Design and Implementation of Smart Attendance Management System Using Multiple Step Authentication

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Abstract— **In the traditional attendance system of Bangladesh, the teachers either call the name or identity number of the students to which the students respond or pass the attendance sheet to the students to sign. With the increase of the number of students in the last two decades, the difficulties in attendance management system has increased remarkably. Again, in case of passing attendance sheet to the students, some students sign multiple times and proxy attendance is taken. These two systems are very time consuming. To overcome these inconveniencies, this paper represents a smart attendance system prototype. In this paper radio frequency identification, biometric fingerprint sensor and password based technologies are integrated to develop a cost effective, reliable attendance management system. A desktop application is developed in C# environment to monitor the attendance system.**

Keywords— **RFID, Biometric fingerprint sensor, password, C# language**

I. INTRODUCTION

The rate of literacy is one of the important parameters for the development of a country. The rate and the standard of education in Bangladesh in past few decades have been increased remarkably. The standard of education depends on the percentage of student attendance in class room, student result, quality of teaching etc. In modern teaching system, instructors allot a certain percentage of marks for attendance in classroom. As the number of students is increasing in classroom more, more time is required for traditional attendance systems. The systems are also faulty in many cases. The late comer students do not get attendance in traditional attendance system as a punishment. Proxy attendance is also a problem in present attendance system. In this paper, a three layer identification system is proposed. The attendance management system is also involved in developing a C# application for constant visualization of attendance. In the section II the literature review, in section III the system architecture and identity verification algorithm, in section IV software development, in section V performance analysis, in

section VI comparative analysis and in section VII future work is described.

II. LITERATURE REVIEW

A real time keypad based attendance system with the ability to collect data form EEPROM to a Raspberry Pi server from different wireless sensor node is developed previously [1]. A matric card and barcode scanner based wireless attendance system is proposed by some researcher [2]. Motion sensor and RFID based attendance system with Web ASP.net application is shown in some research [3]. An RFID based attendance and monitoring system which is connected to a database using SQL is developed by researchers at Notre Dame University [4]. In literature [6], RFID is interfaced with Arduino and the data is sent to web for laboratory attendance. A creative system which is based on secret code generation with MD5 algorithm for each student daily integrating near field communication technology (NFC) is also developed [7]. This work also developed desktop, web and android application. Near field communication technology is also used in [8], to check the attendance of students in Kasetsart University at Si RaCha campus. An excellent system combined with NFC and biometric fingerprint identifier is used for the development of an electronic voting machine recently [5]. An online attendance system where automatically warning letter and graph charts are generated has been proposed by some researchers [9]. Web based attendance system is offered in literature [11] and [12]. The authors of [13] and [14] proposed the integration of biometric fingerprint sensor with zigbee for attendance system. Researchers of University Teknologi MARA Malaysia also developed barcode type attendance [15] which is very much similar to the system describe previously [2].

III. SYSTEM ARCHITECTURE

In this system the main processing unit is arduino mega 2560. The developed system consists of a fingerprint sensor, RFID reader and tag, 4X4 keypad, 16X2 LCD display and a personal computer. The brief description of the architecture of the system and verification algorithm are given below.
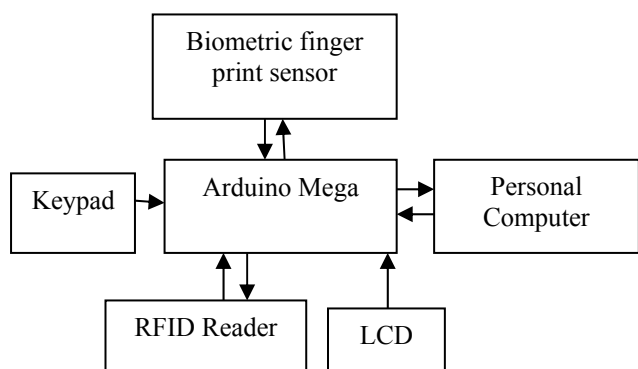
Figure 1. System Architecture

Figure 2. Finger print identification [16]

a) RFID reader and Tag: RFID stands for Radio Frequency Identification. The modern RFID systems are better than the barcode system and system which employs near field communication (NFC). The RFID system widely used in access control, goods identification, passport, tracking vehicle, people etc. RFID tags are three types which includes active, passive and battery powered. The passive tag does not need any external power and this type of tag is used to develop this system. The RFID readers are also three types namely active reader passive tag, active reader active tag and passive reader active tag. The first type of reader is used in this work. At first RFID reader sends a specific radio frequency when the RFID tags are brought near it. As the tag is exposed to the specific radio frequency, it will respond and send a unique tag number to the RFID reader. The RFID reader and tag is interfaced with the processing unit via UART communication.

