SOA Based Preeminence in Educational Institutions Using RFID

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Abstract: Educational sector is an important place where we need the proper monitoring and good infrastructure. One can now find educational institutes equipped with some of the world's best technologies like RFID to support Governance. Here the RFID is integrated along with Service Oriented Architecture (SOA). SOA is extendible, flexible and fits well with the existing bequest systems. Replacing bequest systems and processing with new system & technology is not only costly but also introduces risk of malfunctioning. In this context, the habitual software architectures prove ineffective in providing the right level of cost effective and extendible Information systems across the organization boundaries. And here Prototype is developed considering major use cases involved in educational institutions. The system is taking care of attendance record details, securing restricted areas, tracking the assets and the people, quick and secures access in library and Tracking vehicles.

Keywords: Governance, Bequest systems, RFID, SOA.

1. Introduction

In this world we have many levels of Education Institutions starting from schools, colleges and universities. They are classified by their educational structure (courses) and the infrastructure (facilities) of the concerns. A good infrastructure is constituted when it is going hand to hand with some of the global technologies. Educational institutions are first movers when it comes to using technology. The adoption of the technology helps in equipping there standards. One such technology is RFID.RADIO FREQUENCY IDENTIFICATION system helps in the automated security in the educational institution environment.SOA architecture is used for legacy systems which are at the institution provides complete automation through services. Based on the classification, monitoring concerns internally-focused utilization of information and internet technologies to manage organizational resources –human, material, machines – and administer policies and procedures.

The numbers of educational institutions are increasing recently. The automation is sought to manage these institutions. There are very few educational institutions that have complete automation, but don't have a good maintenance or efficient technology to handle it. In addition some of the institutions have isolated automation where they are not interconnected (between departments).There are many processes in the educational institution which follow paper based procedures which lead to the human errors. In turn that leads to the vulnerability in security issues.
There are areas in institution where we need good security functionalities like:

   a) Library: where book theft issues is a major concern.
   b) Laborites: where vulnerability of equipment theft and no proper inventory maintenances.
   c) Attendance: no proper maintenance of the attendances for the students, staff and visitors (existing manual system leads to human errors).
   d) Vehicles: large vulnerability in wrong entry of vehicle records, since it is a paper based registrations.

These limitations are overcome by proper monitoring along with Radio Frequency identification system (RFID).The security system using RFID has been implemented in systems such as: Asset Tracking in Hospitals, Automobile shops, Contactless Payments (implemented in Blue-chip companies such as American Express, ExxonMobil, and MasterCard), Animal Tracking to supervise the conformance of regulations and supply chain management (Fuhrer & Guinard, 2006).RFID technologies are grouped under the more generic Automatic Identification (Auto-ID) technologies (Fuhrer & Guinard, 2006). Examples of other Auto-ID technologies include Smartcards and Barcodes.

Table 2: Comparison of RFID with other AutoID table (Nahas & Deogun, 2007)

	RFID	Barcode	Smart Card
Line of Sight	Not required (in most cases)	Require-red	Require-d (exposed to reader)
Memory	Small	No memory	Large
Cost	Medium	Low	High
Read Rate	Multiple simultaneously	One at a time	One at a time
Security	Medium (Authentication)	Very Low(Coding)	High (Encryption)
Range	Inches to 100's feet	Feet Inches to feet	feet Inches to feet

The security system using RFID in an educational institution may be implemented from scratch. If a system is implemented from scratch there may be resistance in installing a system. The system implementation using Service Oriented Architecture (SOA) provides a way implement a system by using bequest applications. In addition SOA based system is flexible to incorporate changes to due to change in technology, change in standards and change in acquisition and mergers of the institutions. The proposed security system for educational institution using RFID is SOA based implementation.

Section 2gives details about RFID and SOA. Section 3.discusses the architecture and functionality of the proposed system. Section 4.explains the evaluation parameters of the system. Section 5.concludes.

2. RFID and SOA

RFID technology

A typical RFID system (Gal, Martin, J& Lux, 2001) is made up of three components: tags, readers and the host computer system.

