.

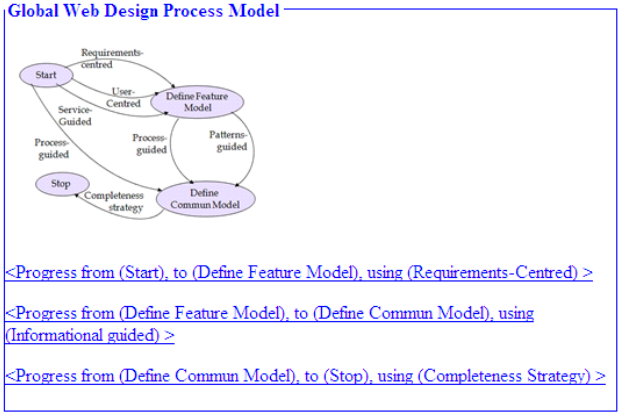
7.2 Example of Interfaces

Once authenticated, web designer should characterize current development situation through the proposed list of situational factors as illustrated by Figure 9.

Fig 8. List of situational factors.

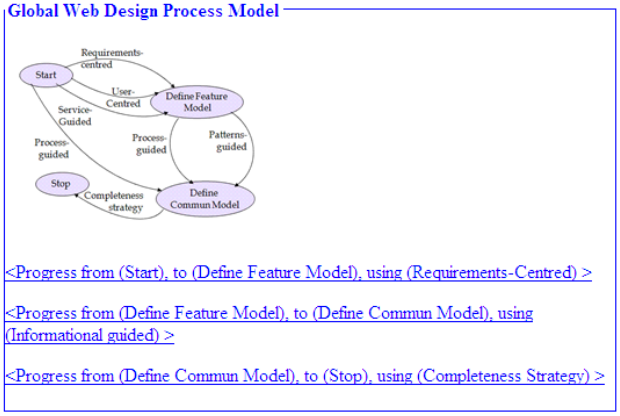
Fig 8. List of situational factors.

Introduced situational factors help web designer in choosing the appropriate strategy among those presented in the MAP.



Fige 9 shows the most appropriate design process model according to introduced situational factors. Each link

displayed shows the most appropriate design process model at a low level of abstraction.



Fige 9. The appropriate design process model according to introduced situational factors.

For instance, web page of

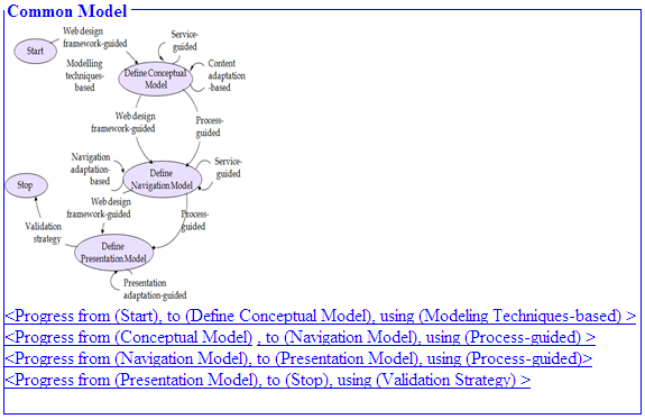


Fig 10 displays the MAP corresponding to "Informational-guided" strategy of the process meta-model.

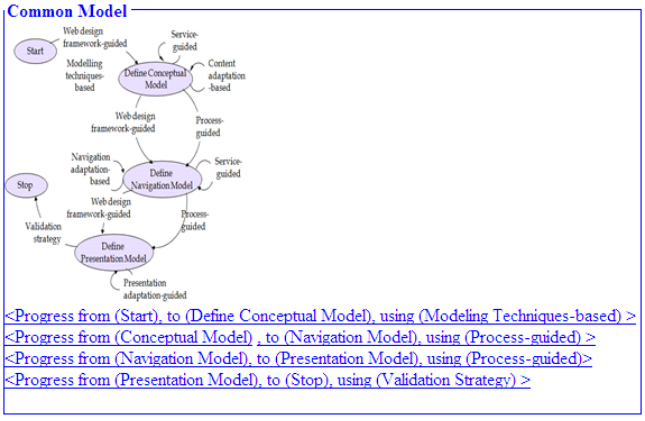
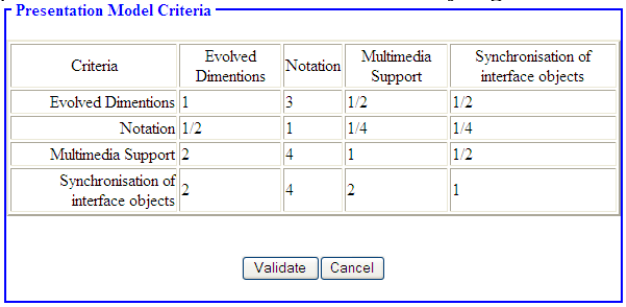


Fig 10. The appropriate design process model refinement of "Informational-guided" strategy.

