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Delegation in Role Based Access Control Model for Workflow Systems

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Abstract

Role -based access control (RBAC) has been introduced in the last few years, and offers a powerful means of specifying access control decisions. The model of RBAC usually assumes that, if there is a role hierarchy then access rights are inherited upwards through the hierarchy.

In organization workflow the main threat is of access control. The Role based access control is one of the best suitable access control model one can think of. It is not only the role hierarchies but also other control factors that affect the access control in the workflow. The paper discusses the control factors and role hierarchies in workflow and brings a new model of RBAC. This paper also over comes the conflicts and proves that the system is safe by applying the new model to the workflow.

Keywords: RBAC, Control factors, Delegation.

1. Introduction

The concept of role is well known. Its standard definition [1] is "a job function within the organization that describes the authority and responsibility conferred on a user assigned to the role". The concept of role in access control is critical and efficient one [2]. The role was taken as the fundamental key component in the reference model proposed [1]. The factors that made role based access control to be used in workflow are [3]

Only a single rule can be applied, when there are multiple occupants of a single position

The access rules do not have to be changed when user's role is changed

Separation of duties policies can be enforced for conflicting roles which place constraints on concurrent role occupancy

In [1], the RBAC framework is extended to include role hierarchies. The model allows the occupants of superior roles to inherit all the positive access rights of their inferiors, and conversely ensures that the occupants of inferior positions inherit any prohibitions that apply to their superiors. However, the authors have pointed the situations that inheritance of access rights down the organizational hierarchy may be undesirable, and suggested the two possible ways of avoiding this by defining the entirely a new ordering of organizational hierarchy to define role hierarchy or defining subsidiary (private) roles outside the organizational hierarchy.

The new ordering is referred in the extended RBAC models like users' location context [4], time context [5], Task-role based access control (TRBAC) and coalition-based access control (CBAC)

[6]. The discussion in these is extended models limited to only two parameters and with fewer constraints.
The paper GenericWA-RBAC: Role Based Access Control Model for Web Applications [7] discusses the general scenario when users from different organization tries to access the native database and maps the different users according to the role hierarchy of the native system. The paper suffers seriously to assure the proper access rights to be assigned to the users of other organization requested for information.
The extended models referred above doesn't discuss about the fitness of the models for the workflow as there are other factors influencing in the workflow, as it is implementation of basic or extended RBAC models for workflow is dreadful.
Work In [8], Vieira and Rito-Silva propose the Work Analysis Refinement Modeling (WARM) methodology, a first approach to derive workflow process definitions by using business process models. This model was having serious drawback of concentrating only on the functional aspect of workflow and neglected the non-functional requirement mainly access control.
In the paper Workflow Access Control from a Business Perspective [9], the basic role based access model is taken for the access control in workflow. This model again doesn't discuss about the other affecting factors in workflow like delegation, decentralization and review.
The rest of paper is organized as follows: the section 2 discusses the control factors in the workflow section 3 narrates the relationship of role hierarchy with control factors; section 4 discusses the new RBAC model for the workflow considering the control factors. Section 5 includes conclusion and future work.

2. Control factors in workflow

Publicly quoted companies and government departments, and most large organizations publicize control factors, which apply throughout the organization. The usage of control factor is also becoming common practice in many systems development organizations and even quality standards recommends (ISO 9000 Standards series [4]) these factors to be mandatory. The control factors are requirements of regulators in the development of critical systems The UK defense, desires these factors for procurement of the safety critical system [10].
The general key components like users, roles, operations and objects are used for access control model and the relations are also quite well defined. The main relations defined in basic RBAC model are user assignment, permission assignments. In case of workflow the other factors also affect the access control. The control factors are discussed below.

1 Decentralization

In a very large organization it becomes impossible for a single person to carryout all the responsibilities assigned to him but in turn there is no option of skipping from his responsibilities. In such scenario the concept of decentralization comes into picture. The superior role will distribute the work responsibility to the some of junior roles. Then the junior roles will have full authority to carry out those actions. Such works are subjected to the review. The key points about the decentralization is

- By assigning authority to the junior role, senior role assign their own immediate access rights to carry out those actions.
- Senior role that have assigned the access rights, are not lost the ability to withdraw the assigned rights to junior role and either perform actions themselves or, to assign those actions to a different person of same role hierarchy or to different role all together [11].

2 Delegation

The decentralization goes hand in hand with decentralization. The senior role, distributes the responsibility to the junior roles and making the junior role equally responsible for the completion of the assigned responsibility by applying the supervision or through review. In the access control

scenario the junior role accepts the rights the rights of senior role temporarily and performs the responsibility assigned by the senior role.
While assigning the permissions the senior role will allow the permission for the task to be performed by the junior role but care is taken to block the other activities, which can be performed by the newly assigned rights and they are the responsibilities of the senior role.

3 Supervision

There is of course a danger that delegates will not carry out their duties properly. For decentralization to work satisfactorily, an additional control principle is needed: supervision and review. This control principle requires one person's actions to be reviewed post hoc by another person, typically their superior in the position hierarchy. The superior usually does not exert direct control over the supervisee at the time that the actions are taken. Supervision is an activity that is carried out on someone by someone else in the immediately superior position. It consists of many activities including monitoring, appraisal, advising, praising and criticize, and outside the scope of any present-day access control system.

4 Review

Review, on the other hand, is carried out on specific activities. In the example that we give in section 3, there is a well-defined review activity for the Accounts Manager, which can be controlled by an access control system provided that it is carried out as part of a computerized application.

5 Separation of Duties

This control factor has been in existence and is familiar to the computer security community from the Clark-Wilson commercial security model [12]. Every critical transaction, the implementation is done by breaking the transaction into at least two separate actions. It is then required that the two actions should not be performed by the same person. This is very effectively implemented in role-based access control by defining mutually incompatible roles, with a constraint preventing their occupation by the same person, either simultaneously or in some time-related fashion [1]. Positive access rights for each of the actions are exclusively assigned to the two incompatible roles, and the constraint enforces separation of duties.

3. Relationship of Control factors in Role hierarchy

In the basic model of RBAC the entities involved in access control are users, roles, permissions, objects. The relationship UA (User assignment) maps the user directly to the hierarchy defined in organization. The hierarchy so far considered is similar to the organizational chart of organization or with little modification organization might have defined its role hierarchies. The important part RBAC relationship is PA (permission assignment) where in the specific permissions are assigned to roles to access the objects, a role can perform the specific task of querying the objects for specific required task assigned to role.
As in earlier section we have shown that in the workflow environment it is not only the strict hierarchy but also the control factors, which do effect the permissions dynamically for the specific role depending on the task. Before we take up the control factors in relationship of role hierarchies, we discuss the relations “is a”, which relaxes strict role hierarchy in the organizational workflow and the “part of” relation that uses the almost all control factors.

1 “is a” relation in role hierarchy

In the actual hierarchy there could be different roles of one kind of group eg. The organization may have different managers like project, technical manager, accounts manager etc., but there could be similar one task like billing each manager has to fill in. For the same reason, the role

hierarchy includes the virtual role “manager” where in all the different managers belong to this role.

r1, r2 $\subset$ R (role)

r1 is a r2 → r2 specializes r1

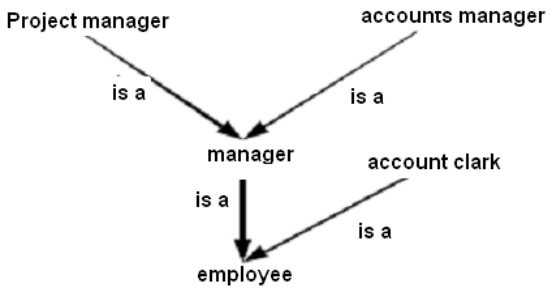

FIGURE 1: Example illustrating “is a” relation

In the above case “manager” is a virtual role. There is no user in the system belongs to only manager. All the managers in the organization are having the privileges of manager. Identification of such virtual roles deduces the redundancy in assignment of permissions to different roles and also the information is shared in secured manner.

2 “part of “ relation in role hierarchy

“Part of” relation is known as aggregation relationship. The different roles are performing the task may involve control factors and these makes the relation complex, when designing the RABC considering the control factors.

A similar concept applies to the activities of an organization as illustrated in Figure 2, the Financial Control activity is composed of Financial Forecasting and Financial Accounting, etc, down to the Accounts Payable and Accounts Receivable activities. The activity hierarchy is partially ordered by subsets of activities.

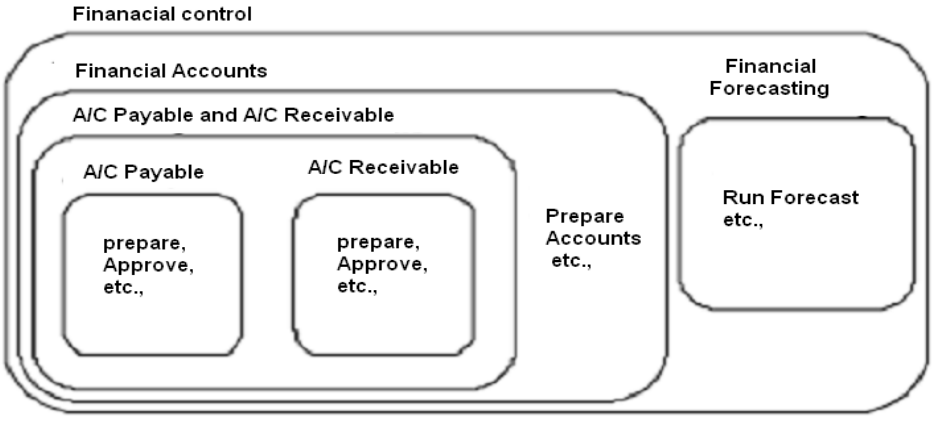

FIGURE 2: Hierarchy based on task uses “Part of” relations

The control factor delegation is effective, when there are more activities to be done by the role with proper supervision.

Let T = $\{T_1, T_2, T_3 \ldots T_n\}$ set of activities

$R = \{R_1, R_2, R_3 \ldots R_j\}$ set of roles in organization

R_1 is responsiblefor T_1

R_1 does T_1 && R_2 delegates (R_1, T_1)

Then R_2 is responsiblefor T_1

In workflow of organization, the delegation is considered is achieved with strict role hierarchy for the above example in Figure 2. The one branch of role hierarchy is demonstrated in Figure 3.

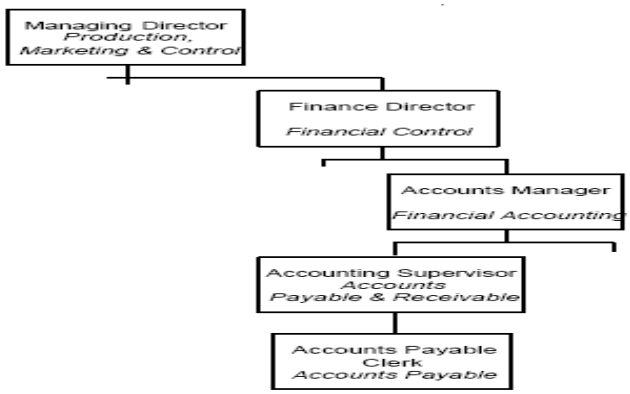

FIGURE 3: Role hierarchy for the delegation

3 Supervision in role hierarchy

The superior role delegates the activity to junior role. The senior is responsible for the task, which he has delegated. There requires the supervision in the process. The supervisor when delegating the task also assigns the required rights to carryout the task. Assignments of rights have to be done carefully otherwise there is a great access control flaw occurs. As far as the supervision is concerned it has to be strictly senior role in hierarchy.

The summary is represented as below.

Let Role R_i delegate the activity T_k to R_j then

R_i Senior to R_j and

Activity T_k is supervised by the role R_i or R_p (where R_p is senior or equal to role hierarchy R_i)

The Figure 4, illustrates the example for financial control activities of Figure 2 with activity role delegation and supervision with role hierarchy.

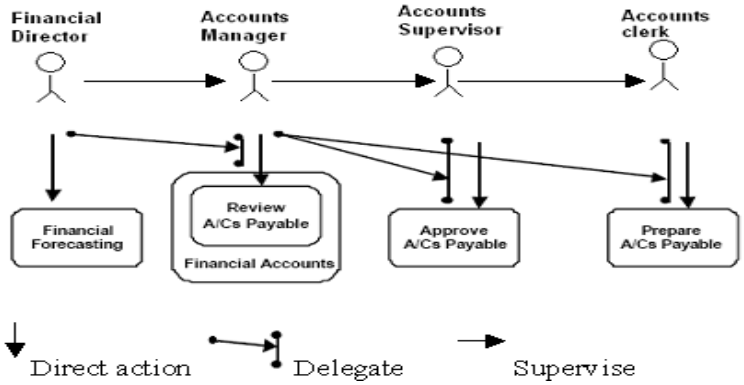

FIGURE 4: Illustration of delegation and supervision activities

The cheque issue activity with different roles involved is demonstrated as below and is self-explanatory.

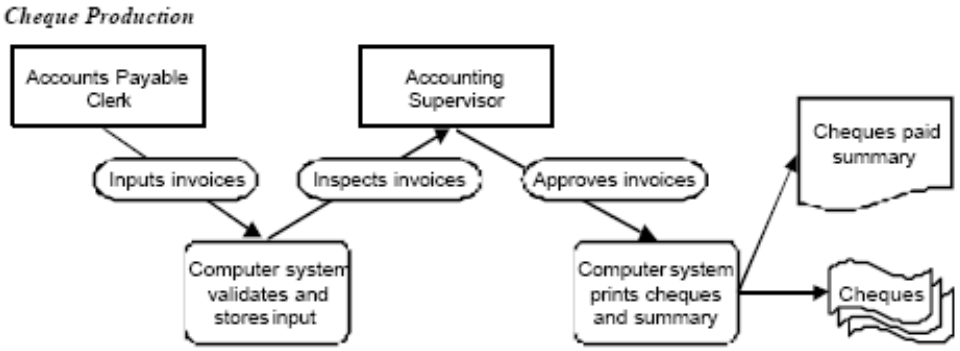

FIGURE 5: The cheque issue activity

4. Proposed Model

The new model proposed includes all the control factors and role hierarchy relationships discussed in section 2 and section 3. We use the role-based hierarchy defined originally in workflow and consolidate this hierarchy with aggregation and supervision hierarchy relationship.

