

RFID BASED NETWORKED GATE ENTRY CONTROL SYSTEM (GECS)

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ABSTRACT

This paper is about an RFID based smart gate entry control system (GECS) which is developed for the employees of an organization to supervise and record their entry related activity. Entire system is developed with low frequency RFID reader & passive tag at one end & network based application software running at the other end. The developed application with back-end application software provides solutions regarding employee presence in the organization, keep track their transaction, and calculate total work duration within organization. Here we discussed data base technique & logic for automatic report generation related to employee's monthly presence activity. We also discussed about why & how SMTP code can be helpful to develop an auto E-mail delivery feature for the monthly report to the concerned employee's institutional Head.

KEYWORDS

RFID, Data Management Software (DMS), TCP/IP, Client-Server, GECS (Gate Entry Control System)

1. INTRODUCTION

This In the present time when information is key to success, commercial and governmental organization is increasingly required to secure their critical data. Thus this is a most reliable technique for this purpose. People have always used individual traits for identification techniques that have been around for centuries, such as passwords and signatures [1]. RFID has also helped to overcome the assailable signature method which is notoriously insecure and can be ignored. RFID is one of the hottest emerging technologies today. Its use has the potential to affect an extremely wide spectrum of the population (from the technology adopters, to vendors, to integrators, and to users) [2]. RFID tags will be found embedded in everything from cereal boxes to prescription medicines to parts of an aircraft to a variety of other machinery [3]. RFID approach exploits randomized read access control and thus prevents hostile tracking and man-in-the-middle attack [4]. Many organizations need a full proof gate entry system to their employees to watch the entry–exit information, presence status of employee into the organization, total working duration within organization. It is also required to keep record of entry information in a database to post analysis & reporting. Most organizations are equipped with such a facility like smart card system, magnetic card reader & biometric identification. Our developed smart RFID based gate entry control system is a newer kind of system which satisfies all the above mentioned requirement like any gate entry system .Because of being equipped with RFID devices there is no need to direct or line of sight link between employee card and sensing device .This system is not only limited to employee entry control, rather than it is useful to any objects entry or exit control, so it will be helpful to theft prevention of objects by employees. The paper is organized as follows: section 2 describes the features of GECS system; section 3 describing the complete architecture of GECS system. Finally results, concluding remarks and the references related to the work are listed in section 4 and 5 and 6 respectively.

2. ADVANCE FEATURE OF DEVELOPED GECS SYSTEM

There are different kind of gate entry control systems are used in organization having several functionality & feature, but in our developed system some important & unique features are incorporated specially related to employee attendance information these are:-

- ❖ To keep the daily “entry-exit” record of an employee of an institute in centrally distributed and networked environment.
- ❖ Display the identity of the person on different remote host with the help of their tag ID.
- ❖ Database logging of the IN- OUT time & total work duration of an employee per day.
- ❖ Automatic monthly report generation of an employee which includes relevant record.
- ❖ Department wise auto report generation for a month at the end of the month, having the same details as above.
- ❖ Sending of monthly report through auto generated E-mail to each and every group leader at the end of month.
- ❖ Application software development with suitable GUI to database maintenance.

3. ARCHITECTURE OF GECS SYSTEM

As according to the working and distributed nature of the GECS system we model the entire system as per following block diagram given in Figure 1. Entire system is in two chunks of hardware that running application software, which developed as per client-server communication algorithms. The work assignment of GECS client is to initiate communication with GECS Server and establish link for the data transfer through TCP/IP protocol over the network, reading the RF tag of person and send the acquired tag information to GECS Server.