Since the reader is interfaced with the processing unit, unregistered tag number will be detected. Here Grove - 125kHz RFID reader is used.

b) Biometric finger print sensor: The method of recognizing a person's physiological or behavioral characteristics is known as biometrics. Some unique physical creed of human being includes fingerprint, iris, voice, facial pattern etc. Biometric finger print sensor GT511C1R by ADH tech is used to develop this system. The sensor has 32 bit ARM cortex M3 core. Its maximum identification time is less than 1.5 seconds. The DSP chip inside the sensor identifies the finger print using SmakFinger3.0 Algorithm. At first the finger prints need to be registered to the finger print sensor. This process is known as enrollment. Enrollment of finger print sensor is done with an input ID. For the enrollment of two successive finger print to the sensor, the sensor enrolls the first finger print and waits for the the removal of the finger from the sensor. After the removal of finger the sensor selects another ID for which it will enroll the next finger print.

For the verification of the finger print, the host at first sends the verify command. After receiving the verification command, the finger print sensor scans the finger print. Then after processing, the sensor sends the ID number i.e. acknowledgement byte to the host device if the fingerprint is registered previously. Otherwise the sensor will not send acknowledgement byte to the host device.
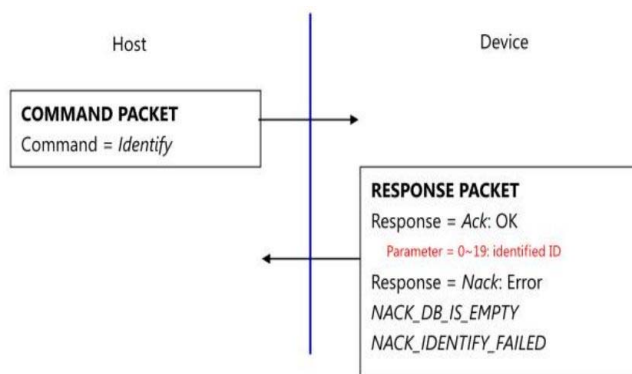
c) Identity Verification:

The identity verification of the system requires three layers of authentication. If any one of the authentication is failed then the next authentication step will never execute and the system will terminate its operation. The three layer identity verification is accomplished by the algorithm which is described in the following figure 2.
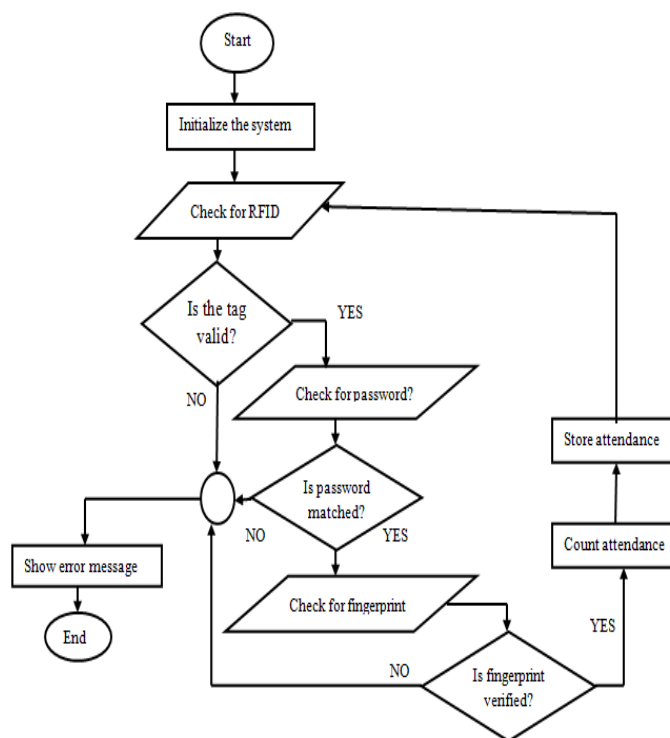