1 Limitations of Existing model

The core RBAC model or any extension models are having the components user, roles, operations, objects and sessions with two relations defined as User Assignment (UA) and Permission Assignment (PA) [1].

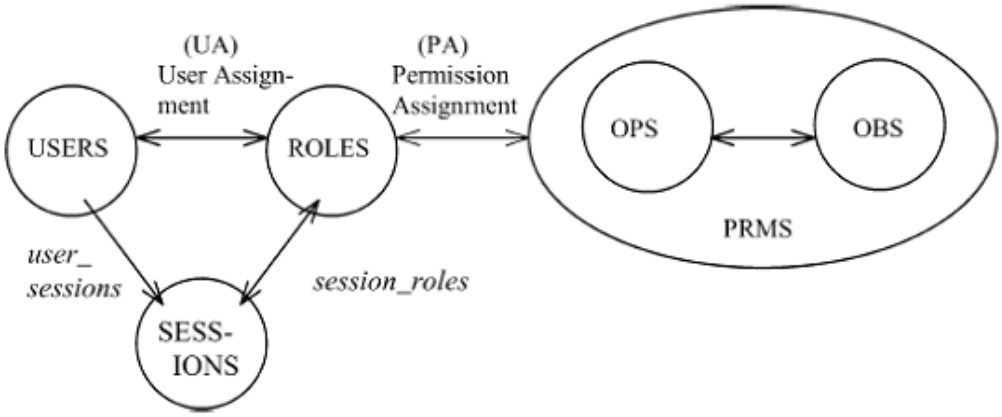

FIGURE 6: Core RBAC Model

The key points to be noted with Core Role Based Access Control model are
1 Set of users exists in organization
2 The roles are specified and these roles are in partial order of hierarchy

3 Each user is mapped to one or more role (many to many relationship) with user→ Role (UA) assignment relation

4 Each role is authorized with permissions to objects through operations on objects with Role → Permission (PA) assignment relationship

From the basic model it is evident that role performing the action/task (if authorized) is having the privileges on the objects, that were assigned to role. When considered the delegation control factor, superior role will delegate the task to one of it inferior role. i,e Superior role allots the specific grants to objects and assigns to a temporary role (but this role exists in hierarchy as junior role) to perform the task. If any of the control factors are introduced in the basic RBAC model, it fails, as there is no component for task/action with associated relationship exists in basic model. This leads model to fail miserably.

2 New Model

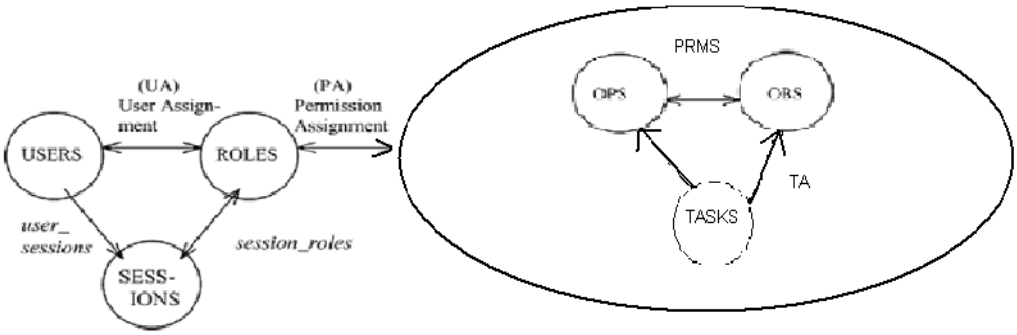

FIGURE 6: Proposed New Model

The new component TASKS is introduced in this model so that the delegation of task is possible from one role (superior role) to another (inferior role). When 'task' is accommodated as component in the model, one assignment relationship also get introduced as TA. The definition of basic components and relationships of new RBAC model are as defined below.

- USERS, ROLES, OPS, and OBS,TASKS (users, roles, operations, objects and TASKS respectively).
- UA $\subseteq$ USERS XROLES, a many-to-many mapping user-to-role assignment relation.
- assigned_users: (r:ROLES)→ 2^{USERS}, the mapping of role r onto a set of users. Formally: assigned users(r) ={ u$\in$ USERS | (u, r) $\in$ UA}.
- PRMS = $2^{(OPS \text{ X} OBS)}$, the set of permissions.
- PA$\subseteq$PRMS X ROLES, a many-to-many mapping permission-to-role assignment relation.
- assigned_permissions(r: ROLES) → 2^{PRMS}, the mapping of role r onto a set of permissions. Formally: assigned permissions(r)= {p $\in$ PRMS | (p, r) $\in$ PA}
- Ob (p: PRMS) → { op $\subseteq$ OPS}, the permission-to-operation mapping, which gives the set of operations associated with permission p.
- Ob(p: PRMS) → { ob$\subseteq$ OBS}, the permission-to-object mapping, which gives the set of objects associated with permission p.
- SESSIONS, the set of sessions.
- user_sessions (u: USERS) → $2^{SESSIONS}$, the mapping of user u onto a set of sessions.
- session_ roles (s: SESSIONS) → 2^{ROLES}, the mapping of session s onto a set of roles.

Formally: session roles (si) $\subseteq$ {r$\in$ ROLES | (session users (si), r) $\in$ UA}.

- avail_session perms(s:SESSIONS) → 2^{PRMS}, the permissions available to a user in a session $\cup$ assigned permissions(r).
  r$\in$ session roles(s)
- TASKS=$2^{(OPS \text{ X } OBS \text{ X ROLES})}$, the set of tasks
- task_assignment $\subseteq$ TASKS X ROLES, a many to many mapping of task-to-roles relationship
- assigned_tasks(r:ROLES) → $2^{(TASKS)}$,the mapping of role r onto set of tasks. Formally assigned _tasks→ {t$\in$TASKS | (t,r) $\in$ TA }

3 Basics of New Model

The new task-assignment relationship needs the powerful policy database, which verifies the authentication and authorization for the delegation of tasks from one role to another. The policy base maintains the information about Role, Objects, Tasks, Permissions and Attributes of objects. The following constraints have to be taken care by the policy base.

1 RULE 1

If only Objects are not available for role R_j (to whom the task is delegated) to perform the task t_j

then

Rj delegates ti → Ri (Role Rj delegates the Task ti to Ri)
Task ti involves extra objects {Ok, Ok+1, .. Ok+i}
Then PA relation assigns the objects to Role Ri
Ri -> {objects belong to Ri} + { Ok, Ok+1, .. Ok+i}
Ri is inferior and authorized to perform task therefore the system is safe

2 RULE 2

When Task is delegated already all objects are accessible by role Ri –Then no extra objects should be made available

(i) ∃
Ri objects→{Oi,Oi+1…Oi+k}
∃Ri Task delegated t_j → {Oi,Oi+1…Oi+k}
No extra objects made available. System is safe but no guarantee system will run smooth that all objects are having permissions required by t_j

(ii) If ∃Ri Task delegated Ti objects available → {Oi,Oi+1…Oi+k}
∀ (∃Oi Verify p_j associated with Task Ti)
if p_j to be granted then
store the p_j's of o_j for R_j
grant new p_j's = {original p_j of o_j } + { New p_j for o_j which tasks needs}

Now the system is live and safe

3 RULE 3

If not all objects for task Ti are available and not all permissions are associated with Objects

(i) For the first part Rule 1 can be applied (i.e. allotting the objects) here system is safe but no guarantee of liveness as permissions are not granted

(ii) For the second part of this scenario apply Rule 2 for all objects the system live and safe

4 RULE 4

If Objects are made available according to t_i Task requirement but not all the attributes of objects are made available

Create the new object with these attributes without violating the constraints on object assign to the role R_i once Supervision or review takes place the R_i (who delegated task) is

append/updated the original Object

4 Design of New Model

In the new proposed model the essential components needed are policy base and a server. The server will authenticate and authorize the delegation of task and policy base will evaluate the constraints on the tasks with respect to objects, permissions and the roles.
The server requests for the data in the policy base, based on the request it got from role to delegation of work to other role. The main validations carried out by server is to verify whether the role requested for delegation of work is superior then to whom the work to be delegated. The server also validates the information about the objects, permissions to be associated to task after delegation.
The Policy base provides the information to the server about the objects and permissions needed by the tasks.
The Figure 7 illustrates the functionality of server and the policy base.

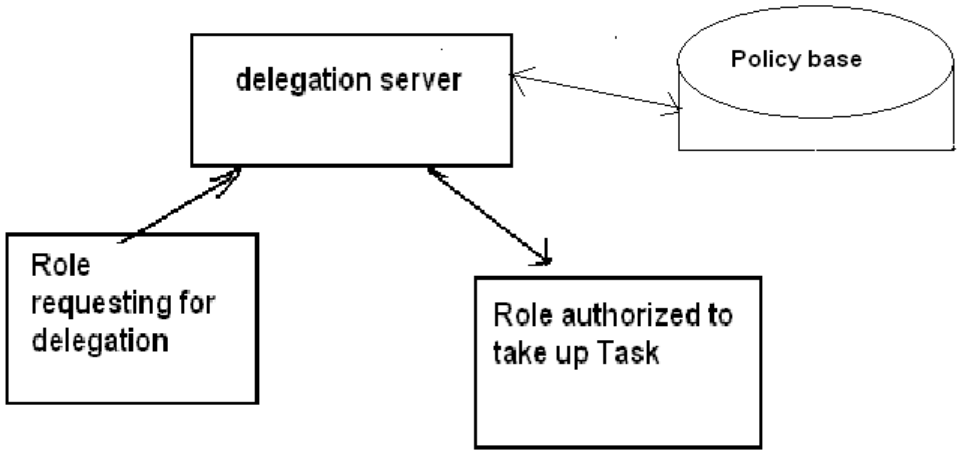

FIGURE 7: Delegation Server and Policy base

5. Conclusion and Future work

The delegation control factor plays a very key role in the workflow system. The implementation of delegation can be adopted in Role Based Access Control model, in any other access control model the implementation becomes very difficult. The proposed new model for the RBAC allows the inclusion of delegation control factor. The efficient design of policies makes it stronger and provides the easy of work with safety. The policy base and server accommodates the task assignment relationship.

The idea of the delegation in RBAC can also be enhanced to the other two control factors, supervision and the review. The same policy base and servers can be strengthened to incorporate these two control factors. The new rules also can be formed to make the workflow system to operate in safe and live conditions.

Acknowledgement

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The time efficient security for broadcast Networks

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Abstract

The audit ability and security of the broadcast network and security needs to be enhanced. This article is proposing the security solutions for such networks that are cost effective. The solution also takes care of the reduction of effective bandwidth-delay product. The improvement in terms of a cost effective comparator improves the efficiency and security of such networks. The threats like Eavesdropping, Interception and modification of transmitted data, Spoofing, Denial of service (DoS), Free–loading, and Accidental threats are some of the threats addressed in this article.

Keywords: Broadcast Networks. Hardware security, Bandwidth delay product. Parallel timing

1 Introduction:

The development or improvement in the broadcast networks is very valuable as these systems are cost effective. The fundamental drawback for the broadcast network is auditing of the system. LAN as broadcast network it never built up with the intension of security as auditing such a system is most difficult. The mechanism of this kind is totally missing in the LAN. The medium access control protocols are less efficient but in such networks cost effective.[1] Hence it is very difficult to find the golden lining between the efficiency (e.g. throughput) and the security (e.g. eavesdrop).

This article highlights the problem and tries to find the hard-wired solution to this. The hardware or the software need the same time in the LAN due to the problem of Bandwidth delay product leading to the major hurdle. The time required by LAN to transmit the information from a host to a destination is given by the equation number 1.Tprop=Time for the propagation in the medium.

Tproc=Time for processing the data.

Tframe=Time for the frame transfer.

The aim is to optimize on the Tproc, which is the dynamic factor and changes from one system to another. Total time required to transmit a frame is always

T= Tprop+ Tproc +Tframe……Equation 1

Of all these three times Tproc is the time that is totally dependent on the network program. The ability to execute this depends on the processor speed. This highly affects the normalized Bandwidth delay product, as maximum Tproc is taken in into the account. Further the efficiency ρ= Reff /R of the network is affected because Reff is inversely proportional to the normalized bandwidth delay product. Here Reff is the effective bit rate and R is the bit rate of the carrier.

Another important issue is all the packets travel till the network layer making it possible to grab other users' information. This raises issue of security of the information in the network. Unnecessary parallel processing of the other systems to deny the frame is reduced.
In this article an effort has been made to address the above-mentioned issues in the LAN by slightly changing the hardware design and checking of the packet at the rate of reception. All the LAN structures can be mapped to OSI models. The OSI Models mapped with different types of LANs is shown in the figure 1(a) and 1(b) respectively.

In the LAN the system that wants to communicate broadcasts the message in the media. The message remains in the media till the bandwidth delay product time. This information is processed by all the machines till the MAC sub layer, which is a software program. The effective total time of the system is null to the extent explained herewith. If a total of n systems are in the network, time lost in unnecessary computation is n-2 to other computers for which the packet needs to be dropped. That is the network as a whole will lose (n-2)* tproc.

As mentioned above the security threats for such network against are too many. [4] The wired and wireless less LANs use authentication techniques to use its recourses. Eavesdropping, Interception and modification of transmitted data, Spoofing, Denial of service (DoS), Free–loading, and Accidental threats are the common problems in terms of the security. Thus, data when under the peer process for processing it is under the threat. [4]

The method proposed in this article is not only dealing with saving of the time in broadcast network but also makes an attempt to give solution to such attacks.

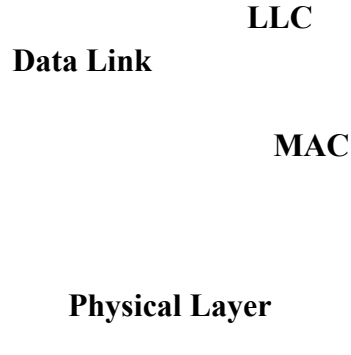

Fig 1(a). OSI Layer

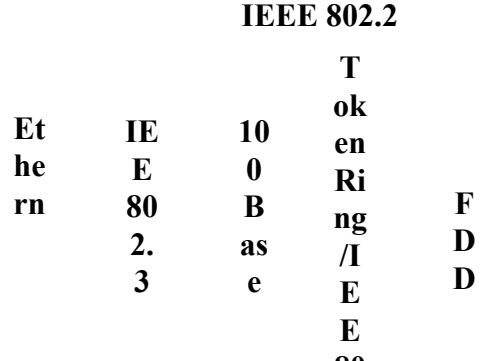

Fig 1(b). LAN Specification

2 The proposed system:

The hardware security blocks the data at the physical layer through MAC address. With the help of a comparator compares the MAC address with the help of a comparator preventing it to get in to the peer process such that the LLC layer cannot access it. This will prevent the nonlegitimate packets to enter in to system.