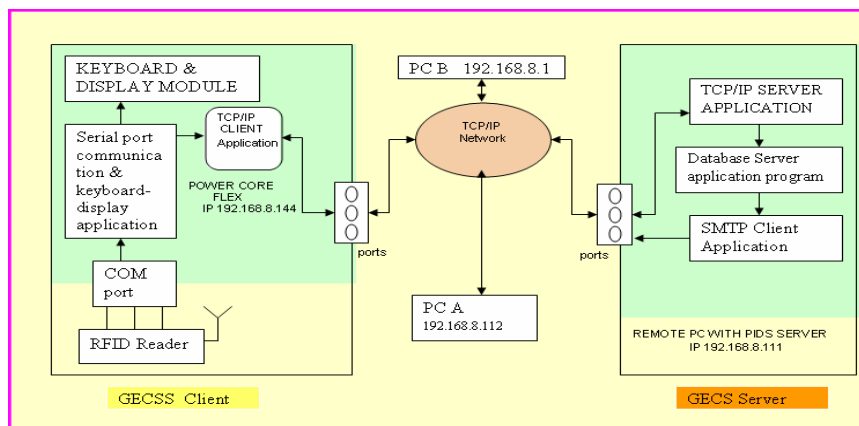


Figure 1. Block Diagram of GECS System

The function of the GECS server is to listen the request of link establishment from the GECS Client, allow them to send the tag data, receiving of data, dispatch the data to Database server, display identity information to the end user, auto and demanded report generation and auto delivery of report to the institution head. GECS client consist of an RF readers developed by Rabbit semiconductor corporation along with LCD display, both are interfaced with a microprocessor based system. This microprocessor based system is used here as a network interface component which takes “received tag information” from RF reader and send to GECS

server through TCP/IP link. While GECS server at other end is basically a Windows OS based PC running application program which comprises all the required features as mentioned above in section 2.

3.1. GECS Client Development

The role of GECS client to read the RF Tag associated with employee ,during transition time ‘to or from’ institute through RF Reader & send the acquired tag information, which will be tag(mark) of identification for that employee, to GECS Server via network through NIC ,which is in our case a Rabbit microprocessor based system. There are two kind of application program developed in Dynamic C 2.1 language, these are:

- ❖ **Serial port interface programme** -it is a code to implement serial port reading through asynchronous communication mode with baud rate -9600 bps, stop bit - 2, parity-none.
- ❖ **TCP Client application-** This part of networked application is developed with socket API provided in library named net.lib of DynamicC to implement TCP/IP protocol at GECS client end.

It follows the client-server algorithm and establishes a communication link to send the tag characters to the TCP server, running at GECS server end .This provide guaranteed connection oriented data transfer environment. The flow chart for developed GECS Client is given in Figure 2.