Tags - An RFID tag is a tiny radio device that is also referred to as a transponder, smart tag, smart label or radio barcode. The tag comprises a simple silicon microchip (typically less than half a millimeters in size) attached to a small flat aerial and mounted on a substrate. The whole device can then be encapsulated in different materials (such as plastic) dependent upon its intended usage. The finished tag can be attached to an object, typically an item, box or pallet and read remotely to ascertain its identity, position or state.

Readers – The reader, sometimes called an interrogator or scanner, sends and receives RF data to and from the tag via antennae.

A reader may have multiple antennae that are responsible for sending and receiving radio waves. The readers can be fixed or mobile, can read information stored on the tags and write information to them.

Host Computer – The data acquired by the readers is then passed to a host computer, which may run specialist RFID software or middleware to filter the data and route it to the correct application, to be processed into useful information.

The RFID based educational institution can be formed by connecting the system's and RFID .The connection and the communication of the systems can be either by wired (Ethernet) or by wireless (Zig Bee) medium.

Service Oriented Architecture

Service-oriented architecture (SOA) (Thomas Erl, 2005, Viswanath Srikanth b& Austin Laird, 2009) is a paradigm for creating and encapsulating business processes in the form of loose-coupling, autonomous and abstracted services. Service-oriented architecture (SOA) is an application framework.

It focuses on day-to-day business applications and is divided into separate business functions, the so-called services. SOA allows users to construct and integrate these services, and without relying on running applications platforms, thereby enhancing the flexibility of business processes. It produces secure, compatible and extensible application integrated solution for the e-commerce activity. With the adoption of SOA, we can use a set of distributed applications to build new e-commerce application systems, effectively use the existing business functions, and improve the software reuse rate. Web services are software systems designed to support interoperable machine-to-machine interaction over a network. This interoperability is gained through a set of XML-based open standards, such as WSDL, SOAP, and UDDI) (Thomas Erl, 2005, Viswanath Srikanth b& Austin Laird, 2009). These standards provide a common approach for defining, publishing, and using web services.
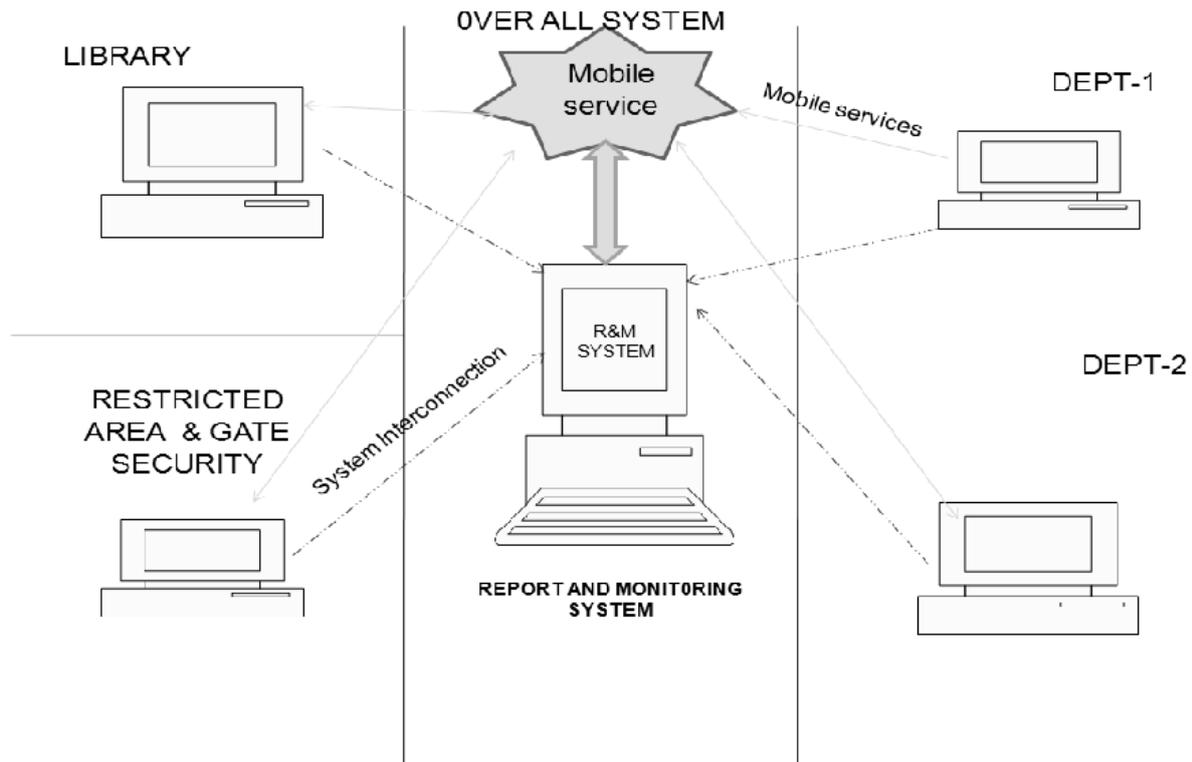
3. Architecture of the System