Use a comparator that uses selection sorting technique so that the system being faster than the software driven method.

The proposed will work as follows after the suggested change. All the comparators will sense the start of the frame. They will accept the start of and read the address in the frames. If the address is of the true owner then only LLC layer will be invoked and processor will be interrupted, else the packet will be dropped. Even the broadcast condition also can be checked in

the same comparators. This will prevent any unauthenticated user to eavesdrop in the other user's data packet.
The Tproc will be reduced such that in turn will reduce the bandwidth delay product as bandwidth is usually a larger term and delay is smaller.

Manchester line coding is followed in Ethernet and it's a self-clocked code that can trigger the register of the comparator automatically. [5] Thus the implementation of this system is also expected to be cost effective in terms of keeping the system audited for security. All the registers have to be numbered and can be authenticated by the system administrator. The diagram 2 gives the schematic representation about the implementation of such a system.

1 Analysis of the system:

The above scheme is analyzed for different possible threats. Table 1 discusses the pitfalls, nature of the problem and proposed solution in the system. [2]

Figure 2. Proposed Schema

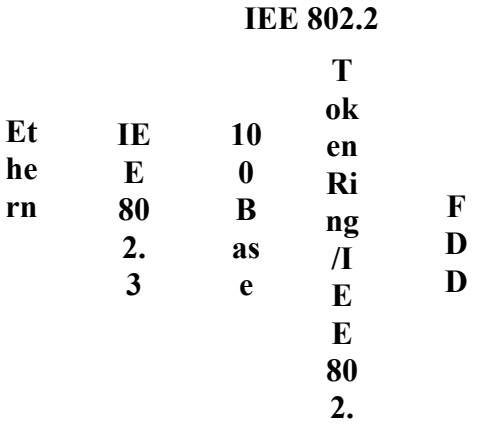

Table 1. The analysis of the system.

The pitfall	Nature of problem	Solution by the proposed system
Interception and modification of transmitted data	Attacker can gain access to the network, he or she can insert a rogue computer to intercept and modify network data communicated between two legitimate parties	The only legitimate users will have the access, as the register will not interrupt the computer processor.
Eavesdropping	Disclosure of confidential data, disclosure of unprotected user credentials, and the potential for identity theft. It also allows sophisticated intruders to collect information about your IT environment, which can be used to mount an attack on other systems or data that might not otherwise be	The registers in the comparators will let the data come into the system only if it is matched hence this possibility will be ruled out. The admin will not let the system that is not registered with its comparator will not be allowed to access.

	vulnerable.	
Spoofing	Ready access to an internal network allows an intruder to forge apparently legitimate data in ways that would not be possible from outside the network, for example, a spoofed e–mail message. People, including system administrators, tend to trust items that originate internally far more than something that originates outside the corporate network	Ready access does not exist in the present system.
Free–loading	An intruder may want nothing more sinister than to use your network as free point of access to the Internet. Though not as damaging as some of the other threats, this will, at the very least, not only lower the available level of service for your legitimate users but may also introduce viruses and other threats.	Intruder can not be identified by the proposed system

3 Conclusion:

The method proposed is proposed for a better performance of broadcasting network such that security and audit ability increases and at the same time performance of the system is efficient with respect to time. In spite of, all these system will be cost effective. The system blocks the data at the physical layer than the LLC.

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Adaptive Approaches to Context Aware Mobile Learning Applications

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Abstract

Learning has gone through major changes from its inception in the human race. Among all such major changes mobile learning is the latest to happen with the advent of mobile learning technologies that have the potential to revolutionize distance education by bringing the concept of anytime and anywhere to reality. From the learner's perceptive, mobile learning is "any sort of leaning that happens when the learner is not at a fixed, pre-determined location or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies". Research in context aware mobile learning has concentrated on how to adapt applications to context. This paper reviews and discusses few mobile learning systems the approach in implementing context awareness and adaptation, and presents some others good work done in this line.

Keywords: adaptation, adaptive learning, context, learning activity, learner model, learning automata, mobile learning.

1. INTRODUCTION

Mobile learning has become widespread, and students nowadays are able to learn anywhere and at any time, enabled by mobile technologies and wireless internet connections. Mobile learning can be distinguished "by rapid and continual changes of context, as the learner moves between locations and encounters localized resources, services and co-learners" [1], and these different situations are described by different learning contexts [2]. The diversity of mobile and wireless technologies and the nature of dynamics in mobile environments complicate context awareness.

Context-aware mobile learning has become increasingly important because of the dynamic and continually changing learning settings in the learner's mobile learning environment giving rise to many different learning contexts. The challenge is to exploit the changing environment with a new class of learning applications that can adapt to dynamic learning situations accordingly. The task of a context-aware mobile learning application is to sense the mobile environment and react/adapt to the changing context during a student's learning process [1]. Context is a key in the design of more adaptive mobile learning systems [3] and context-awareness must be integrated

within the systems in order for them to be truly effective [4]. Mobile devices and sensing technologies are combined to provide physical and environmental contexts in mobile applications.

Two characteristics of context have been described by Laerhoven [21] as activity and environment. The task that the user is performing at the moment is described by the activity, and focuses on the user of the device and his/her habits. The physical and social surroundings of the user are described by the environment, such as the current location and movements in the environment etc. The increasing use of mobile applications in varying contexts, locations and surrounding environments means that if these applications were made context-aware, then contextually relevant information from the devices can be transferred to the user [22].
In the mobile learning context, it is helpful to consider context awareness and adaptivity as two sides of the same coin [5]. The purpose of the adaptivity and context awareness is to provide better support for variety of learners, given that they may have very different skill and motivations to learn in varying contexts. Adaptivity can be one form of adaptation; or as a quality of a system to automatically and autonomically regulate and organize its functioning, the appearance of its User Interface and the order of information it offers [6].

In this paper, we present some of the different approaches and methods to context aware and adaptation/adaptivity that are already present in the literature. The remainder of this paper is organized as follows. In Section 2, we describe the Characteristics of an ideal learning system adaptive to the learner and to his/her context proposed by Telmo Zarraonandia, et al. In Section 3, we present three different (layered, modular, interaction) types of adaptive systems. In Section 4, we present different (Bayesian, Learning automata, Agent) type of methods for adaptivity implementation. In Section 5, we present Bijective adaptation between context and adaptivity in a mobile and collaborative learning. Finally, conclusions and future work is given in Section 6.

2. DESIRABLE CHARACTERISTICS OF AN IDEAL LEARNING SYSTEM ADAPTIVE TO THE LEARNER AND TO HIS/HER CONTEXT

Telmo Zarraonandia, Camino Fernandez, Paloma Diaz & Jorge Torres[7] have selected a group of desirable characteristics for an ideal learning system that is able to adapt the course to learner specific characteristics, knowledge, objectives and learning goals, also sensitive to the context in which the learning session is taking place and capable to adjust the appropriate parameters accordingly.

Different kinds of information has been separated and represented by means of different models like Domain Model, User Model and Adaptive Model, of which Adaptive Model is of our interest here.

“Adaptive Model: This model relates the two other models (Domain & User) defining which materials will be presented and how the presentation will take place in order to achieve the learning goal, optimizing the learning process. The characteristics that were considered for this model are:

- To use some kind of pedagogical approach for the adaptation.
- Pedagogical rules updateable: As the pedagogical approach may vary depending on the learning theory that is applied or on the knowledge domain, they wanted their system to be flexible enough to give the instructors the possibility of programming different pedagogical approaches for the same course.
- Levels of sequencing of learning material: to adapt the sequence of concepts presented to the user in order to achieve his/her learning goal (knowledge routes) and to adapt the sequence of learning materials presented to the user in order to achieve the knowledge of a particular concept (content sequencing)..
- Learner progress consideration: Capability to generate the knowledge routes of

materials dynamically by taking into consideration the learner progress during the course.
- Re-routing: Capability to re-plan the knowledge route if special difficulties are detected with a particular concept and even to change the current pedagogical method if the system detects it is not performing well for that particular learner.
- Use of standards to define the rules that govern the adaptation."

The above said characteristics are of most important when the learning system transforms into a mobile learning system taking into account all the dimensions of mobility.

3. ADAPTIVE SYSTEMS

3.1 Context Aware and Adaptive Learning

In architecture [8] of a context-aware and adaptive learning, Jane Yau and Mike Joy proposed two Adaptation Layers: The information has been considered for the survey purpose and presented here as taken from the cited reference.

"Learning Preferences Adaptation Layer: This layer consists of the Learning Preferences Adaptation Module, which contains sub-modules - Learning Styles Adaptation, Learning Priorities Adaptation and Knowledge Level Adaptation.

The learning preferences of a learner are retrieved from the Learner Profile database and incorporated into the relevant sub-module for the appropriate learning objects to be chosen at a later stage.

Matching the correct level of information according to the learner's most appropriate learning style can also create a more enjoyable and effective learning experience for the learner [9].

Contextual Features Adaptation Layer: This layer consists of the Contextual Features Adaptation Module, which contains sub-modules – Location-specific Adaptation and Time-specific Adaptation. Each of the contextual features are retrieved from the Learner Schedule database and incorporated into the relevant sub-module for the appropriate learning objects to be chosen at a later stage.

By placing a User Verification option, the problem of learner not conforming to his/her schedule is rectified; This prompts the user at the beginning of the learning session to indicate whether the location and the available time that the tool has retrieved is accurate. Another method which can also be used to detect discrepancies between the learner's stated location and his/her current location is to have an option for Software Verification.

The importance of obtaining the actual location of the user derives from the fact that the contextual features surrounding the location are different in various different places, and can affect the learner's ability to study such as their concentration level, which can be affected by the level of noise in the location or environment.

A number of methods for obtaining the noise level to determine the possible level of concentration that the learner has at a location have been considered. Firstly, a microphone sensor can be used to detect the noise level which can approximately indicate the level of concentration that the learner has in such an environment with that level of noise. Secondly, results obtained by Cui and Bull [10] can be used to map the concentration level of a learner to a certain type of location.

In the study conducted, student's location of study and their corresponding chosen level of

concentration were recorded and discovered that the chosen concentration levels in various types of location by different students were found consistent even though noise levels may have been different. The results indicate that students shared similar levels of concentration in the same location despite the varying levels of noise. This also suggests that there are other elements in the environment which could affect a student's concentration level such a movement."

3.2 Context - based Adaptation in M-Learning

In architecture [11] for a Context-based Adaptation in M-Learning proposed by Estefania Martin, Nuria Andueza, Rosa M. Carro manages data about users and activities so that the most suitable activities to be accomplished at each time are suggested to each user are taken care of by Activity adaptation module.

"Activity adaptation module: This module is responsible for deciding about the availability of activities and of generating the list of available activities to be sent to the alert module which is responsible for alerting the learner about the same depending on the various contextual element values and by processing a set of rules that indicate in which cases the situation of the user is appropriate for alerting him/her about the availability of activity.
This module is structured into three sub-modules: Structure-based adaptation, Context-based General Adaptation and Individual Adaptation.

Firstly, the Structure-based Adaptation sub-module processes the structural rules, which establish, for each type of user accessing the system, the relationship between activities, as well as the order in which they must be performed, if any. Its main aim is to generate a list of activities to be suggested to the user. The first step is to select the activities according tot the most appropriate rules for a certain user. For the same activity, the list of sub-activities can be different depending on certain conditions related with the user's personal features, preferences, as well as his/her current situation, including the context(spare time, location, available devices), pending activities and actions during his/her interaction. Therefore, the rule activation conditions are checked and the corresponding rules are triggered.

Secondly, the Context-based General Adaptation sub-module consists of a filter that processes a set of general rules to choose the type of activities more suitable of being accomplished by the user. It adds/removes activities depending on their type (review, individual exercises, collaborative activities or messages, among others). This filter affects to all the activities to be performed.

Finally, the Individual Adaptation sub-module checks the conditions of atomic activities, if any. These conditions can be related to any user feature or action stored in the user model."

Rule-based adaptation techniques are used in the above discussed system.

3.3. Interaction through Context Adaptation

In the investigative study [12] by Yuan-Kai Wang shows importance of context-awareness and adaptation in mobile learning, proposes Context Aware Mobile Learning (CAML) that senses mobile environment and reacts or adapts to changing context during learning process has four interaction modes.

The challenge is to exploit the changing environment with a new class of learning applications that can adapt to dynamic learning situations accordingly. Interaction through situated or reactive adaptation can improve learning process. There are four key modes of interactions in Context

Aware Mobile Learning (CAML):

"(a) Spatio-temporal dependent interface: It is situated user interface adapted according to time and location contexts. For a mobile learner in classroom at course period, lecture slides and student notes are most important interfaces. However, homework and group discussions become primary when the learner changes place to home after course period. Located learning objects that are nearby or meaningful are emphasized or otherwise made easier to choose.

(b) Contextual event notification: Learning process is mostly planed as a calendar with a lot of scheduled activities, such as lecturing, test, examination, homework, and so forth. Timely execution of some course activities, such as the reminding of homework, can be implemented as context-triggered event. Notification is dynamically scaled and adapted by inferring interruptibility based on the user's recent activity and context of the mobile environment. The interruptibility of event notification could be spatio-temporal context dependent as a simple example. Facility and activity contexts are also helpful for contextual event notification.

(c) Context-aware communication: Communication can be divided into asynchronous and synchronous messaging between teachers and students, or among students. Asynchronous messaging, such as email, discussion board are desired when the recipient is unavailable or if either is not currently near a computer. Synchronous messaging, such as online chats are more appropriate after course for group discussion. Context of online status can be used to gauge whether the learner is in a course context or a social context where an interruption is less appropriate. Spatio-temporal, facility and activity contexts are important for the appropriate utilization of communication methods.

(d) Navigation and retrieval of learning materials: Learner can reactively or actively browse and search learning materials. In reactive learning, accurate learning materials are delivered to the learner if the activity context of personal learning progress is obtained. In active learning, effective browsing and searching of tremendous learning materials are important and can be achieved by context restriction. For example, proximate selection is one way of context restriction by spatial context."