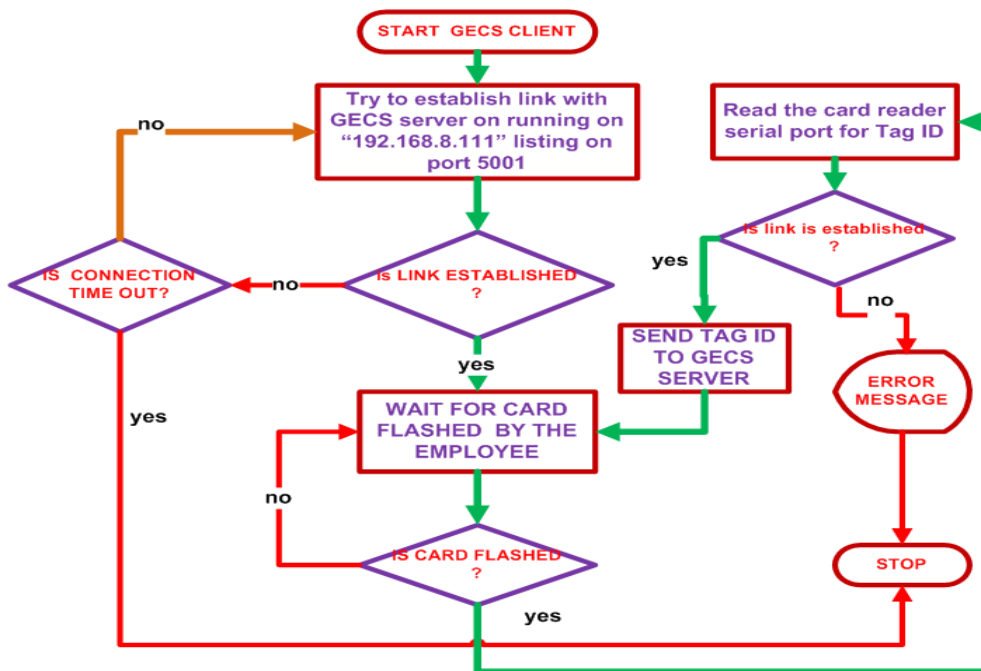


Figure 2. Flowchart for GECS Client

3.2. GECS Server Development

GECS server application contains three thread based parallel executable application developed with the help of Winsock 2.0 & ODBC API in MFC (Microsoft Foundation Class) at Visual C++6.0 platform. The main work of GECS server to receive the tag data from network through TCP server application, which is send by the GECS client and provide this data to GECS Database server for identification & display, attendance information logging, & employee

attendance report generation. GECS server has also a SMTP client which will send the generated report to the concerned group leaders through an auto generated E-mail.

3.3. GECS TCP Server Development

To implement GECS TCP Server in VC++ , we have used CasynchronousSocket (MFC class) as a base class, with the CAsyncSocket as a derived class and socket API function provided by MFC, with this we have implemented the entire modular step of create, bind, listen, accept, read, write & close , which are the necessary steps to implement server algorithm. The entire flow chart for TCP server is in Figure 3.