When web designer intends to define Presentation Model, he/she is invited to introduce his preferences according to presentation model criteria as illustrated by Fig 11.



Criteria	Evolved Dimentions	Notation	Multimedia Support	Synchronisation of interface objects
Evolved Dimentions	1	3	1/2	1/2
Notation	1/2	1	1/4	1/4
Multimedia Support	2	4	1	1/2
Synchronisation of interface objects	2	4	2	1

Fig 11. The AHP matrix of presentation model criteria.

Once web designer validates introduced values in displayed matrix, AHP method is amerced to get out the most appropriate method component. Consequently, web design has to follow given guidelines of selected method component to achieve his goal that is, here, the definition of presentation model.

7.3 Empirical Study and Results

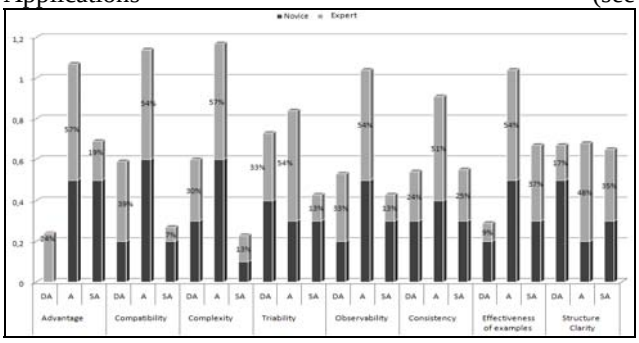
To validate our proposed approach, an empirical evaluation was completed. The evaluation method for assessing the effectiveness of the methodology was defined on the basis of the Diffusion Theory [23] which examines the rate and the motivations of adoption of a technological innovation by a group of potential users. The Diffusion Theory demonstrates that a technological innovation has chances to be successful if its quality is appreciated by the community of adopters.

The Diffusion Theory defines five perceived quality attributes of an innovative product, which can be also considered the five characteristics of a successful innovation: Triability, Observability, Relative Advantage, Complexity, and Compatibility. The quality of the document presenting the proposed approach was also assessed by means of three other attributes: Consistency, Effectiveness of the examples and Structure Clarity.

We have, at the beginning, worked with two classes of about 60 students in master: students specialized in multimedia that we classified as "Expert" and others who follow "computer security" discipline classified as "Novice". We have let them know in detail the proposed approach. We have provided students with a document presenting an in-depth explanation of the approach with examples and were then asked to provide structured feedback. Obviously, the number of sample users is not representative of the community of web designers. However, it gives an initial interesting feedback on how such a systematic approach to requirements is considered by web professionals. On the basis of the perceived quality

criteria, an online questionnaire with eight key questions was designed. For each question the evaluators could choose among the following options to express their level of agreement: Strongly Agree / Agree / Disagree.

In general, students consider proposed approach as a good-quality and effective proposal for designing Web Applications (see Fig **12**).



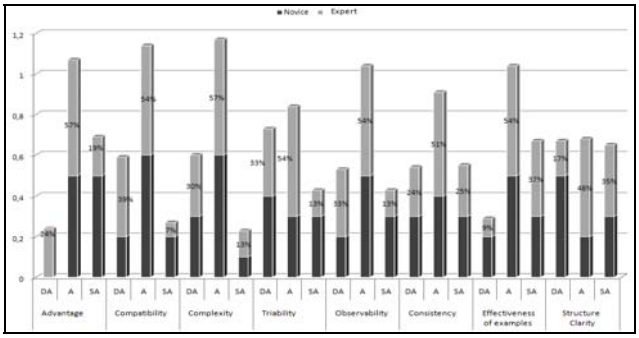


Fig 12. Synopsis of students' responses.