4. IMPLEMENTING ADAPTIVITY IN MOBILE LEARNING

4.1. Using Learning automata as probabilistic adaptation engines

Economides A.A. proposed adaptation engine in an Adaptive Mobile System [13] that used Learning automata to implement the probabilistic adaptation decisions.

"Adaptation Engine: The inputs to the Adaptation engine are – learner's state, the educational activity's state, the infrastructure's state and the environment's state (Table1). The output consists of the adapted educational activity's state, and the adapted infrastructure's state (Table 1).

$U(t)=[L(t),A(t),I(t),E(t)]$ is the input to the adaptation engine at time t.

$O(t+1)=[A(t+1),I(t+1)]$ is the output from the adaptation engine at time t+1.

Input U(t)	Output O(t+1)
L(t): Learner's state A(t):Educational Activity's state I(t): Infrastructure's state E(t): Environment's state	A(t+1):Adapted educational Activity I(t+1):Adapted Infrastructure.

TABLE 1: Input and Output of the Adaptation Engine.

Learning Automata Adaptation: Here probabilistic algorithms to adaptively select the most appropriate state of the educational activity or/and the infrastructure are proposed. They employ learning automata that reinforce a good decision and penalize a bad one [14].

At time t, the adaptation engine selects the state for the educational activity to be A(t)=Am with probability PAm(t), and the state for the infrastructure to be I(t)=tn with probability PIn(t). Define PA(t)=[PA1(t),…,PAM(t)], and PI(t)=[PI1(t),…,PIN(t)].

Considering Learning Automata Adaptation decisions, following are given:

Assume that at time t, the A(t)= Am is selected probabilistically according to PA(t).
If this results in "good" outcome (e.g., the learner is satisfied) then increase the probability of selecting again the Am and decrease the probabilities of selecting all other As.
Otherwise, do the opposite.

Assume that at time t, the I(t)= In is selected probabilistically according to PI(t).
If this results in "good" outcome (e.g., the learner is satisfied) then increase the probability of selecting again the In and decrease the probabilities of selecting all other Is.
Otherwise, do the opposite.

For example, Let assume that there are two networks in the vicinity of the mobile learner. The problem is to select the network that will provide her the best communication performance and reliability in order to achieve her educational activity.

Therefore, let I1 be the Infrastructure including the first network, and I2 be the Infrastructure including the second network.

Let also, PI1 be the probability of selecting the I1, and PI2 be the probability of selecting the I2.

Let at time t, In(n=1 or 2) is selected with probability PIn(t).

If the communication performance and reliability delivered to the learner is "good", then increase PIn(t+1), the probability of selecting again infrastructure In: PIn(t+1)=PIn(t)+a*(1-PIn(t)), 0<a<1,
Otherwise, decrease PIn(t+1): PIn(t+1)=PIn(t)-b*PIn(t), 0<b<1,

Of course, PI1(t+1) +PI2(t+1) =1.

In the above example, the Linear Reward-Penalty learning automation has been used. However, other learning automata algorithms [14] may also be used depending on the situation."

4.2. Using Bayesian network to determine mobile learner's style and adapt to it

Yu Dan and Chen XinMeng [15] used the Bayesian networks to determine mobile learner's styles exploring the potential of individualization of learning process for the learners to implement adaptive mobile learning system architecture that provides a mechanism for adapting content presentation to the mobile learner model and device model, improving mobile learning process.

"Each individual has his/her unique way of learning. Learning style greatly affects the learning process, and therefore the outcome[16]. Mobile learners, who are typically distance learners, usually work individually without external support and have various learning backgrounds and levels. This work here uses Bayesian network to determine mobile learner's styles, which is based on Felder-Silverman learning style theory.

Felder-Silverman learning style theory categorizes an individual's preferred learning style by five dimensions: active/reflective, sensory/intuitive, visual/auditory, sequential/global and inductive/deductive [17]. As inductive/deductive dimension has been deleted from the previous theory because of pedagogical reasons, here they modeled four dimensions of Felder-Silverman framework in their application domain. They built a Bayesian network representing the learning style with a knowledge engineering approach[18].

For each dimension they analyzed respective determining elements in mobile environment, and listed these elements and their values that can take in the following:

Active/reflective (Processing):
Wiki: participation, no participation.
Short message reply: many, few.
Forum: reply, browse, no use.

Sensory/intuitive(Perception):
Reading: facts, theory.
Example: before exposition, after exposition.

Visual/auditory(Input):
Learning material: audio, video.
Chat: audio, video.

Sequential/global(Understanding):
Information Processing: step by step, jump.
Answer: result after steps, only result.

According to the above analyses, they implemented by Bayesian network(Fig.1) encoding relations among three types of variables: learning styles, four dimensions of the learning styles, and different elements that determine learning styles.

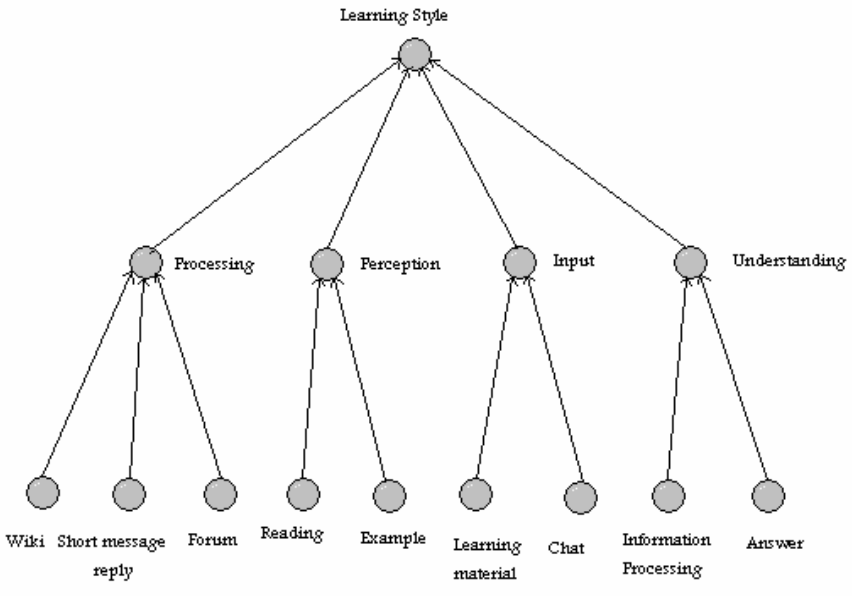


FIGURE.1 Bayesian network modeling mobile learner's styles

Once establishing the probability values associated with each node of the graph by expert knowledge and collected data, they made probabilistic inference of a learner's style. For example, suppose for a learner, we obtain the probability values from observation for the reading and example, and then with the conditional probability table of node Perception they compute the probability P (perception) to determine the student is a sensory learner or an intuitive learner."

4.3. Supporting Adaptivity in Agent-Based Learning Systems

Shanghua Sun, Mike Joy & Nathan Griffiths developed an agent-based learning system [19] that incorporates learning objects to facilitate personalization, and is based on a learning style theory as the pedagogic foundation for adaptivity, and evaluation indicates that the approach is able to provide personalized(or adapted) learning materials and improve the adaptivity in learning systems.

"Here the system locates the student's learning style preference into the learning style space, and also stores each student's current learning style, and the style attributes of each learning object, as coordinates in the four-dimensional space. The system will then search the repository of learning objects, to fetch appropriate learning object with similar dimensional descriptions. These are supported by agent technology to realize the algorithm and implement the process. The objects are then presented to the student, and the subsequent interactions between the student and these learning objects may be used to modify the learning style attributes recorded for a student.

Agent technology has been used to facilitate autonomy and adaptivity, decoupled from the pedagogic foundations of the system [20]. Their system consists of five agents as shown in the figure 2, namely Student Agent, Record Agent, Modelling Agent, Learning Object Agent and the Evaluation Agent. Each agent is designed to satisfy a certain functional requirement to actualize the service purpose of the education system, namely to provide dynamic and adaptive learning materials to individual users.

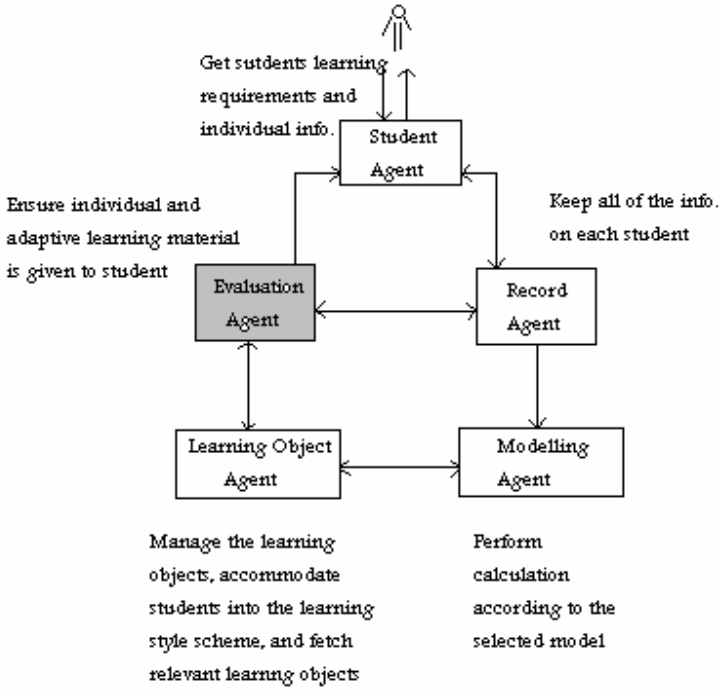
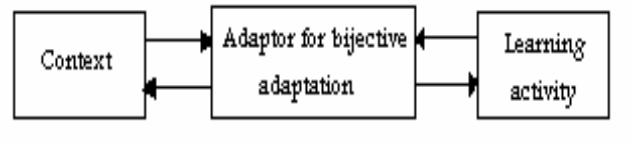


FIGURE 2. System Architecture

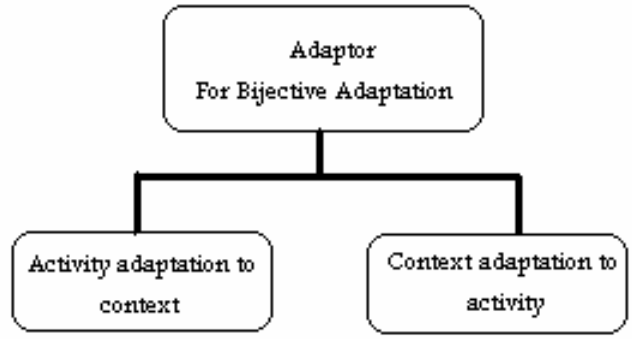
The Evaluation Agent ensures that learning objects are presented in individual and adaptive learning paths to each individual student. Here the use of learning objects and learning style in a agent-based learning system to enhance adaptivity has been introduced. At the conceptual level, personalization and adaptivity are achieved by the use of learning style schemes to tailor the presentation of learning objects to individual students. Conversely, at the practical level, this adaptivity is achieved by providing a set of agents that use a combination of prebuilt and acquired knowledge to determine the leaning styles and learning objects that are appropriate for individual students. Evaluation of the system effectiveness and efficiency is to be assessed."

5. Bijective Adaptation between context and activity

Jihen Malek, Mona Laroussi and Alain derycke [3] have presented an innovative approach for modeling a Bijective adaptation between context and learning activities within mobile and collaborative learning environments; in which is an adaptor that defines two classes of functionalities: the adaptation of learning activity to context and the adaptation of context to learning activity.



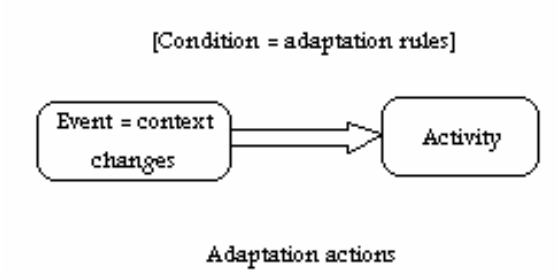
"Adaptor for Bijective Adaptation: This adaptor models all possible interactions between context and learning activity because context and learning activities influence each others in learning processes. This adaptor provides developers with all the possible adaptation actions that should be taken into account through a bijective adaptation process.



i. Activity Adaptation to Context

An activity is adapted or conducted with some variations depending on some values of contextual elements attributes. So, only relevant context changes are modeled and taken into account for the triggering of the activity adaptation process.

When event (or relevant context changes) occurs, conditions (or adaptation rules) are checked and then Activity adaptation process actions are triggered.



Three levels are differentiated within an activity adaptation process:

Presentation level: for example, if the physical environment is characterized by a high noise level and the learning activity includes a sound, then adaptation action compels the inhibition of this sound if it is not necessary for performing the activity.

Navigational level: to model the navigational schema of learning activity, they used UML activity diagrams as shown in figure 3 below. Adaptation actions at this level will consist of the selection of the appropriate learning sub-activity according to the current context.

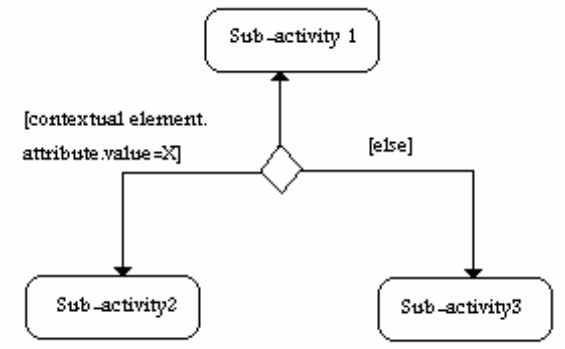


FIGURE 3. Navigational schema of learning activity

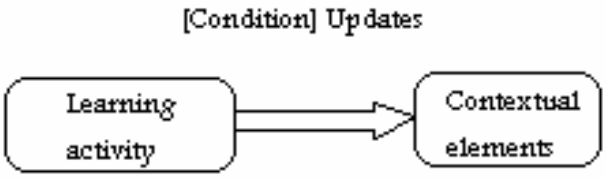
For example, the number of connected learners of the teamwork is used as selection criteria which outlay the nature of the adequate sub-activity.