Figure 2. Flow chart for Identity verification

IV. SOFTWARE DEVELOPMENT

Visual Studio 2012 has been used to develop a windows application in C# language. In this application the instructor or the teacher must give his specific password to access the software. The students can't access this application due to password protection and to avoid any misuse of this software. After log-in procedure, the teacher can connect or disconnect the hardware device with the software. The course teacher

name and the course number are then showed on the application. The students are then allowed to give their access parameters to the hardware device for attendance. If the student ID is verified then the software saves the student ID, student name and percentage of attendance in a text document. A serial port object has been instantiated to receive data from hardware device. When the device connect button is pressed the specific serial COM port is opened and the textbox under this button shows device connectivity status. A data receive event handler has been used to receive data when serial port event occurs due to incoming data on serial receive buffer.
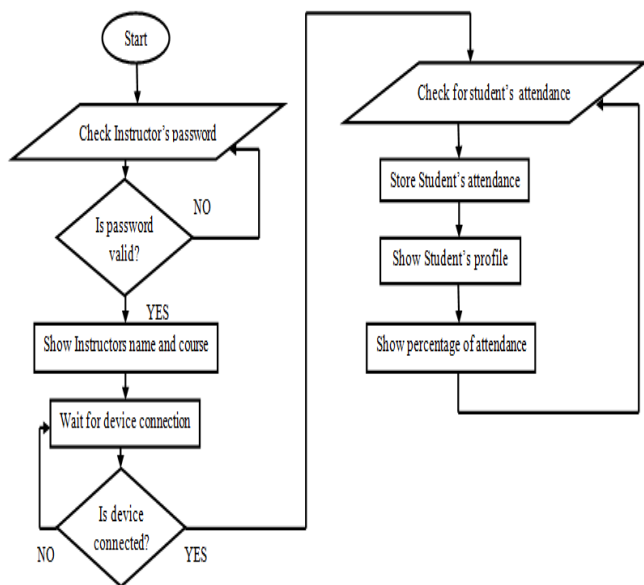

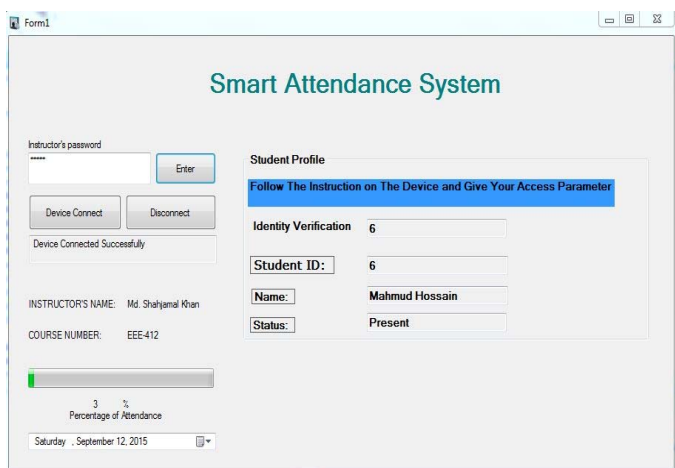Figure 3. Flowchart of the desktop application

Figure 4. Desktop application

V. PERFORMANCE ANALYSIS

The performance evaluation of the system is done in different ways. The system is shown in the figure 5.
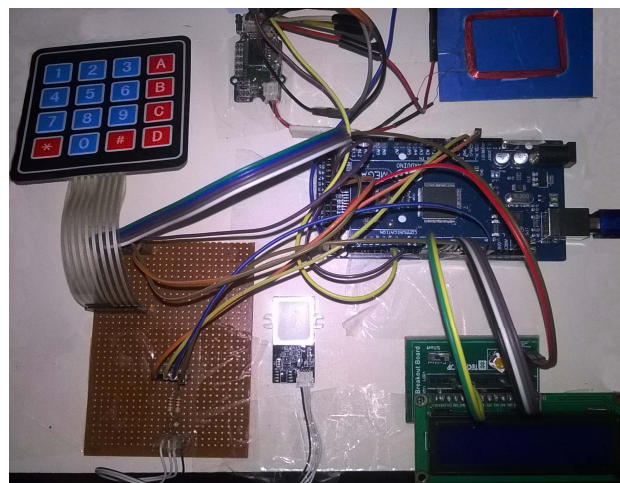