Figure 1.The architecture of the system

To build the RFID enabled Education Institution, several actors and assets should be tagged:

- ❖ Each employee will be tagged using smart employee card
- ❖ Each student will also be tagged having their unique ID
- ❖ Different office items will be tagged using RFID based labels
- ❖ Each office, classroom, lab will be assigned a unique ID that will be stored in RFID reader unit

Furthermore, RFID reader units are placed at strategic places as follows:

- ❖ RFID reader unit will be placed next to the door of each room
- ❖ Reader unit will also be placed at the Institution entrance and exit
- ❖ Institution cafeteria and common rooms will be equipped with reader node
- ❖ Labs and classrooms will also be having at-least one reader at the entrance and exit

Use Cases

There are several use cases for Education Institution to identify the benefits of RFID like identification, tracking, smart lecture room, office automation, smart lab, room security, smart attendance marking etc. Following, some of the important use cases are defined.

a) Logging in for Student: When the Student Enters the Class they can flash the registered card in front of the RFID Reader which verifies the Student and mark his attendance .also capturing his image using web cam.

b) Logging in for Lecturer: When the Lecturer walks into the office, he / she can flash a RFID card, which then verifies the information stored within the database. Once that is done, the Lecturer attendance is marked.

c) Tracking of person and equipment: Equipments are tagged with inexpensive RFID and their movement from one room to another is monitored. In case of person tracking, both employees and students of the institution can be tracked or their last known location could be revealed. When a person enters or leaves a room, its log is maintained and by applying simple queries to the database server system, the movement of a person can be easily tracked. This helps in immediately locating a person and may cut several ambiguities among employees and students.

d) Securing restricted areas: There are some areas which needs high security and privacy. And there should be proper authentication and authorization for accessing those areas. Example areas like examination wing and server rooms. So the authorized people with authorized tags are only permitted to enter and the door gets open and his identity is captured in flash camera (examination officials). If any unauthorized persons like visitors, students or others, those who try to access the area or cross the area then the RFID reader alert the administrator and locks the room. By this the restricted area are secured and privacy is maintained.

e) Tracking vehicles: Identifying or tracing the institutional vehicles inside the campus in the emergency can be possible and easer by tracing the tags which embedded in the vehicles. And then alerting the driver who is driving it. Even the intuitional vehicles outside the campus can also be monitored by GPS embedded RFID readers.

f) Fast and secure access in library: Since the heart of any educational institution is library and it is a vast place with high mobility. The RFID tag in the books help in fast access and quick issuing process to the students and the books tag are mapped to the student tag for issues. Here the book arrangements (serializing) are automated through the tags. If any disarrangement of books occurs then it is tacked and alters immediately. The readers at the gate point helps in book theft and identify the nonissues books.

Wired (Ethernet): In wired the systems are connected using Ethernet and when a card (RFID) is read by the reader in the concern area then it is reported to the local system (like department system). Then the information is forwarded to the central security and reporting system By SOAP protocols (where the messages are send in the form of XML commands) and it reaches the central system and then to the database. The mobile service is provided here for facilitating the emergency conditions like, when a staff forgets the time table and not engaging the class at time, and then he/she can be alerted through the messages (sms) by the mobile services.