Intentional level: The intentional level doesn't have the same role as the other levels of adaptation. This level guarantees that learning activity's objectives are preserved and not modified by the adaptation whatever the latter is; presentation or navigational level.

ii. Context Adaptation to Activity

a. Activity updates context

The values of some contextual element's attributes are updated when an activity is completed, but some conditions must be checked before the update (when activity's goals are achieved).



For example, passing an exam updates the user model in a way that extends the learner's knowledge in that relative area.

b. Activity adapts context

Some contextual elements can be adapted to the activity needs. So context adaptation process consists of controlling the context parameters in order to adapt them to the activity needs. This adaptation aims to create an adequate learning environment which helps learners concentrate better on their learning activity.

For example, the volume of the tape recorder stereo will be adjusted automatically according to the type of activity performed by the learner and the degree of needed concentration."

6. Conclusion and Future Work

This paper presents few mobile learning systems approach in implementing context awareness and adaptation. Adaptation is achieved in terms of the learner context, the learner's knowledge levels, the content that is to be presented, the learner's style which may vary from learner to learner and Adaptation to the device's context. Finally we identify that there is a need for explicitly modeling the entities in a mobile learning environment including learner and his behavior in dynamically varying contextual elements and representing inherently existing associations between all the above said approaches to be modeled for an effective mobile learning system which enhances the mobile learner experience, knowledge and usage of the device. We conclude that further research is needed in modeling the user interactions at application level, activity level and at user interface level to understand user intentions and acceptability levels for a given context(s) to make mobile learning more intelligent for adaptation and hence become learner friendly resulting in maximization of the mobile learning goals.

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Enhanced Intelligent Risk Divination Using Added Quality Attributes Injected ATAM and Design Patterns

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Abstract

Architectural Tradeoff Analysis Method is a method for evaluation of architecture-level designs and identifies trade-off points between attributes, facilitates communication between stakeholders. ATAM has got the limitations like not a predictor of quality achievement, not deals more quality attributes, Efficiency always depends on the expertise and potential of stakeholders. In this paper we have proposed a system which uses ATAM to predict the risk analysis, with more possible quality attributes. We have used artificial intelligence to predict the risk of the SA based on the Knowledge base of the Stakeholder Experts.

Keywords: Architectural Tradeoff Analysis Method (ATAM), Stakeholders (SH), Stakeholder Experts (SHE), Design pattern (DP), Software Architecture(SA), Risk factor (RF), Radial Basis Function Neural Network (RBF-NN).

1. INTRODUCTION

Quality attributes of bulky software systems are primarily determined by the system's software architecture. The software architecture of a software-intensive system seriously decides system quality. The ability to appraise software architectures earlier than they are realized in finished systems can considerably reduce the risk that the delivered systems will not meet their quality goals. For architecture evaluation, the Carnegie Mellon® Software Engineering Institute (SEI) developed the Architectural Tradeoff Analysis Method (ATAM) [7]. There are more research going on ATAM limitations and improvements [1, 2, 3, 4, 5, 6].

ATAM is a method for evaluating architecture-level designs and identifies trade-off points between attributes, facilitates communication between stakeholders (such as user, developer, customer, maintainer) from the perspective of each attribute, clarifies and refines requirements, and provides a framework for an ongoing, concurrent process of system design and analysis.

In Our Previos Paper [29], we have discussed, we could find that ATAM is a risk identification mechanism not a predictor [8] of quality achievement. Normally ATAM does not discuss with all possible quality attributes. Efficiency of ATAM depends on the expertise and potential of stakeholders (SH). Here we have extended our previous work[29]. The same new method will

predict the risk of software architecture with additional possible quality attributes and with the knowledgebase collected from historical data or SHE.

The rest of the paper discusses our approach and is organized as follows. Section 2 discusses the related work in the Architecture Tradeoff Analysis Method. Section 3 briefly explains the proposed system. Design Patterns and software architecture are explained in section 4. Section 5 describes the quality attributes. The survey on QA and DP are given in section 6.Section 7 presents the training and testing using RBF-NN and Section 8 concludes the paper.

2. RELATED WORK

Rick Kazman et al. [1] have proposed the Architecture Tradeoff Analysis Method (ATAM), a structured technique for understanding the tradeoffs inherent in the architectures of software intensive systems.

Robert L et al. [2] integrate the SEI ATAM and SEI CBAM. They build on their success in developing and piloting a collection of software architecture methods, they are focusing on integrating them, and building the bridges between them and the processes and architecture efforts outside the SEI, all the while continuing to refine existing methods and models. Paul Clements et al. [3] deal with the application of the SEI Architecture Tradeoff Analysis Method (ATAM) to the U.S. Army's Warfighter Information Network-Tactical (WIN-T) system and present the WIN-T program context, the definition of software architecture, and the background of the WIN-T organization and system being evaluated.

Siv Hilde et al. [4] have proposed the integrated security verification and security solution design trade-off analysis (SVDT) approach. SVDT is useful when there is a diverse set of requirements imposed upon a security critical system, such as a required security level, time-to-market and budget constraints and end users' expectations. Iain Bate et al. [5] have proposed the nine-step process of the Architecture Trade-Off Analysis Method (ATAM) and they address how the system's objectives should be decomposed and designed into components (i.e. the location and nature of interfaces); and what functionality the components should provide to achieve the system's objectives.

Mildred N et al. [6] have proposed the Architectural Tradeoff Analysis Method (ATAM) to evaluate two architectures and the goal of their evaluation is to determine which of the two architectures better provide the required services of the system. Their paper presents a detailed analysis of the different phases of ATAM on the two architectures. Erich Gamma et al. [9] have proposed to capture design experience in a form that people can use effectively. To that end they have documented some of the most important design patterns and present them as a catalog and the purpose of their book is to record experience in designing object-oriented software as design patterns. Each design pattern systematically names, explains, and evaluates an important and recurring design in object-oriented systems.

Atchara Mahaweerawat et al. [15] have proposed a new approach for predicting and classification of faults in object-oriented software systems. In particular, faults due to the use of inheritance and polymorphism are considered as they account for significant portion of faults in object-oriented systems. Their proposed fault prediction model is based on supervised learning using Multilayer Perception Neural Network. The results of fault prediction are analyzed in terms of classification correctness and some other standard criteria. Stefan Biffl et al. [16] have given the ideas for QATAM, a technique for the evaluation of QA strategies and their tradeoffs in the context of a software process and they illustrate the application of QATAM in an ongoing research project Lifecycle, which aim at improving evidence-based application of QA activities in SMEs.

Femi G et al. [17] have discussed the main tenets of the extended method, and illustrated its use through a small case study and they extend the popular ATAM (Architecture Tradeoff Analysis Method) method into a holistic approach that analyzes the quality attribute tradeoffs not only for the product line architecture, but for the individual product architectures as well. Ahmed BinSubaih et al. [18] have proposed ATAM to the test on their architecture and discuss the findings based on the outputs generated which include lists of risks, nonrisks, sensitivities, and tradeoffs made. They have developed to aid game portability between game engines and they present an Architecture Reactive View (ARV) to consolidate disparate outputs generated by ATAM into one which they consider as an improvement to ATAM. [19] [20] [21] are also the related work

3. PROPOSED SYSTEM

We underwent the detailed survey and finally arrived a more attributes which is more suitable for better performance of trade-off analysis .We have also introduced design pattern based software architecture analysis and it's relationship with quality attributes.

Then we have chosen artificial intelligence to predict the risk of the SA. The impact of quality attributes on design pattern (IQADP) is analyzed. This input and the RF arrived using ATAM can either be achieved from the historical data or the result of a survey with the SHE. This IQADP is trained along with the RF. During testing only IQADP is given as input to get the RF.

4. DESIGN PATTERN (DP) AND SOFTWARE ARCHITECTURE (SA)

In software engineering, a design pattern [9, 10] is a common replicable solution to a frequently happening problem in software design. A design pattern is not a completed design that can be transformed straight away into code. It is a depiction or template for how to resolve a problem that can be used in many different situations. Object-oriented design patterns characteristically show relationships and communications between classes or objects, without specifying the ending application classes or objects that are involved. Algorithms are not thought of as design patterns, since they resolve computational problems rather than design problems.

Not every software patterns are design patterns. Other kinds of patterns, such as architectural patterns, illustrate problems and answers that have alternative scopes. Design patterns pact specifically with problems at the level of software design.

Design patterns can pace up the development procedure by supplying tested, proven development paradigms. Reusing design patterns assists to avoid subtle issues that can cause major problems, and it also improves code readability for developers and designers who are proverbial with the patterns. Efficient software design necessitates considering issues that may not become visible until later in the implementation [11].

Often, people only understand how to relate certain software design techniques to certain problems. These techniques are difficult to apply to a wider range of problems. Design patterns provide general solutions, documented in a format that doesn't require specifics tied to a particular problem.

Design patterns form a consistent language that can be used to depict classic solutions to common object oriented design problems. These patterns allow us to discuss systems of objects as quasi-encapsulated entities. By using design patterns to solve programming problems, the proper perspective on the design process can be maintained.

Design patterns are composed of more sections. Of particular notice are the Structure, Participants, and Collaboration sections. These sections explain a design motif: a prototypical

micro-architecture that developers duplicate and adapt to their particular designs to solve the repeated problem described by the design pattern. A micro-architecture is a collection of program constituents (e.g., classes, methods...) and their relations. Developers use the design pattern by introducing in their designs this prototypical micro-architecture, which means that micro-architectures in their designs will have structure and association similar to the selected design pattern.

In addition, patterns allow developers to converse by means of well-known, well understood names for software interactions. Common design patterns can be improved over time, making them further robust than unplanned designs. Considering situations where patterns are used suitably in a program to solve their consequent design problems and assuming that the developers have a good knowledge of design patterns.

5. QUALITY ATTRIBUTES (QA)

We investigated the impact of design patterns on the overall quality of program in a SH point of view, thus attributes like Learnability and Understandability refer to the whole program and not to the pattern solely.

The quality attributes are defined as:

1. **Robustness:** The degree to which an executable program prolongs to function suitably under a typical circumstances or conditions.
2. **Scalability:** Scalability is the ease with which an application or component can be customized to expand its offered capabilities at runtime.
3. **Reusability:** Reusability here is the degree to which a piece of design be capable to be reused in another design.
4. **Trainability:** The degree to which the code source of a program is effortless to be trained by new developers.
5. **Realizability:** The degree to which the code source of a program is easy to understand.
6. **Modularity:** The degree to which the implementation of functions in a program are independent from one another.
7. **Modularity at runtime:** The degree to which functions of a program are independent from one another during execution.
8. **Generality:** The degree to which a software product can achieve a wide range of functions.
9. **Extendability:** The degree to which architectural, data or procedural design can be extended.
10. **Simplicity:** The degree to which a program can be understood without intricacy.
11. **Maintainability:** The maintainability of the code source of a program is its aptitude to undergo repair and evolution.
12. **Availability:** The availability of the code source of a program is a measure of its readiness for usage
13. **Reliability:** The reliability of a system is a measure of the ability of a system to keep operating over time.

6. THE SURVEY ON QA and DP

Considering situations where patterns are used appropriately in a program to solve SH's corresponding design problems and assuming that the SH have a good knowledge of design patterns, we underwent a survey. We prepared a questionnaire and asked SH to circle the letter corresponding to their answer to the questions. If they hesitate between options, we asked the most conservative choice. If they have a doubt, they were asked to choose option F. The options given were

1. Very affirmative
2. Affirmative
3. Insignificant
4. Negative
5. Very Negative
6. No Idea

For the survey we chose 23 DPs which are Abstract Factory, Builder, Factory Method, Prototype, Singleton, Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy, Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State, Strategy, Template Method, and Visitor.

The example of sample Questionnaire is given in Figure 2.

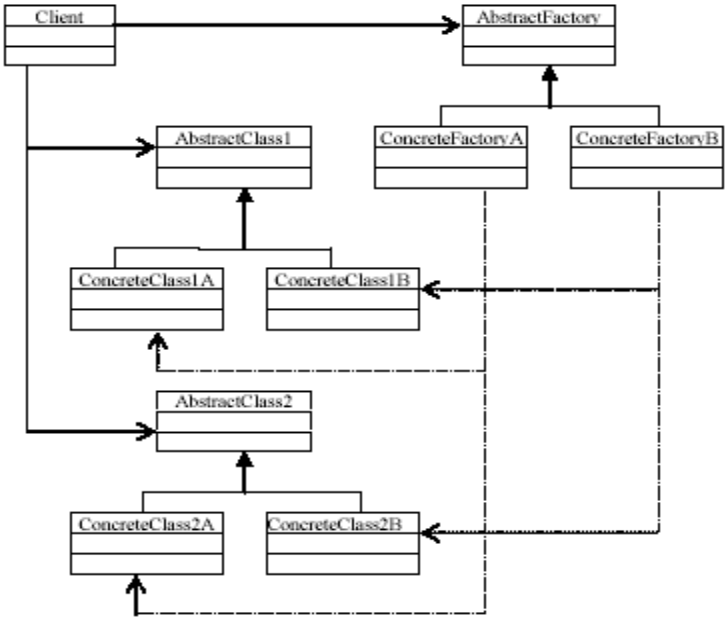

FIGURE1: Design pattern sample (Abstract Factory)

Abstract Factory							Comments
Robustness	1	2	3	4	5	6	
Scalability	1	2	3	4	5	6	
Reusability	1	2	3	4	5	6	
Trainability	1	2	3	4	5	6	
Realizability	1	2	3	4	5	6	
Modularity	1	2	3	4	5	6	
Modularity at runtime	1	2	3	4	5	6	
Generability	1	2	3	4	5	6	
Extendability	1	2	3	4	5	6	
Simbilicity	1	2	3	4	5	6	
Maintainability	1	2	3	4	5	6	
Availability	1	2	3	4	5	6	
Reliability	1	2	3	4	5	6	

FIGURE2: Sample Questionnaire used in the Survey

7. TRAINING AND TESTING

7.1 Radial Basis Function Neural Network (RBF-NN)

Radial Basis Functions emerged as a variant of artificial neural network in late 80's.Radial basis function (RBF) neural network is based on supervised learning. RBF networks were independently proposed by many researchers and are a popular alternative to the MLP. RBF networks are also good at modeling nonlinear data and can be trained in one stage rather than using an iterative process as in MLP and also learn the given application quickly. RBF's are embedded in a two layer neural network, where each hidden unit implements a radial activated function [22]. Due to their nonlinear approximation properties, RBF networks are able to model complex mappings, which perception by means of multiple intermediary layers [23].