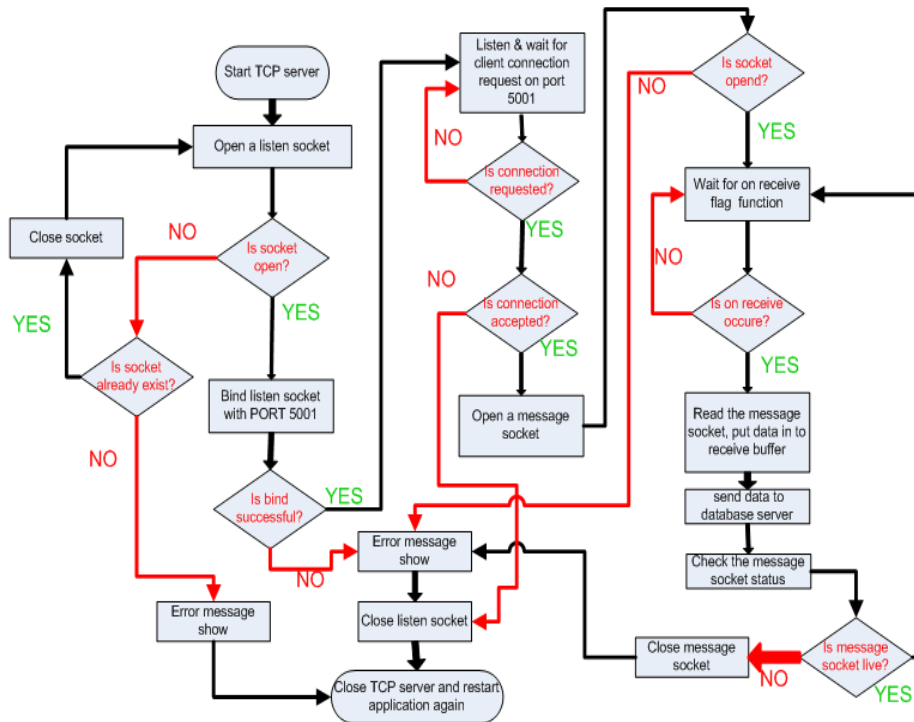


Figure 3. GECS TCP-Server Flowchart

3.4. GECS Database Server Development

Chawathe et al. [5] presented an overview of RFID data management. Very important ingredient of application program development is Database Server development with the help of ODBC API and MFC database classes of VC++. The role of the program is to create a daily record table at beginning of day and at starting of the system, search the concerned employee tag & log (write) employee relevant In-Out timing with current status of entry as well as the other relevant information log, parameterized record searching & monthly report generation at the end of month is also carried out by this server. Database writing or logging is slightly tricky and complex than other operation might be done in the database record table. Because of security purpose of the data source, database uses transaction enabling & transaction conformance command to write new data or update any field value of record-set, these are done by two functions Begin **Transact ()** & **CommitTransact()** function. The flow chart to write data in the database & complete database server are given in the Figure 3 and Figure 4.

The SMTP client is also a client-server protocol based program which is used to send an E-mail to a group of people i.e. all group leaders in our case, with employee attendance record as an attachment. At the beginning of month the database server create a Microsoft access (.mdb) file containing separate employee record table for previous month and save it to some defined place on the hard disk. Immediately SMTP client will make a request for connection to network SMTP Server (already existed for the network) on their specified port 25, after link establishment it will send the E-mail to Mail server which will again route it to network to destined computer. The flow chart of developed SMTP client is given in Figure 6. The SMTP client code uses three classes CSMTPEMessage, CSMTPEConnection, CSMTPEAttachment. CSMTPEMessage class provides member variable & member function to configure To, Cc, Bcc field of the e-mail configuration, while CSMTPEConnection class is used to create connection with SMTP server. Last class CSMTPEAttachment is used to manage attachment string.