4. SOA Based implementation

The students, staffs and visitors are provided with the active tag. And there provided with some authentication and authorizations. The department central system holds the service like students attendance, staff attendance time table handling, staff alert messages etc.
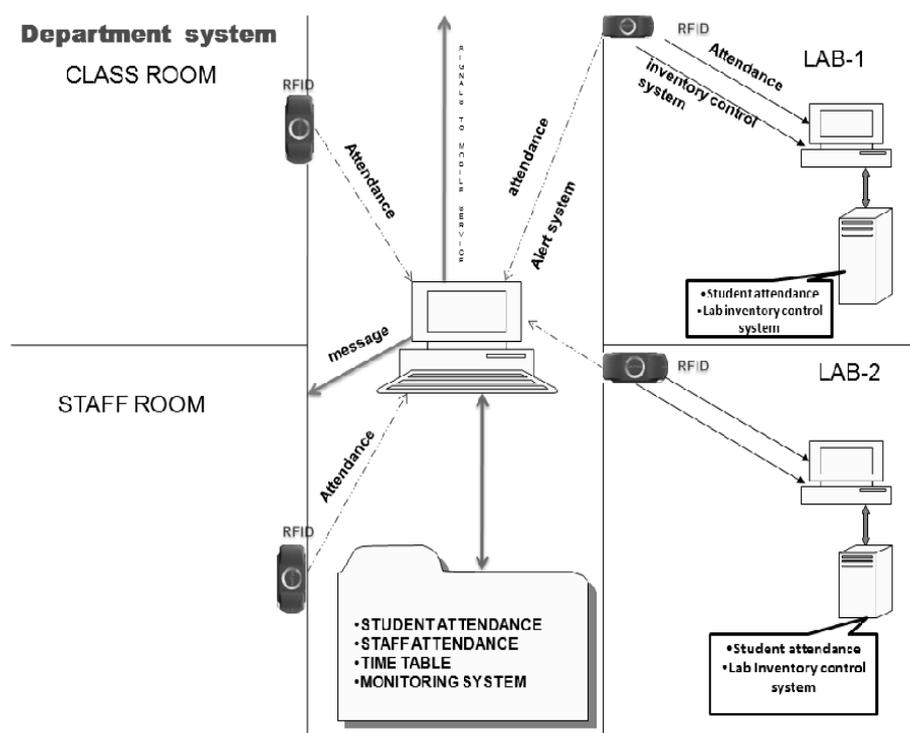

Figure 2. Services in a single department

When a student is entering into his/her class the RFID reader reads the student ID tag and his/her attendance is marked in the department system and his in and out time is also noted. Similarly the staff attendance is also noted in the department system when the staff enters the department. Suppose a second year student enters in the first year class without proper authentication then the department system is alerted, this feature helps to restrict in-disciplinary happening like ragging. The mobile services are used for staff alert and messaging. It is used when a staff forgets and he/she not handling the class on his period time. In such cases the department system uses the mobile services and sends SMS to the concern staff about the time table. Monitoring services: Student authorizations are limited at server rooms and visitors are limited at laboratories. These are restricted areas where they are not supposed to be and if any, then the RFID system will alarm and alerts concern authority. The equipments and files are provided with Passive tags and if any thrift occurs then the RFID system deducts it and alerts the authorities. The missing object can also be traced easily by RFID system.