Radial basis networks can require more neurons than standard feed forward back propagation networks, but often they can be designed in a fraction of the time it takes to train standard feed forward networks. They work best when many training vectors are available. RBF networks have been successfully applied to a large diversity of applications including interpolation [24], image restoration [25], shape-from-shading [26], 3-D object modeling [27], data fusion [28], etc.

RBF-NN is used by many authors for prediction [13, 14, 15] .During testing; the impact of quality attributes on design pattern (IQADP) is analyzed as discussed in the previous section. Then RF was analyzed based on ATAM. IQADP and RF were trained using RBF-NN.

While testing, the SA is analyzed to get the number and types of DPs used. These are given to RBF-NN to get the RF based on the trained data arrived using the previous procedure.

8. CONCLUSION

In this paper we have discussed some limitation of ATAM and proposed an Expert System. The proposed system can be used for Predicting risk factors of a SA based on SHE using RBF-NN. The Knowledge Base we have proposed is based on the expert SHE so the accuracy is improved. We have analyzed and added more possible quality attribute to improve the quality of RISK prediction. The performance of ATAM is also improved as it is automated.

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Implementation of Back-Propagation Algorithm For Renal Datamining

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Abstract

The present medical era data mining place a important role for quick access of appropriate information. To achieve this full automation is required which means less human interference. Therefore automatic renal data mining with decision making algorithm is necessary. Renal failure contributes to major health problem. In this research work a distributed neural network has been applied to a data mining problem for classification of renal data to have for proper diagnosis of patient. A multi layer perceptron with back propagation algorithm has been used. The network was trained offline using 500 patterns each of 17 inputs. Using the weight obtained during training, fresh patterns were tested for accuracy of diagnosis.

Keywords: Datamining, Renal data, Back-propagation algorithm, Diagnosis.

1. INTRODUCTION

Two types of databases are available in medical domain. The one is a dataset acquired by medical experts, which are collected for a special research topic. These data have the following characteristics: (1) The number of records are small. (2) The number of attributes for each record are large, compared with the number of records. (3) The number of attributes with missing values are very few. This type of databases is called p-databases(prospective databases). The analysis of those data is called prospective analysis in epidemiology, because data collection is triggered by the generated hypothesis. Statistical analysis has been usually applied to these datasets [l-7].

The second type is a huge dataset retrieved from hospital information systems. These data are stored in a database automatically without any specific research purpose. Usually, these databases only include laboratory tests, although researchers in medical informatics are discussing how to store medical image, and physical examinations as electronic patient records [8-11]. These data in hospital information system (HIS) have the following characteristics: (1) The number of records are very huge. (2) The large number of attributes for each record (more than

several hundred).(3) Many missing values will be observed. (4) Many temporal sub-records are stored for each record (patient). This type of databases is called r-databases(retrospective databases). The analysis of these data is called retrospective analysis in epidemiology, because data will be analyzed after data collection. Those data will lose any good features which prospective data holds and even statistical techniques do not perform well. This type of data is very similar to business databases. Concerning p-databases, data will be prepared with a hypothesis generated by medical experts very carefully. Thus, the quality of data is very high, and any data analysis technique will be applicable and useful. Only the problem with p-databases is that the number of measurements is very large, compared with the number of records. Thus, data reduction or rule induction will be useful to detect the important attributes for analysis. On the other hand, as for r-databases, there are many difficult issues for data analysis.

1.1 Renal systems

The renal system consists of all the organs involved in formation and release of urine. It includes the kidneys, ureters, bladder and urethra. Initially, it is without specific symptoms and can only be detected as an increase in serum creatine. As the kidney function decreases, renal failure is a serious medical condition affecting the kidneys. When persons suffer from renal failure, their kidneys are not functioning properly or no longer work at all. Renal failure can be a progressive disease or a temporary one depending on the cause and available treatment options.

The kidneys are glands that are located in the abdominal region just above the pelvis on either side of the body. When functioning normally, the kidneys separate and filter excess water and waste from the blood stream. The kidneys are responsible for producing urine, which is used to flush away the toxins. The kidneys maintain a healthy balance of fluids and electrolytes, or salt compounds, in the body. In renal failure the kidneys undergo cellular death and are unable to filter wastes, produce urine and maintain fluid balances. This dysfunction causes a build up of toxins in the body which can affect the blood, brain and heart, as well as other complications. Renal failure is very serious and even deadly if left untreated.

The quantity and complexity of data acquired, time-stamped and stored in clinical databases by automated medical devices is rapidly and continuously increasing. As a result, it becomes more and more important to provide clinicians with easy-to-use interactive tools to analyze huge amounts of this data. These tools would serve different purposes, such as supporting clinical decision making, evaluating the quality of the provided care, and carrying out medical research. The specific clinical context is in the domain of hemodialysis, where clinicians have to deal with huge amounts of data automatically acquired during the hemodialytic treatment of patients suffering from renal failure.

2. PROBLEM DEFINITION

The problem is to implement an intelligent data mining concept for the huge amount of renal data. As the number of patients is growing rapidly due to food habits and other deficiencies in the body, renal failure plays predominantly in the life of patient. Quick diagnosis and telemedicine requires immediate solution for a patient. This can be achieved properly only from the knowledge gained from the experts with regard to diagnosing methods.

Renal data such as person age in terms of years, male / female, Edema, Oliguri, Normochronic, Urgent, Hypertension, Diabetics, Family History, Polymer Chain Reaction, Obesity, Hemoglobin, Cholostral, Creatine have been collected for 1000 patients. In this research work, back-propagation algorithm is used to implement data mining. BPA is a supervised algorithm to train an artificial neural network. It is an intelligent method for mining information meaningfully and quickly.

3 SCHEMATIC ARCHITECTURE

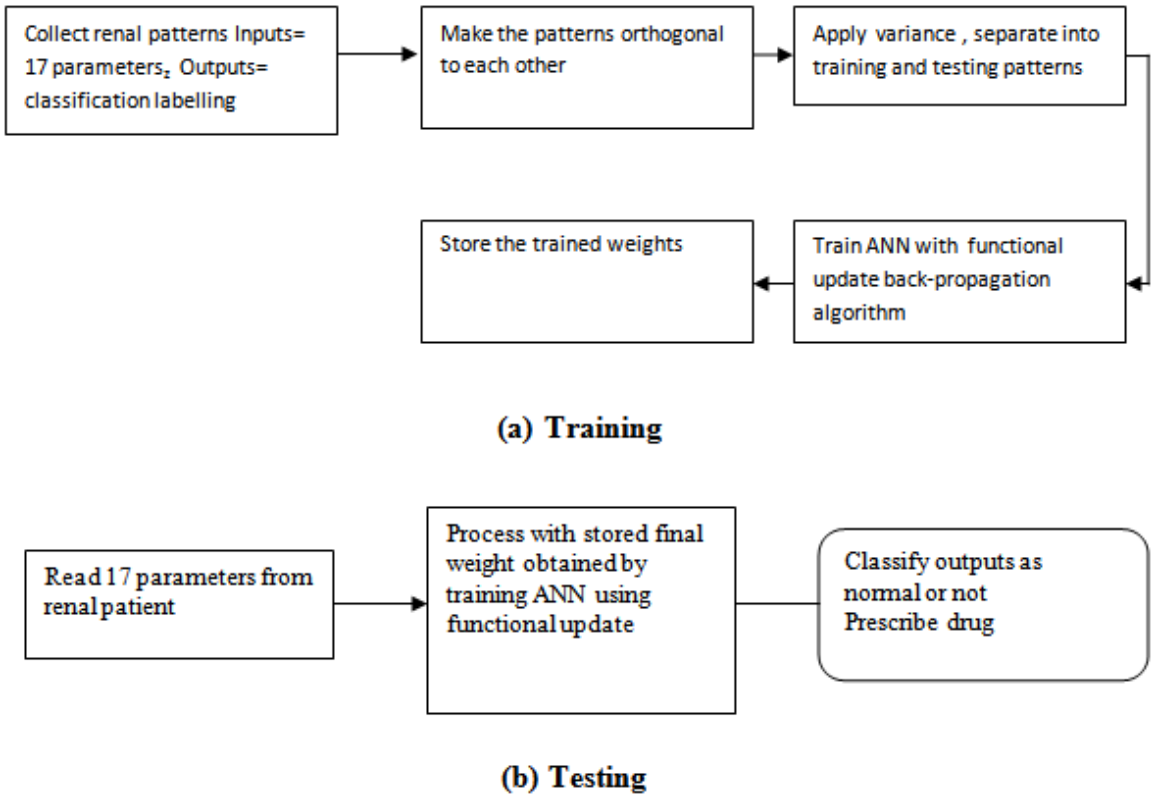

FIGURE.1: Renal data mining

4 ARTIFICIAL NEURAL NETWORKS

A neural network is constructed by highly interconnected processing units (nodes or neurons) which perform simple mathematical operations, Fortuna et. al [12]. Neural networks are characterized by their topologies, weight vectors and activation function which are used in the hidden layers and output layer, Lippmann [13]. The topology refers to the number of hidden layers and connection between nodes in the hidden layers. The activation functions that can be used are sigmoid, hyperbolic tangent and sine, Yao and Fang [14]. The network models can be static or dynamic Hush and Horne [15]. Static networks include single layer perceptrons and multilayer perceptrons. A perceptron or adaptive linear element (ADALINE), Widrow [16] refers to

a computing unit. This forms the basic building block for neural networks. The input to a perceptron is the summation of input pattern vectors by weight vectors. In Figure 2, the basic function of a single layer perceptron is shown.

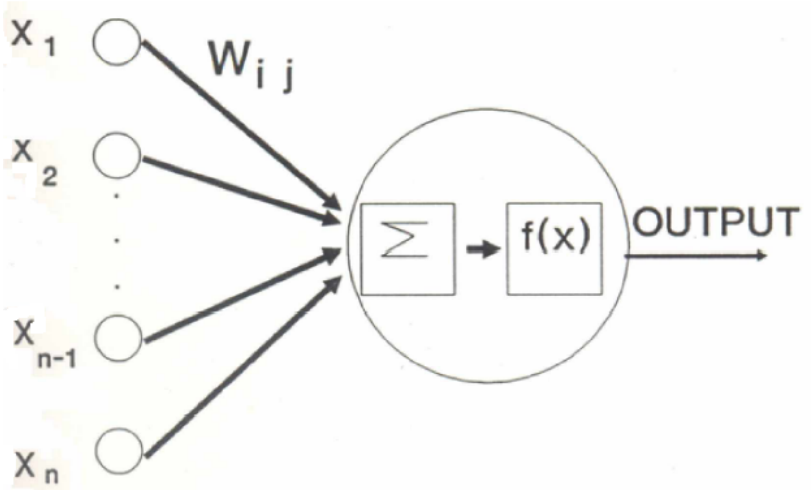

FIGURE 2:. Operation of a neuron

In Figure 3, a multilayer perceptron is shown schematically. Information flows in a feed-forward manner from input layer to the output layer through hidden layers. The number of nodes in the input layer and output layer is fixed. It depends upon the number of input variables and the number of output variables in a pattern. In this work, there are six input variables and one output variable. The number of nodes in a hidden layer and the number of hidden layers are variable. Depending upon the type of application, the network parameters such as the number of nodes in the hidden layers and the number of hidden layers are found by trial and error method, Hirose et. al [17]

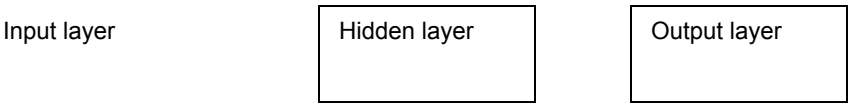

FIGURE 3: Multilayer perceptron

In most of the applications one hidden layer is sufficient. The activation function which is used to train the ANN, is the sigmoid function and it is given by:

(1)

where

f (x) is a non - linear differentiable function,

where

N_n is the total number of nodes in the n^{th} layer

W_{ij} is the weight vector connecting i^{th} neuron of a layer with the j^{th} neuron in the next layer.

θ is the threshold applied to the nodes in the hidden layers and output layer and

P is the pattern number.

In the first hidden layer, x_i is treated as an input pattern vector and for the successive layers, x_i is the output of the i^{th} neuron of the proceeding layer. The output x_i of a neuron in the hidden layers and in the output layer is calculated by :

(2)

For each pattern, error E (p) in the output layers is calculated by :

(3)

where
M is the total number of layer which include the input layer and the output layer,
N_M is the number of nodes in the output layer.
$d_i(p)$ is the desired output of a pattern and
$X_i^M(p)$ is the calculated output of the network for the same pattern at the output layer.
The total error E for all patterns is calculated by :

(4)

where
L is the total number of patterns.

4.1 Disadvantages of steepest-descent method

The number of cycles required for E to reach the desired minimum is very large. The E does not reach the desired minimum due to some local minima whose domains of attraction are as large as that for the global minimum. The algorithm converges to one of those local minima and hence learning stops prematurely or the value diverges. The updating of weights will not stop unless every input is outside the significant update region. The significant update region is from 0.1 to 0.9. Due to this, the output of the network will be approaching either 0.0 or 1.0. This requires a large number of iterations for the convergence of the algorithm.

5 Functional update method (FUM)

In classification problems, input patterns can be grouped into classified subset and misclassified subset for any given weights, Huang [18] The input patterns are said to be misclassified if the error `D' in the output layer is greater than 0.5 The input patterns are said to be classified if D is less than 0.5. Weights are modified only when D is greater than 0.5. The functional update algorithm used is as follows :

Step 1 : Initialize the weights randomly.
Step 2 : Present a pattern with new inputs and desired outputs.
Step 3 : Compute network output by Equation (2).
Step 4 : Determine V^n, the set of valid update data in the output layer for the i^{th} output node by :

$$0.5 < D < 1 - \in \quad (5)$$

where

$\in$ is the error fixed by the programmer

If V^n is empty, i.e. not even one node in the output layer does satisfy Equation (5), go to step 8. Otherwise go to step 5.