- Relative Advantage: No "Novice" student has expressed his non satisfactory relatively to this criteria. This is explained by the different types of guidance that the approach proposes and the coverage of the most web design aspects.
76% of "Expert" students have strongly agreed or agreed. This denotes the expected advantage of the proposed approach. However, 24% have expressed their non satisfactory. After having discussion with them, they have explained that they are used to use a simple web page editor for developing their web sites.

- Compatibility: 39% of "Expert" students have expressed that the approach is not compatible with their manner of developing web applications. This percentage was explained by two reasons: (1) they are used to develop web applications without any modeling and in ad-hoc manner and (2) they didn't have any idea about the MAP formalism.

- Complexity: only 30% of "Novice" students and 30% of "Expert" students have disagreed about this criterion. This denotes the usability of the proposed approach making it possible its adoption by a large number of end users.

- Triability: 33% of "Expert" students have disagreed. They have criticized the limited number of web development methods adopted in the approach.

- Observability: more than 60% of "Expert" and "Novice" students were persuaded of results and benefits of the approach.

In general, besides a general positive appreciation of the approach, students made also suggestions for improvements, such as detailing a process guide that might lead in the components assembly. This is part of future work to be done.
Although approach is finalized, we have observed that to be efficient, we have to store, in method repository, components issues from different web development methods. At present, besides to OOHDM and UWE methods, we are working at method re-engineering of others methods.

8. Conclusions

The paper has presented our proposed approach subscribing in the context of Web oriented Situational Method Engineering discipline. The advantage of this method is that we can reuse relevant, established method components of existing methods. In this way, an optimized method for every development situation is being developed.
We have begun by describing the web design process model which is formalized with MAP formalism. It guides web designer in the design of his/her web application at different levels of abstraction. We have focused, after that, in describing how the approach guides during selection of the most appropriate components through fixed criteria. The approach provides, also, guidance in the application of selected method components. In the last section, we have presented some interfaces of the developed tool supporting the approach.
At present, we are actually focusing on developing guidelines to assemble and integrate method components to constitute a web oriented situational method. We are working on a model-driven approach based on MDA technique. We have achieved assembly of product models through a set of defined rules. The process models assembly is under development.

References

[1] Brinkkemper, S. (1996). Method engineering: engineering of information systems development methods and tools. Information & Software Technology 38(4), 275-280.

[2] Ceri, S., Fraternali, P., Bongio, A., Brambilla, M., Comai, S., & Matera, M. (2002). Designing Data-Intensive Web Applications. Morgan Kaufmann Publishers Inc.

[3] Chakraborty, D. & Chen, H. (2000). Service discovery in the future for mobile commerce. Crossroads 7, 2, 18-24.

[4] Christodoulou, S. P., Styliaras, G. D., & Papatheodrou, T. S. (1998). Evaluation of hypermedia application development and management systems. In Proceedings of the Ninth ACM Conference on Hypertext and Hypermedia : Links, Objects, Time and Space (Pittsburgh, Pennsylvania, United States, June 20 - 24, 1998). HYPERTEXT '98. ACM, New York, NY, 1-10.

[5] De Troyer, O.M.F. & Leune, C. (1998). WSDM: a User-Centered Design Method for Web Sites. Computer Networks and ISDN Systems, volume 30, No. 1-7, (pp. 85-93).

[6] Diaz, A., Isakowitz, T., Maiorana, V. & Gilabert, G. (1997). Extending the capabilities of rmm: Russian dolls and hypertext. In 30th Hawaii International Conference on System Sciences (HICSS-30). volume 6. (pp 177-186). IEEE Computer Society.

[7] Fraternali, P. (1999). Tools and approaches for developing data-intensive Web applications: a survey. ACM Comput. Surv. 31, 3 (pp 227-263).

[8] Garlatti, S. & Prié, Y. (2004). Adaptation et personnalisation dans le Web sémantique. Revue I3 Information-Interaction - Intelligence, volume Numéro Hors-série Web sémantique.

[9] Ginige, A. & Murugesan, S. (2001). Web Engineering - An Introduction. IEEE MultiMedia 8(1). (pp 14-18).

[10] Grosz, G., Rolland, C., Schwer, S., Souveyet, C., Plihon, V., Si-said, S., Ben Achour, C. & Gnaho, C. (1997). Modeling and Engineering the Requirements Engineering Process: An Overview of the NATURE Approach. Requirements Engineering Journal, 115-131.