Figure 5. Smart attendance system

A. Unencumbered Interfacing:

Both the hardware and the software interfacing has been made user friendly, so the operator need not to be trained. Since modular design is adapted, interfacing the hardware is easier. This also provides advantage in replacement and maintenance of any subsystem. The hardware provides digital output to the processing unit which is more immune to external noise. The developed system performance shown in the figure 6
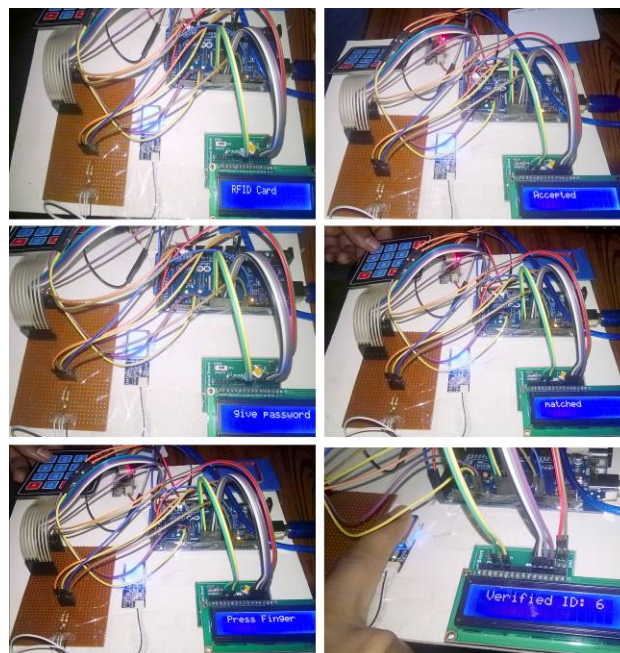

Figure 6. Operation of Attendance system

B. Cost Analysis:

Even though cost of fingerprint sensor and RFID module is moderate, the system works perfectly. As it is a prototype design and modular too, the costing for this prototype is considerably high. But if the whole system is developed and

integrated commercially then cost effectiveness of the system will be increased. If the Arduino Mega 2560 is replaced with low cost Atmel or PIC microcontroller chip then it will minimize cost considerably.

C. Fast Response Time

The response time of the system is moderately fast. If the finger is placed properly then typically it will take less than a second for identification. As the RFID data receive task is serial interrupt driven, the response for RFID identification is very fast. Though the keypad response time depends on user input, efficient use of the system keeps the response time remarkably less.

VI. COMPARATIVE ANALYSIS

The following table shows the comparative analysis between the proposed system and the similar types of systems that were developed previously.

Table I : Comparative Analysis of Different System

Authors	Password	RFID	Finger print	Others
Shailendra et al. [1]	**Yes**	No	No	No
M. I. Moksin et al.[2]	No	No	No	**Barcode**
M.A. Abas et al.[3]	No	**Yes**	No	**Motion Detector**
A. Kassem et al.5]	**Yes**	No	No	No
T. J. Zhi et al.[7]	**Yes**	No	No	**NFC**
P. Subpratatsavee et al.[8]	No	No	No	**NFC and Image Verification**
N. I. Zainal et al.[11]	No	No	**Yes**	No
M. Basheer K. P. at el.[12]	No	No	**Yes**	No
L. Jian-po et al.[14]	No	No	**Yes**	**Wireless**
E. Peter U et al.[15]	**Yes**	No	No	**Barcode**
Proposed method	**Yes**	**Yes**	**Yes**	No

In the above mentioned table, it is seen that only one or two step authentication for attendance is used in most of the methods. But the proposed method shows three steps of authentication which make it more reliable.

VII. FUTURE WORK

In future, this work can be improved by incorporating IoT applications with the existing system. If IoT application is incorporated, then the attendance status can be seen from the mobile devices which are connected to the dedicated server. For IoT based attendance management system, GPRS & light weight protocol can be used. MQTT is a light weight data transmission protocol. Since small data packet can be used in this system, MQTT protocol will be perfect choice here.

VIII. CONCLUSION

The system described in this paper is for taking general purpose attendance. Though several methods of taking attendance was proposed previously, most of the systems did not integrate more than two sub systems which makes them vulnerable when proxy attendance is given by students on behalf of their absent friends. With minor modification such as face identification, this system can also be used for security purpose.

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