Step 5: Compute the objective function E (p) by :

(6)

Step 6 : In BPA algorithm with FU, adapt weights by using equations given in Table 1.
Step 7 : Repeat by going to step 3.
Step 8 : Change the sigmoid function of the output neuron to the signum function

The main advantage of FUBPA is that it will stop as soon as the misclassified set is empty. The flow chart for FUBPA is given in Figure 4

6. DESCRIPTION OF EXPERIMENTS

6.1 Experimental set-up

Renal data such as person age in terms of years, male / female, Edema, Oliguri, Normochronic, Urgent, Hypertension, Diabetics, Family History, Polymer Chain Reaction, Obesity, Hemoglobin, Cholostral, Creatine have been collected for 1000 patients. The collected data are given in Table 1. A total of 17 parameters about renal organ have been collected from 1000 patients.

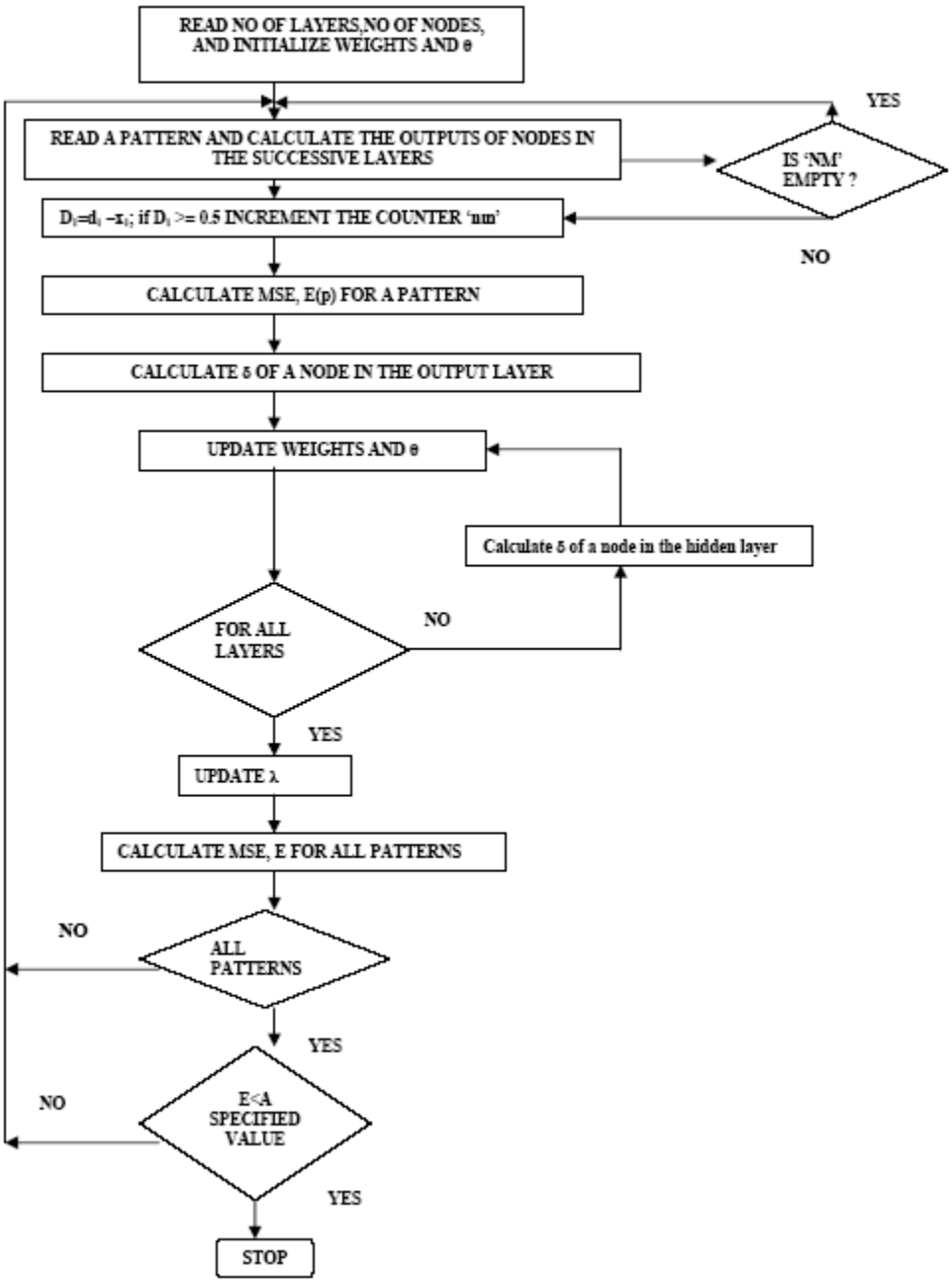
READ NO OF LAYERS,NO OF NODES, AND INITIALIZE WEIGHTS AND θ
READ A PATTERN AND CALCULATE THE OUTPUTS OF NODES IN THE SUCCESSIVE LAYERS
IS 'NM' EMPTY ?
YES
NO
$D_i=d_i - x_i$; if $D_i >= 0.5$ INCREMENT THE COUNTER 'num'
CALCULATE MSE, E(p) FOR A PATTERN
CALCULATE δ OF A NODE IN THE OUTPUT LAYER
UPDATE WEIGHTS AND θ
Calculate δ of a node in the hidden layer
FOR ALL LAYERS
NO
YES
UPDATE λ
CALCULATE MSE, E FOR ALL PATTERNS
NO
ALL PATTERNS
YES
NO
E<A SPECIFIED VALUE
YES
STOP

FIGURE.4: Functional update Back Propagation Algorithm(FUBPA)

Age = [49 40 35 28 36 30 43 40 60 48 30 25 42 25 55 50 65 31 75 50 60 29 62 55 21 42 40 60 70 56 22 27 30 46 22 65
65 25 62 40 62 27 57 42 40 32 32 25 60 39 57 61 30 37 60 56 44 45 30 30 30 52 57 37 13 25 26 45 42 24 36 63 67 64 48
55 67 60 51 74 34 53 70 56 66 40 60 55 20 53 58 55 64 54 49 65 52 28 40 59 53 48 40 35 48 35 65 65 54 28 51 22 57 19
60 60 48 45 35 65 60 55 75 50 53 60 72 33 60 59 60 74 51 45 42 13 58 58 63 18 28 20 59 40 50 40 60 45 46 52 48 27 72
62 59 45 25 60 32 47 25 45 55 45 26 20 45 38 35 66 52 60 47 43 70 41 50 40 34 70 56 49 67 66 54 46 68 55 26 55 40 54
30 62 70 65 41 42 65 49 55 30 50 48 56 45 61 41 65 48 43 70 53 51 50 25 33 49 55 52 60 25 42 40 54 17 70 40 42 70
52];
Sex = [1 0 1 1 0 1 1 1 0 1 1 0 1 0 0 1 1 1 1 1 1 0 1 1 0 0 1 0 1 1 0 1 1 0 1 1 0 0 0 1 1 0 0 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 0 0 1
1 1 0 0 1 1 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 0 1 1 1 1 1 1 0 0 1 0 1 1 0 1 1 1 1 1 1 1 1 1 0 1 0 1 0 1 1 1 1 0 1 1 0 1 1
1 1 0 1 0 1 0 0 1 1 0 1 1 0 1 0 1 0 1 1 1 1 0 1 1 0 1 0 1 0 1 1 0 1 0 0 1 1 1 0 1 1 1 1 1 0 1 1 1 1 0 0 1 1 1 1 1 0 1 0 1 1 0 1 0
1 1 1 1 1 0 1 1 1 1 1 0 0 0 1 1 1 1 1 1 1 0 0 1 1 1 1 0 1 1 0 1 0 0 0 0 0 0 1 1];
Ede = [1 1 1 1 1 1 1 0 1 1 0 1 1 1 0 0 0 1 1 1 1 0 1 0 1 1 1 1 0 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 1 1 0 1 0 1 1 0 1 1 1 0 1 0
1 1 1 1 1 1 1 1 1 0 1 0 1 1 1 1 1 0 0 1 1 1 0 1 0 1 1 1 1 1 0 1 0 1 1 1 1 0 1 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1 0 1 1 1 1 0
1 0 1 1 1 1 1 1 1 0 1 0 1 0 1 0 1 1 1 0 1 1 1 1 1 1 1 1 0 0 1 1 1 0 0 1 0 1 1 0 1 1 1 1 1 1 1 1 1 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1 1 1 0 1 0 1 1 1 1 1 1 1 1 1 0 1 1 0 1 1 1 1 1 1 1];
Puf = [1 1 1 1 1 1 1 1 0 1 1 0 1 1 1 0 0 0 1 1 0 1 0 1 0 1 1 1 1 0 1 1 1 0 1 1 0 1 1 1 1 1 1 1 1 1 1 0 0 0 1 0 0 1 0 1 1 0 1 1 1 0 1 0
1 1 1 1 1 1 1 1 1 0 1 0 1 1 0 0 0 0 0 1 1 1 0 0 0 1 1 1 1 1 1 1 1 0 1 1 1 1 1 0 1 1 1 1 1 1 0 1 1 1 1 1 1 0 1 0 1 1 1 1 1 1 1 1 0 1 1 1 1 0
0 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1 0 1 0 1 0 1 1 1 1 1 1 1 1 0 0 1 1 0 0 0 1 0 1 1 0 1 1 1 1 1 1 1 1 1 0 0 1 1 0 0 1 1 1 1 1 1 0 1 1 1 0 1 1
1 1 1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1 1 1 0 1 0 1 1 1 1 0 1 1 1 0 0 1 0 1 1 1 0 1 1];
Oli = [1 1 1 0 1 1 1 1 1 1 0 1 1 1 0 1 0 0 1 1 1 0 1 1 1 1 0 0 1 1 1 0 1 1 1 1 0 1 0 1 0 1 0 1 1 0 0 1 0 1 1 0 1 1 1 1 1 1 0 0 1 1
0 1 1 1 1 1 0 1 1 1 0 1 1 0 0 1 0 0 0 1 1 0 0 0 0 1 1 1 1 0 1 0 1 1 0 1 1 0 1 1 1 1 1 1 0 1 1 1 1 0 0 1 0 1 0 0 0 0 1 0 0 1 1 1 0 0
0 0 1 1 1 0 0 1 1 0 1 1 0 1 1 1 0 0 0 0 1 1 0 0 1 1 0 0 0 0 1 0 0 0 1 0 1 0 0 0 1 1 1 1 1 0 0 1 0 1 1 1 0 0 1 1 0 1 1 0 0 1 0 0 1
1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 1 1 1 1 1 0 0 0 1 1 0 1 1 1 0 0 0 1 1 0 1 0 1 0];
Pol = [0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 1 0 0];
Noc = [0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 1 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
1 1 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0
0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 1 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 1 0 0 0 0 0 0 0 0 0 1 1 1 0 0 1 0 0];
Urg = [0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0];
Hes = [0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0
0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0];
Hyp = [0 0 0 1 0 1 0 0 1 1 1 1 1 1 1 0 0 1 1 0 0 1 0 0 1 1 1 1 1 0 0 1 0 1 0 1 0 1 1 0 1 1 1 1 0 1 1 1 0 0 0 1 0 1 1 2 1 1 1 1 0
1 0 0 1 1 1 1 1 1 1 1 0 1 1 1 0 1 0 1 1 1 1 1 1 2 0 2 1 1 1 1 1 1 3 0 0 1 0 0 1 0 1 0 2 0 0 1 1 1 1 1 0 0 1 1 1 2 0 1 0 1 0 2 1 1
1 1 1 1 1 1 1 1 0 1 3 1 1 0 1 0 0 1 0 1 1 1 3 1 1 1 1 0 3 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1 1 1 1 0 0 1 1 1 0 0 3 3 1 1 0 1 2 1 1 1 1
1 1 1 2 1 1 1 1 2 1 0 0 1 2 0 2 1 0 1 0 1 1 1 1 0 1 1 1 2 1 1 1 1 1 1 0 0 0 1 0 1];
Dia = [3 0 0 0 0 0 0 0 0 3 0 0 0 0 3 0 0 0 0 0 0 0 0 0 0 0 1 3 0 0 0 0 0 0 0 0 0 1 3 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 3 0 0 1 0 0
1 0 3 0 0 0 1 1 0 0 0 0 0 0 0 3 0 1 3 0 1 0 0 2 0 0 2 0 0 0 0 0 3 3 0 0 0 0 0 0 1 0 3 0 0 0 0 2 2 0 0 0 3 0 2 1 1 0 0 1 2 0 2 3 2 1
0 0 0 2 1 0 1 0 0 0 2 0 2 0 0 0 2 2 0 0 1 3 0 0 0 0 3 0 2 0 0 3 0 0 0 3 0 0 0 0 0 0 0 0 3 0 1 3 0 0 1 3 0 0 0 0 0 0 0 0 3 3 0 0 0 0 1
2 0 0 2 2 0 0 2 0 0 0 0 1 3 0 0 0 1 1 1 0 3 2 1 0 0 1 0 2 0 1 0 0 0 0 2 1 0 1 3];
Tob = [0 0 1 0 0 0 0 0 0 0 1 0 1 0 0 0 1 1 0 0 1 0 1 1 0 1 0 0 1 1 0 0 0 0 0 1 0 0 0 1 1 0 0 0 0 0 0 0 1 1 1 0 1 1 0 1 1 1 0 0 0
0 0 0 0 1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 1 1 0 1 0 1 0 0 0 1 0 0 0 0 0 1 1 0 1 1 0 1 1 1 1 0 0 0 0 0 0 1 1 0 0 0 1 0 0 1
1 0 0 1 0 1 0 0 1 0 1 1 0 0 1 0 0 0 1 1 1 0 0 1 1 0 1 0 1 0 1 0 0 1 0 0 1 0 0 0 0 0 1 0 0 1 0 1 1 1 0 0 0 1 0 1 1 0 0 0 0 0 0 1 0
0 0 1 0 0 0 0 1 0 1 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 0 1 0 0 0 0 1 0 1 0];
Fam = [0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0];
PCR = [2.2 2.65 2.0 1.31 4.04 0.4 .65 .22 1.42 1.7 2.7 .65 2.19 1.89 .87 .66 .68 1.1 2.4 3.43 2.09 1.76 2.64 .06 .45 .27 2.7
3.18 1.15 2.78 1.71 1.1 2.4 1.76 .16 .36 1.93 4.2 1.5 1.8 1.6 1.69 1.51 .85 .98 2.2 3.92 .7 .3 .55 2.4 .18 3.56 .3 2.15 3.83
.74 .18 1.95 2.8 2.4 1.17 1.78 3.78 1.34 1.14 3.38 3.18 .27 1.42 1.5 .3 1.2 2.4 2.0 .98 1.0 .30 1.1 2.0 1.2 2.1 .23 .38 .5 .3
1.94 1.0 1.0 .12 .2 2.2 1.51 .97 1.3 1.8 .72 3.0 .31 2.7 2.1 .76 2.44 1.47 1.17 1.4 .75 2.02 1.67 .37 1.1 2.0 1.08 1.82 2.0
1.9 2.3 1.2 2.13 1.37 .04 .56 .57 1.85 2.8 1.22 .25 1.28 .3 1.46 2.1 .44 1.87 .91 1.2 1.3 .25 .58 2.5 1.67 1.53 2.28 1.9 .95
2.74 .62 .28 2.1 1.35 2.5 2.7 2.6 1.18 .03 .98 .58 2.8 .7 2.61 .5 1.95 3.25 1.1 .76 .9 1.9 .8 .4 1.44 .65 1.4 1.62 2.6 2.01
1.65 2.39 .28 .5 .4 .9 .16 2.1 1.73 3.7 3.4 3.0 1.77 1.5 .7 .8 3.5 2.74 .18 1.91 .02 3.62 1.4 .22 1.2 .3 2.9 .4 3.9 2.44 1.9 1.1
.4 2.08 1.8 2.0 2.06 4.29 2.6 1.55 .7 1.3 2.4 1.6 .07 1.71 .4 2.51 .4 .2 .14 1.6 2.62 1.3 .32 .4 1.52];
Obs = [0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0];
Hem = [13.2 10.8 7.2 12.0 12.1 13.8 13.0 9.8 12.8 13.7 11.4 8.0 8.8 11.6 12.1 12.0 8.8 13.0 10.2 10.8 7.1 7.8 10.8 13.0 13.0 12.6 4.8 11.0 11.5 12.6 8.8 11.0 3.8 9.8 10.2 11.0 9.2 5.2 10.8 12.0 12.6 12.6 9.1 11.5 13.2 11.0 8.8 8.2 11.0 13.0 12.8 12.1 11.0 10.8 9.7 7.2 12.6 11.5 13.8 7.8 3.8 11.0 10.2 8.8 9.4 12.6 8.8 11.0 12.6 12.8 13.9 10.8 12.0 9.8 9.8 8.8 13.2 11.0 13.0 9.2 11.5 8.2 9.8 15.0 14.2 11.0 9.2 7.8 7.8 11.5 12.0 9.8 11.0 13.2 5.2 10.2 10.2 7.2 9.8 7.8 8.2 10.8 11.8 9.2 9.8 12.0 8.2 8.2 8.8 10.2 12.06 12.8 13.0 8.2 12.8 11.5 9.8 9.8 14.2 15.0 11.4 11.5 10.3 9.2 7.8 13.9 12.8 14.0 11.0 9.4 8.2 12.6 10.2 8.4 9.2 8.2 9.0 6.0 16.8 7.1 9.4 4.8 8.8 10.2 8.4 13.2 13.6 5.2 10.8 9.8 10.8 8.8 10.2 10.8 9.2 13.0 6.6 13.9 7.2 7.8 9.8 11.5 7.8 11.4 11.8 8.9 8.2 6.6 7.2 9.4 9.2 12.8 10.3 12.8 12.1 9.2 9.8 6.8 11.4 8.8 12.0 6.8 8.8 8.8 7.8 11.0 12.2 13.9 8.7 10.8 10.8 8.7 10.8 10.2 7.8 10.2 11.0 12.0 8.2 10.2 7.8 13.8 10.2 12.0 9.2 14.2 7.8 5.8 9.2 9.8 9.8 9.8 7.8 9.2 11.0 9.8 6.8 8.8 12.6 6.8 8.8 9.2 5.2 9.2 9.8 6.0 8.2 10.3 7.2 7.2 7.2];
Cre = [330 88 180 299 115 875 88 340 180 280 270 290 185 88 88 370 240 105 490 710 180 360 550 130 88 85 466 550 140 105 85 105 369 260 88 250 88 330 280 160 200 330 190 470 430 330 330 380 200 732 88 250 220 350 410 410 190 260 200 360 369 95 430 95 600 270 350 90 85 260 320 120 380 622 166 290 157 170 530 825 380 320 270 300 88 536 350 710 190 565 170 360 340 88 888 580 470 350 510 1500 320 470 130 710 809 95 350 550 120 732 200 334 88 180 80 84 200 390 1300 110 140 210 450 220 704 450 200 380 110 450 290 310 80 510 270 228 210 501 651 501 1478 430 105 316 320 360 88 563 387 350 290 431 378 88 280 220 1300 88 825 600 430 88 410 430 500 732 500 600 600 550 510 100 410 430 320 180 310 616 360 825 90 607 756 290 123 120 149 475 176 210 237 457 510 280 86 175 192 254 250 853 324 260 184 404 157 572 422 1540 202 298 280 352 114 86 289 501 1170 271 80 184 642 80 1082 457 175 448 369 219 589 289 271];
Chol = [175 178 176 206 206 172 190 190 175 180 196 210 380 196 180 182 186 168 176 179 169 185 172 176 185 172 179 176 185 185 236 196 166 190 168 200 172 188 170 182 196 195 189 168 190 195 166 166 180 169 165 192 182 179 206 170 180 208 188 191 166 183 196 260 196 196 180 185 190 180 208 196 191 198 166 188 182 177 182 166 165 186 188 201 188 170 190 186 192 196 186 182 200 180 186 181 185 182 165 162 186 180 165 195 177 210 179 170 192 188 166 185 200 195 236 141 275 195 161 172 165 173 185 188 166 162 195 199 178 185 163 164 206 190 188 180 188 165 172 180 168 176 190 150 171 182 178 175 173 170 181 170 172 168 190 178 170 168 173 185 180 172 179 190 188 196 184 152 189 188 192 168 190 172 168 215 177 166 188 151 196 180 196 181 178 211 185 190 168 146 190 175 185 195 168 172 168 190 156 188 186 166 190 200 170 161 155 172 165 172 180 190 160 186 167 167 152 162 193 180 148 210 160 190 162 182 182 172 168 165 176];