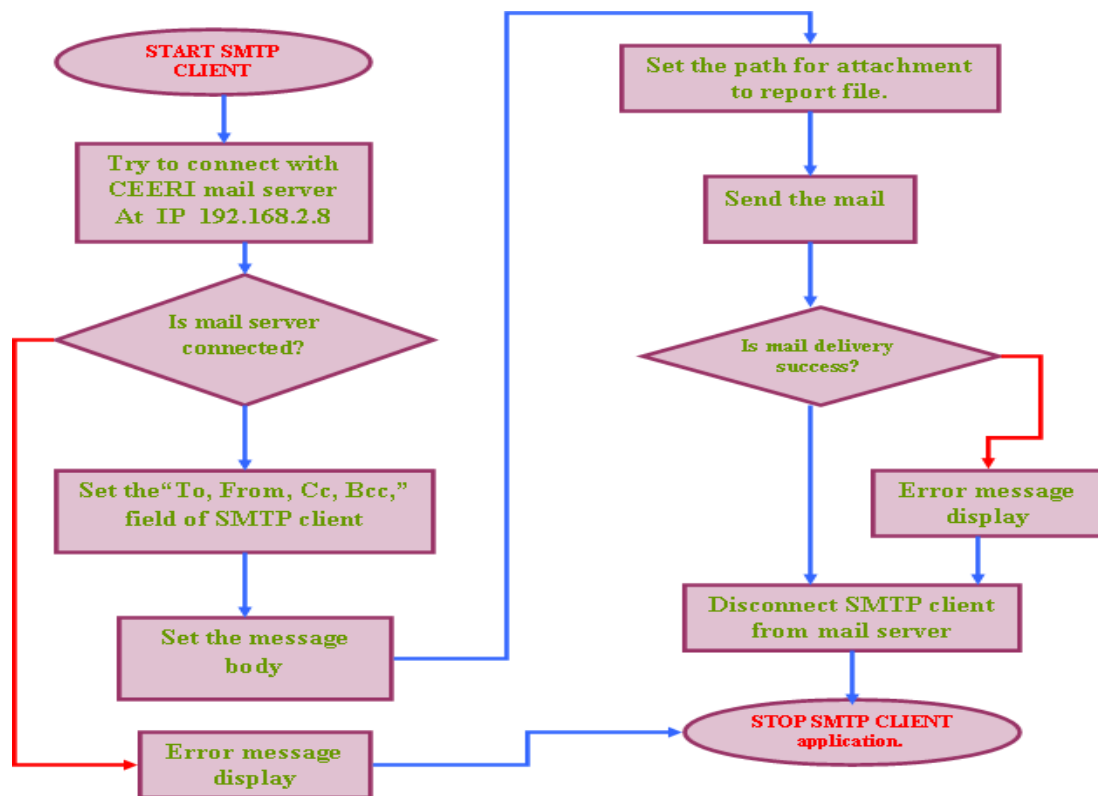


Figure 6. SMTP Client Flowchart

4. SIMULATION RESULT & PERFORMANCE OF THE SYSTEM

With developed prototype system having IP address "192.168.8.144" for the GECS client, & "192.168.8.111" for GECS server listening on port 5001, we tested our system and we got satisfactory result showing in Figure 7.

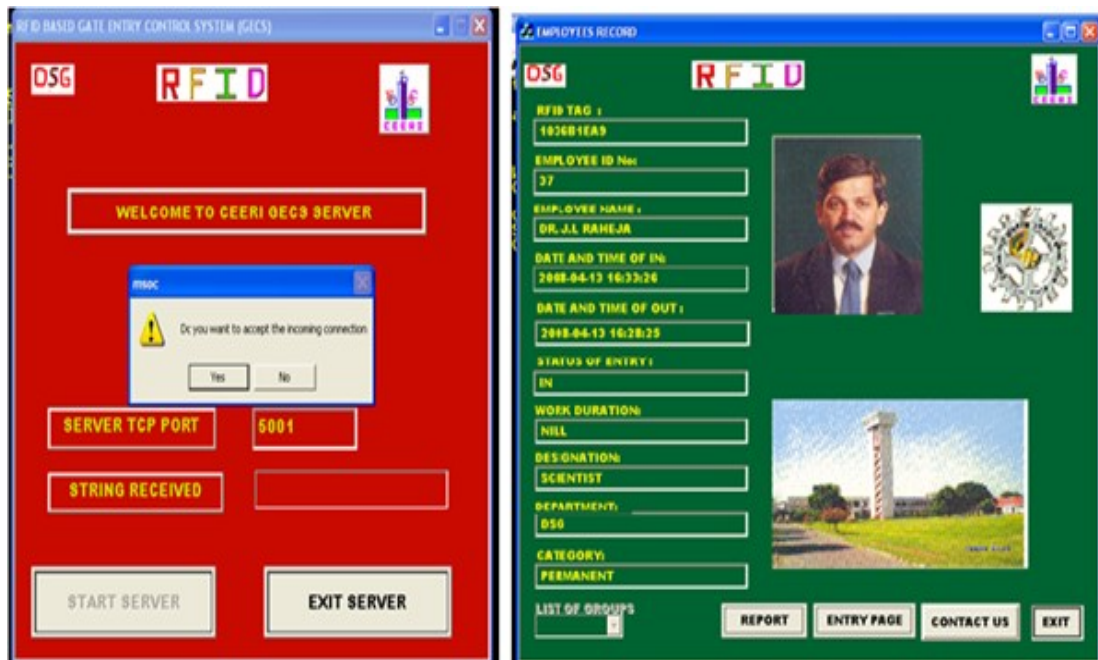
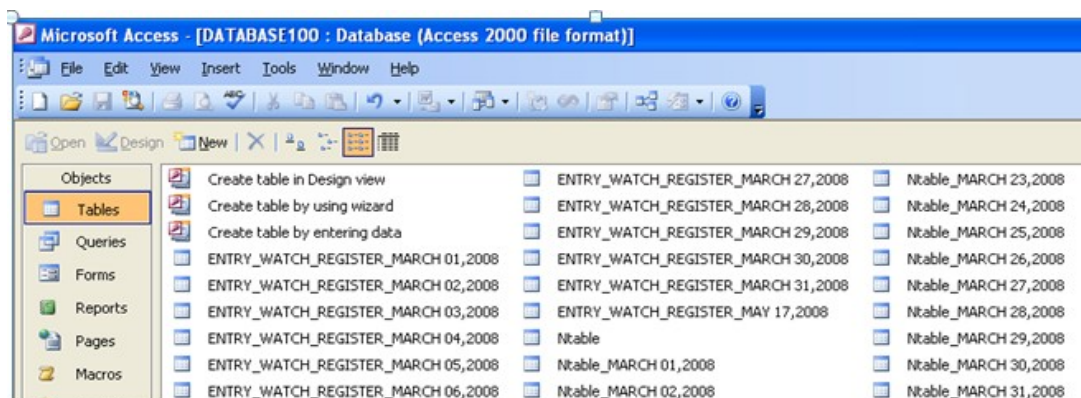