The library information system helps in good governance in the library using RFID; since all people are given with RFID tags, when they enter the library automatically his/her identity is noted through RFID. And the inventories in the library are maintained properly with help of RFID tagging systems. And when it comes to security the book thrift can be restricted through RFID system at the gates, which alerts on book thrifts when the book crosses without proper issue process.
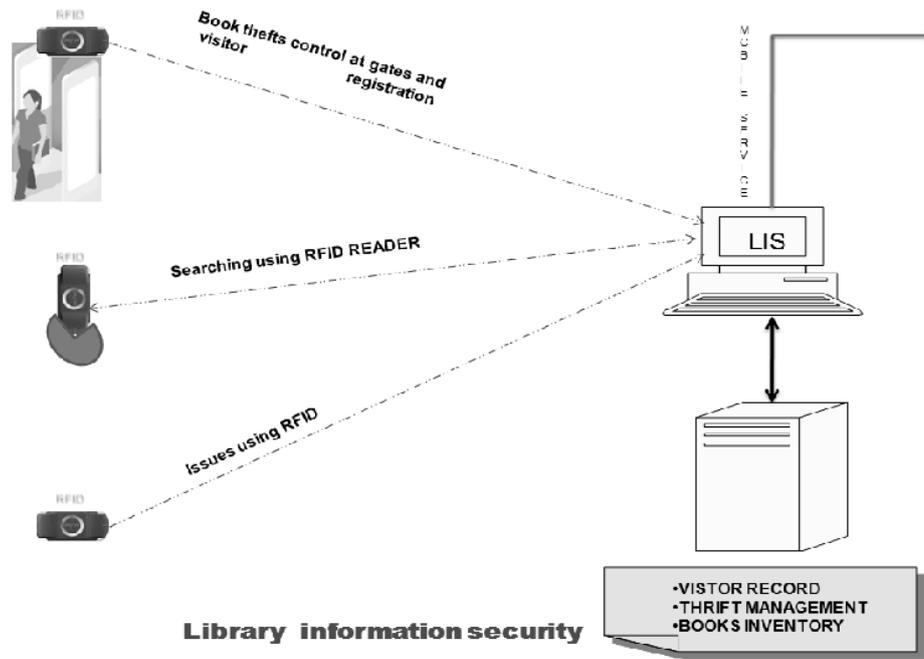
Figure 3. Library Management

The messages service (provided by SOA) provided to facilitate and for security features. The messages here are constructed using XML format and sent in SOAP protocol. Then this message is formulated in the central system (security system) using UDDI and WSDL .The UDDI is a registry which registers the message and UDDI is used to locate the service and process the message to that service.
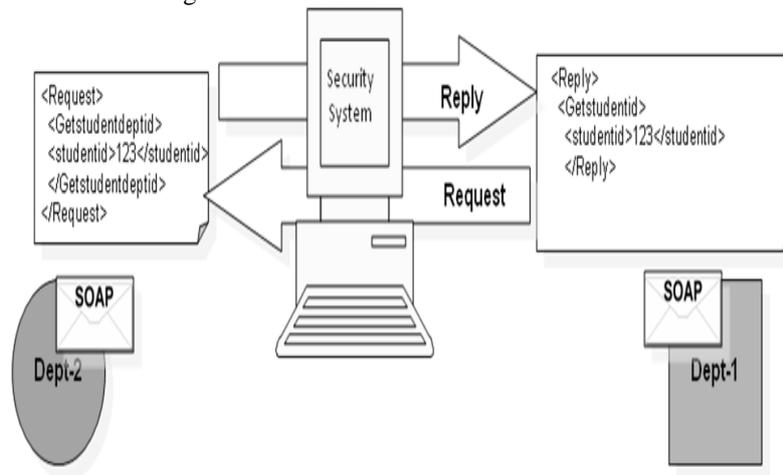

Figure 4.message services between departments

The messages service (provided by SOA) provided to facilitate and for security features. The messages here are constructed using XML format and sent in SOAP protocol. Then this message is formulated in the central system (security system) using UDDI and WSDL .The UDDI is a registry which registers the message and UDDI is used to locate the service and process the message to that service. Here when a person is entering in the department(1), then the RFID reader reads the tag of the person and passes his/her identity to the department(1) local system and his/her entry is marked . But if the person is non-departmental person, then the system checks the tag and forwards the identity to the central system as a message service (xml) through SOAP protocol and then the central system checks EPC CODE (tag ID) of the person and checks his/her department and mapping with the help of the WSDL.Then the messages is forwarded to the concern department(2), and ID is checked by the department(2) local system and verified whether that person is valid to go into other department on that time period .