Table 1 Sample Renal data collected from patients

Target outputs
Classification =[3 1 2 2 1 1 1 1 2 3 1 2 2 2 3 1 2 1 2 2 2 2 2 1 1 3 3 2 2 1 1 2 2 2 1 2 3 2 2 1 2 2 3 2 1 1 1 2 1 1 1 1 1 2 2 3 2 1 1 2 2 2 2 3 2 2 2 3 3 2 1 1 1 2 2 1 3 1 3 3 2 3 1 1 3 1 2 3 2 2 1 2 2 3 3 1 2 2 1 2 3 2 3 2 1 2 2 3 3 2 1 2 3 2 3 3 3 2 1 2 3 2 3 3 3 3 1 1 2 3 3 2 3 2 2 2 3 2 2 2 2 1 3 3 2 1 3 3 2 2 2 2 3 1 1 1 2 3 2 1 2 3 2 2 2 2 2 2 2 2 3 2 3 3 2 2 3 3 2 1 2 1 2 2 2 3 3 2 2 1 1 2 3 1 2 3 3 2 2 3 2 2 1 2 2 3 1 2 2 2 2 2 2 3 3 2 2 2 3 2 3 2 2 2 2 2 2 3 2 2 3 3 2 2 2 2 2 3 2 3 2 2 2 2 2 2 2 1 2 2 1 1 2 2 2 3 1 2 2 3 2 2 3 3 2 1 2 2 2 2 2 2 3 2 1 2 2 2 2 1 2 2 2 2 1 2 2 1 3 2 2 1 2 3 2 2 2 1 2 2 1 2 3 3 3 2 2 3 2 3 2 2 2 1 2 2 2 3 2 2 2 2 2 2 2 1 2 3 2 3 2 2 2 2 2 2 2 3 2 2 2 3 2 2 3 2 3 2 2 3 2 2 3 3 2 2 2 2 3 3 3 2 2 2 2 3 3 2 2 2 2 2 2 2 3 3 2 2 2 2 3 3 3 2 1 1 2 2 3 3 3 3 3 2 2 2 2 2 3 2 1 2 3 2 2 2 2 1 2 2 2 2 2 1 3 2 3 3 2 3 2 2 2 3 2 2 1 2 1 2 2 1 2 2 2 3 3 2 3 2 3 3 3 2 3 2 2 3 2 3 3 3 2 2 2 2 2 2 2 2 3 3 3 3 3 3 2 2 3 2 2 2 1 3 3 2 2 2 3 2 3 3 1 3 2 3 2 2 2 1 3 2 2 2 1 3 3 2 2 2 1 2 2 2 2 2 2];

Table 2 Corresponding target outputs used for training the ANN

6.2 Data Preparation

The data include information on the dialysis prescription, data electronically collected during each dialysis treatment, laboratory tests, pharmacy records, patient diagnosis and demographic data. Before each session, the patient was weighed and her/his blood pressure (systolic and diastolic) registered while sitting (supine pressure), and when possible, while standing. The weight and blood pressure measurements are repeated at the end of the session. The levels of sodium, bicarbonate, potassium, calcium, and glucose in the dialysis solution are recorded.

Total time for the dialysis session, blood flow rate, total volume of blood processed, dialysis flow rate, and the overall average pressures at the arterial and venial side of the blood pump were another set of collected values. A set of measurements was collected by the dialysis machine every twenty minutes or on request. This set includes systemic blood pressure, pulse, blood flow rate, arterial and venial blood pump pressures, trans-membrane pressure, and the rate of ultrafiltration. To reduce data noise, averages were computed over the fifteen readings taken by the machine during the dialysis session.

The demographic and outcomes data set contains the patient's date of birth, gender, and race; the date(s) of death, kidney transplant, and transfer into or out of the dialysis center. The final portion contains the diagnosis codes for the primary and secondary diagnoses. Differences between each patient's average post and pre systemic blood pressures were calculated for all

four combinations of systolic and diastolic pressures and supine and standing positions. The pulse pressures (determined by the difference between the systolic and diastolic blood pressures) were calculated for both pre and post conditions for both supine and standing positions. Differences between the supine and standing pressures were also calculated for both systolic and diastolic blood pressure and for the pre and post dialysis conditions. Some new features were added to the data set by using the concept of data transformation. Averages were computed for each patient for all variables to form a single representative record (aggregate data set). Initial data mining focused on a selected group of long-term dialysis patients with at least fifteen or more visits.

6.3 Selection of data

Selection of patterns for training the neural network is important as they should be representative of all the patterns collected during machining. Therefore, statistical techniques have been used to select the patterns out of 500 patterns collected during the experiment. The number of classes selected are two. Patterns with maximum variance VE_i^2 are selected. The maximum VEi^2 of a pattern is calculated by:

(7)

where

nf is the number of features.

7 RESULTS AND DISCUSSIONS

Data mining has been carried out using an approach of partial individual visit data set mining. The grouping of features for partial data sets was prepared, keeping in mind medical relevance between these features (e.g. dialysis chemical solution, weight, blood pressure, difference in blood pressure (i.e. pulse pressure), etc. Eleven different combinations were determined to form trial data sets. These eleven data sets were mined separately using rough set based and decision-tree based data mining algorithms. Each data subset produced two sets of rules (classifiers), one each from the two data mining algorithms. Thus in all there were twenty-two classifiers capable of predicting the outcomes for new patients. These classifiers were developed to perform multi-angle, highly reliable (parallel redundancy concept in reliability engineering), robust, accurate decisions/predictions. The classifiers can be combined to form a single classifier, which could be used for prediction of new patients or individual classifiers could come with their own prediction and these predictions, could be combined by using voting/weighted-voting schemes. There was considerable increase in the prediction accuracy of individual visit over the aggregate data set

7.1 Medical Significance

The significant features identified by data mining algorithms are as follows diagnosis, time on dialysis, deviation from target weight, blood pressures ranges for different patients, calcium and potassium levels in dialysis solution, total blood volume, blood flow rate, venial pressures. Table 2 gives the classification performance and Table 3 gives the amount of misclassification for different number of nodes in the hidden layer of the network

SL. No	No of Hidden layers	Classifications		
		I	II	III
		53	116	62
1	5	49	92	59
2	6	49	92	59
3	7	51	90	58
4	8	51	90	58
5	9	52	88	60
6	10	51	92	59
7	11	51	92	59
8	12	50	92	57
9	13	48	95	60
10	14	52	82	56
11	15	52	82	56
12	16	50	98	59
13	17	46	99	60
14	18	50	91	53
15	19	50	92	51
16	20	49	78	33
17	21	41	96	60

TABLE 3: Effect of nodes in hidden layer and percentage of classification

8 CONCLUSION AND FUTURE SCOPE OF WORK

This work addresses the problem of recognition of visual types of renal artery lesions from radiological signs. Important issues are related to this work, in particular the determination of a visual type independent of the observer. To evaluate the extent to which the result of the classification is objective, we need to establish a 'significant cases database as well as to justify and validate the quantification scheme used in the domain. Another aspect of this work is to provide a conceptual description of normal and abnormal aspects of a renal artery that can be integrated into a more general medical decision making systems.

The most significant result obtained from this research was to demonstrate that data mining, data transformation, data partitioning, and decision-making algorithms are useful for survival prediction of dialysis patients. The potential for making accurate decisions for individual patients is enormous and the classification accuracy is high enough (above 75–85%) to warrant use of additional resources and conduct further research. Data transformation increased the classification accuracy by approximately 11%. Analyzing and comparing the data mining rule sets produced a list of significant parameters, such as the diagnosis, total dialysis time, potassium, calcium and sodium levels, deviation from target weight, arterial pressure, post-dialysis pulse rate supine, difference between post- and pre-supine.

SL. No	No of Hidden layers	Mis classifications		
		I	II	III
		53	116	62

1	5	4	24	3
2	6	4	24	3
3	7	2	26	4
4	8	2	26	4
5	9	1	28	2
6	10	2	24	3
7	11	2	24	3
8	12	3	24	5
9	13	5	21	2
10	14	1	34	6
11	15	1	34	6
12	16	3	18	3
13	17	7	17	2
14	18	3	25	9
15	19	3	24	11
16	20	4	38	29
17	21	12	20	2

TABLE 4 Effect of no. of nodes in hidden layer and misclassification

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