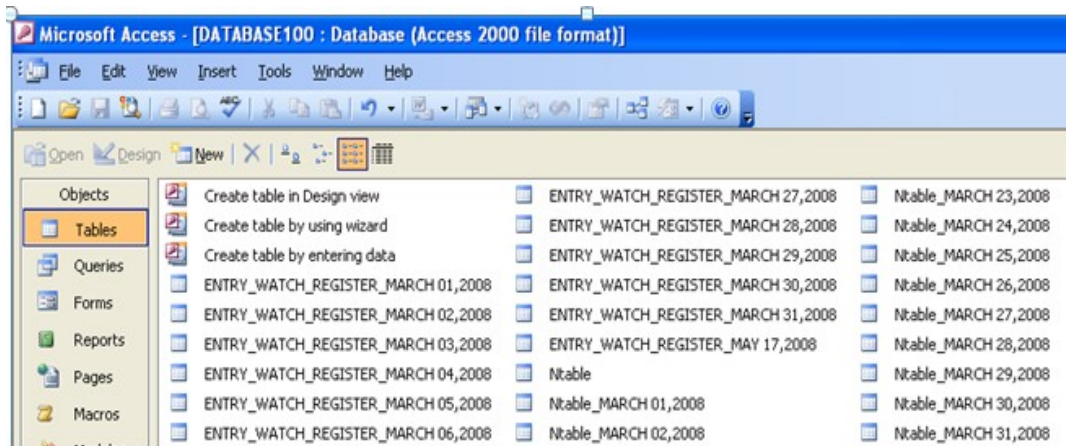
Figure 7. GECS Server accepting connection on port 5001 and Employee identification with record display

4.1. Result of employee In-Out time logging and daily record file creation, with auto E-mail delivery of generated report

Two databases created with data source name (DSN) "mydatabase" linked with DATABASE100.mdb & "emplrecordreport" linked with empreport.mdb. In DATABASE100.mdb daily one record table is created which log the in-out timing and total work duration with other relevant record parameter. The other database file is used to hold the monthly group employee record for reporting purpose which is send by SMTP client to all group leaders. SMTP client make connection request on port 25 of mail server located at IP address "192.168.8.2". Figure 8 (a) and (b) showing the daily record table and data logging status respectively, while Fig.(4.3a) &(4.3b) are showing the group employee monthly report and received e-mail send by SMTP client respectively. To generate manual report for an employee of a group and manage the database information regarding new employee registration an aesthetic GUI for entry application developed in visual C with the help of CDialog displayed in Figure 4.3(c) & (d) respectively.