Then the reply message is send through the central system to the department (1) local system and the department (1) recommended to block or allow the person depending on the reply of the department (2) system message. This message services are cared out in all around the campus like departments, laborites, restricted areas which helps in efficient security and tradability services. Vehicle management system helps in proper vehicle record maintenance through RFID, when a institution vehicle enter there campus the RFID system record the vehicle information like in and out time and the driver information who is riding it.
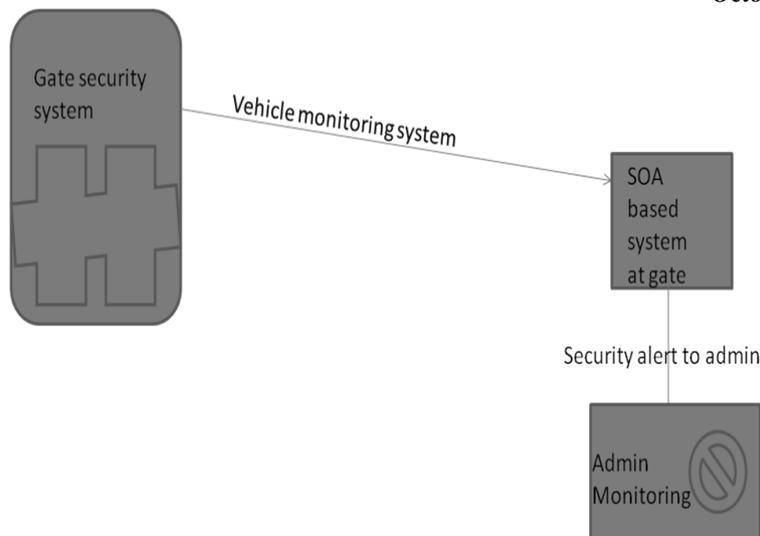
Figure 5. Gate Security

And the vehicle can be traced in the campus on emergencies through RFID. And we can also monitor the vehicle with the help of RFID.

5.   SERVICE FLOW IN THE SOA BASED SYSTEM

In SOA, An orchestration is defined by a workflow, or process execution plan. An orchestration tends to include steps in an ordered or prescribed sequence and with pre-defined interactions. The pre defined inactions are as follows in the RFID enabled SOA based system.

5.1 SOA Orchestration

Student and staff attendance services
Student RFID tag check
If (student entry==correct class)
Mark attendance (timing) and activate flash camera
Else if (student entry==wrong class)
Alert DEPTSYS

staff
If (staff entry==staff)
Mark attendance and activate flash camera

Student traceability service
Student search
[Ser DEPT SYS to SS
Enter the tag ==EPC:code
Locate the person]

Non-department student and student discipline traceability services
Non department Student check
If (RFID tag == non department (EPC))
Ser DEPTSYS to SS to DEPTSYS(EPC)
rly DEPTSYS(EPC) to SS to DEPTSYS
If(id person==permitted)
Allow
Else(inform DEPTSYS)]
Block.

Laboratory attendance and equipments theft control services
Student RFID tag check
If (student entry==correct lab)
Mark attendance (timing) and activate flash camera
Else if (non dept student entry==wrong class)
Alert LABSYS and DEPTSYS

Equipments theft control services
[LAB EQUP==out off lab door(RFID door)
Alert LABSYS and DEPTSYS
If (authorized)
Allow and alert LABSYS]

Library system

Visitors check fast login service
[ser req LIS to SS
req Ss to deptsys
RFID card check with deptsys
rly deptsys to SS to LIS
If(id person==free)
Allow
Else(inform deptsys)]

Fast book searching services
[Enter book id to RFID reader memory]
If (book id match==beep)
Take the book
Else (no match)
Book theft control services
If [book not issued==alert]
Alarm activated
Else (mark entry)

Visitor's traceability services on emergency
[ser LIS to SS
Find RFID tag=epc:code
Locate the person]

Restricted Areas and Gate Security

Efficient, safe entry registration and locking services in restricted areas like examination wing
[If (RFID tag==authorized person)
Lock open, register the entry and activate cc TV camera
Else (unauthorized)
Activate alarm]
Monitoring service for institutional vehicle
[RFID tag==vehicle, driver
Register the entry

6.   Evaluation

The new system can be evaluated using

- ❖ Decrease in number of thief books
- ❖ Proper inventory maintenance
- ❖ No isolated automation since we inter connect all system to gather and which also gives good and efficient e- Governance.
- ❖ No human errors (in record maintenances).
- ❖ Greater attention to improve service delivery mechanism.
- ❖ Emphasis upon the wider access of information (by interconnections).