[11] Güell, N., Schwabe, D., and Vilain, P. (2000). Modeling Interactions and Navigation in Web Applications. In Proceedings of the Workshops on Conceptual Modeling Approaches For E-Business and. S. W. Liddle, H. C. Mayr, and B. Thalheim, Eds. Lecture Notes In Computer Science, vol. 1921. Springer-Verlag, London. (pp 115-127).

[12] Isakowitz, T., Stohr, E. A., & Balasubramanian, P. (1995). RMM: a methodology for structured hypermedia design. Commun. ACM 38, 8, 34-44.

[13] Kappel, G., Pröll, B., Retschitzegger, W. & Schwinger, W. (2003). Customisation for ubiquitous web applications a comparison of approaches. International Journal Web Engineering Technol. 1(1): 79-111.

[14] Kappel, G., Retschitzegger, W. & Schwinger, W. (2000). Modeling Customizable Web Applications. Kyoto International Conference on Digital Libraries, 387.

[15] Karlsson, F. (2002). Bridging the gap between method for method configuration and situational method engineering. Promote IT, Skövde, Sweden.

[16] Koch, N. (2001). Software Engineering for Adaptive Hypermedia Systems: Reference Model, Modeling Techniques and Development Process. Softwaretechnik-Trends 21(1).

[17] Kumar, K. & Welke, R. J. (1992). Methodology Engineering: a proposal for situation-specific methodology construction. In Challenges and Strategies For Research in Systems Development, W. W. Cotterman and J. A. Senn, Eds. John Wiley Information Systems. John Wiley & Sons, New York, NY, (pp 257-269).

[18] Lee, H. & Lee, C. (2000). Using Scenario for building hypermedia systems. Proceedings of the INFORMS KORMS.

[19] Montero, S., Díaz, P. & Aedo, I. (2002). Requirements for Hypermedia Development Methods: A Survey of Outstanding Methods. Proceedings of the 14th International Conference on Advanced Information Systems Engineering (CAiSE '02).

[20] Olsina, L. (1998). Building a Web-based information system applying the hypermedia flexible process modeling strategy. Proceedings of the 1st International Workshop on Hypermedia development.

[21] Prakash, N. (1999). On method statics and dynamics. Inf. Syst. 24, 9, 613-637.

[22] Ralyté, Y. & Rolland, C. (2001). An assembly process model for method engineering. Proceedings of the 13th Multi International Conference on Advanced Information Systems Engineering, CAISE'01, Interlaken, Switzerland.

[23] Rogers, E. M. (1995). Diffusion of Innovations. The Free Press.

[24] Rolland, C., Prakash, N. & Benjamen, A. (1999). A Multi-Model view of Process Modeling, Journal of Requirements Engineering, 4, 169-187.

[25] Saaty, T. (1980). The Analytic Hierarchy Process. McGraw Hill International.

[26] Selmi, S., Kraiem, N. & Hajjami Ben Ghezala, H. (2007). Toward Web oriented Situational Methods. IEEE International Conference on Information Reuse and Integration, Las Vegas.

[27] Selmi, S. (2008). Proposition d'une Approche Situationnelle de Développement d'Applications Web. Unpublished doctoral dissertation, Ecole Nationale des Sciences de l'Informatique.

[28] Takahashi, K. & Liang, E. (1997). Analysis and design of Web-based information systems. In Selected Papers from the Sixth international Conference on World Wide Web (Santa Clara, California, United States). P. H. Enslow, M. Genesereth, and A. Patterson, Eds. Elsevier Science Publishers Ltd., Essex, 1167-1180.

[29] Ushold, M. & King, M. (1995). Toward a Methodology for Building Ontologies. Workshop on Basic Ontological Issues in Knowledge Sharing.

[30] Villanova-Olivier, M. (2002). Adaptabilité dans les systèmes d'information sur le web: Modélisation et mise en oeuvre de l'accès progressif. Published doctoral dissertation. Institut National Polytechnique de Grenoble.

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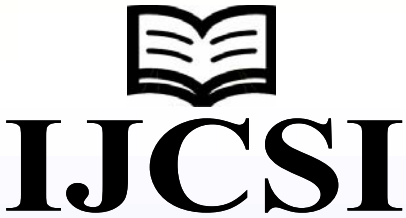

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