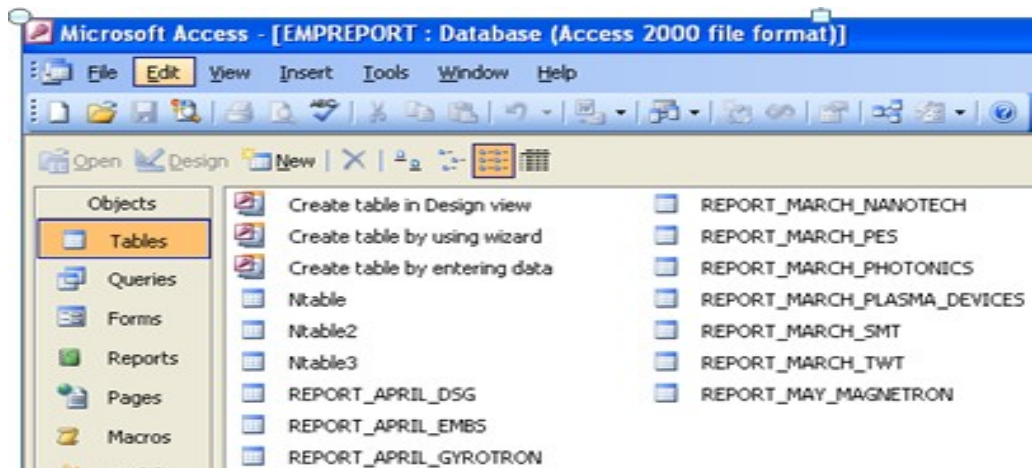


(a)



(b)

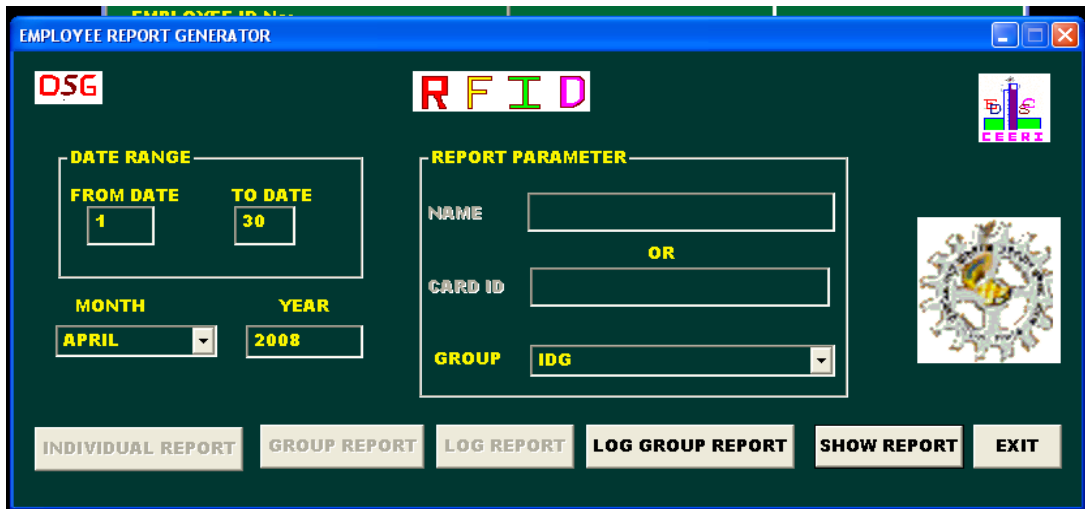
Figure 8. (a) Daily employee record table and (b) in-out data logging in auto created record table



(a)



(b)



(c)



(d)

Figure 9. (a) Monthly group report, (b) Received group report through e-mail attachment, (c) GUI for manual report generation and (d) GUI for new entry in database

Experimental setup of hardware prototype system is shown in Figure 10.



Figure 10. GECS Client system hardware with RFID reader, tag and microprocessor based NIC unit and a RF Tag flashing in front of reader

5. CONCLUDING REMARKS

The developed RFID based GECS system providing satisfactory goal achievement to trace employee attendance & their record with identification, in automated way. The transmission of tag information between the two GECS modules over the intranet link is successfully achieved with guaranteed link establishment through TCP/IP protocol. The successful development of database application for employee attendance logging and reporting is done with the help of RDBMS in an efficient way. The developed SMTP protocol based application for auto-email delivery of the generated monthly report is an innovative approach for such a kind of smart RFID based system like inventory and access control.

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