7.   Conclusions and Future Work

A smart space developed with the use of RFID technology brings numerous advantages and some of them are described in this paper in the context of an Institution. The beauty of the developed system is that it provides these features quite inexpensively. The system works in tandem with RFID reader boards, control circuits and database servers. Facilities like room automation, object tracking, library management, vehicle tracking and theft control are some of the features that can be effectively utilized in any office environment provided by our system. Since it is made distributed systems, it is easy to implement and easy to govern. Since we are implementing with the SOA, which provides a relatively cheap and more cost-effective solution to address problems like introduces risk of malfunctioning of newer

system.More over this proposed system is likely to be implemented in all Engineering College first and if all educational institutions construct this type of system then we can form an interconnection and make an overall monitoring for education department.

The system, however, have weaknesses and prone to trickeries. In future, it is planned to couple the system with biometrics and additional control equipments to cater for misuse and deceit.

References
[1] Ahmed, A., Quraishi, S., Sattar, Z. & Alam, Z. B. (2008) "RFID based Smart Office", unpublished, thesis report.
[2] Backus, M. (2001) "E-Governance and Developing Countries, *Introduction and examples",* Research Report, No. 3.
[3] Bannister, F. & Walsh, N. (2002) The virtual public servant: Ireland's public services broker. Information Polity: The *International Journal of Government & Democracy in the Information Age*, 7 (2/3) pp115.
[4] Bedi, K., Singh, P.J. & Srivastava, S. (2001) government net: *new governance opportunities for India*. New Delhi: Sage.
[5] Fraga, E. (2002) "Trends in e-Government: How to Plan, Design, and Measure e-Government". *Government Management Information Sciences (GMIS) Conference*, June 17, Santa Fe, New Mexico, U.S.A.
[6] Fuhrer, P. & Guinard, D. (2006) "Building a Smart Hospital using RFID technologies", Proceedings of ECEH06, Fribourg, Switzerland.
[7] Holmes, D. (2001) *eGov: eBusiness Strategies for Government*. London, U.K.: Nicholas Brealey.
[8] Howard, M. (2001) E-Government across the globe: How will "e" change government? *Government Finance Review*, vol. 17, Issue 4, pp. 6-9.
[9] Huzaifa Al Nahas, Jitender S. Deogun, (2007). "Radio Frequency Identification Applications in Smart Hospitals", in proceedings of 20th IEEE international symposium on Computer-Based Medical Systems (CBMS 2007), pp. 337-342, Maribor, Slovenia.
[10] Irani, Z., Al-Sebie, M. & Elliman, T. (2006) Transaction Stage of e-Government Systems: Identification of Its Location and Importance**,** System Sciences, 2006. HICSS *Proceedings of the 39th Annual Hawaii International Conference*, Volume 4, Issue, 04-07 pp. 82c - 82c.
[11] Keohane, R. O. & Nye, J. S. (2000)Introduction, In Nye, J. S. and Donahue, J.D. (editors), *Governance in a Globalization World*. Washington, D.C.: Brookings Institution Press.
[12] Le Gal, C., Martin, J., & Lux,A.(2001) "SmartOffice: design of an intelligent environment", IEEE Intelligent Systems, vol 16, issue 4, pp.60-66.
[13] Mark Weiser, (1991) "The computer of the 21st century", Scientific American, vol 265(3), pp.66—75.
[14] Thomas Erl, (2005) "Service-Oriented Architecture: Concepts, Technology, and Design ", (4th edition) Prentice Hall PTR.
[15] Viswanath Srikanth (IBM) & Austin Laird (Oracle), (2009) "Adoption of Service Oriented Architecture (SOA) for Enterprise Systems in Education", Public Draft 1.0.