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Smart RFID Based Attendance System Using Arduino

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ABSTRACT: The Recent trends in Information and Communication Technology (ICT) and engineering embrace several applications and processes in a variety of educational and industrial domains in the last several years. Most educational institutions' administrators and corporate organizations are concerned about student and worker's irregular attendance. The conventional method of taking attendance by calling names or signing on paper is very time consuming and insecure, hence inefficient. Radio Frequency Identification (RFID) based attendance system is one of the solutions to address this problem. This system proposed in this research work can be used to take attendance in schools, offices, and public institutions. The proposed RFID based attendance system will provide robust, secure and automatic attendance. The proposed system will use modern technology and support to institutions and parents to deal with most of the problems of existing attendance systems. There are several other benefits of RFID based system such as web-based and mobile interfaces, daily absent report, an automatic SMS alert to parent/guardian, reduce administrative work, improve the ratio of attendance, economical and highly efficient. This proposed system has the ability to uniquely identify each person based on their RFID tag type of ID card make the process of taking the attendance easier, faster and secure as compared to conventional method. Students or workers only need to place their ID card on the reader and their attendance will be taken immediately. Thus, the design and Implementation of this smart system access control to create one of the most popular automatic identification by using Radio Frequency Identification (RFID) tools controlled by Arduino technology is the goal of this paper.

KEYWORDS: Identification, Radio Frequency, Arduino, Institutions, Attendance,

I. INTRODUCTION

The simpler and more effective method for identification is the RFID as it provides an efficient, simple and smart method for unique identification unlike other known smart methods like barcode, optical character recognition, biometric and smart card. The RFID System is much more flexible and open for extensive and wider and possible areas of use. Like transportation and logistics, security and animal tagging, postal tracking, time and attendance and road toll management. RFID tags act as small transponders that respond to queries from a reader wirelessly and transmitting a serial number or similar identifier. Generally RFID system used to design an access control system so that unauthorized personnel won't be able to gain access to restricted buildings or zones. For Access Control, employees used an access badge with RFID chip in it. If the RFID chip code matched with the record code then only the gate opens otherwise it will be closed. The radio frequency identification (RFID) systems are getting popularity from last several years due to several reasons such as economical, time saving, resource saving, reduced effort and easy to implement [1]. It is important to trace inventory for any E-commerce company because of opening new markets such as Amazon, EBay and Ali Baba. The RFID components are developed using state-of-the-art technology to create and read tags. The efficiency and accuracy of RFID systems are improved. Wal-Mart, General Electric, USA Department of Immigration, and USA Department of Defense organizations are already getting the benefits of RFID based systems [2]. A RFID tag is composed of an antenna, a wireless transducer and an encapsulating material. RFID has the ability to identify each object uniquely based on RFID tags. The RFID system consists of two main parts RFID tag and reader. The RFID tag is represented by a small transmitter which answers to the questions or inquires wirelessly, and sending code number corresponding to the identifier. A Reader sends out electromagnetic waves that induce current in the tags antenna. This method does not use for student identification only but it can be used for entering the building or the marketing.[3] The system which is being designed and implemented in this paper is composed from two main parts hardware and software. The hardware is designed by using (RFID, Arduino, and Microcontroller panel) which can reveal special ID features unlike anything else in the card, thus the flexibility and possibilities associated with the RFID system of identification makes it a prime choice for both private and corporate institutions to mitigate and solve attendance, access and identification issues.

II. LITERATURE REVIEW

Gatsheni et al. [4] developed a system to automate the attendance of the students using RFID technology. A tag is issued to each student at the time of his/her registration in the Central University of Technology. The university is currently marking attendance manually. The proposed system is tested only by taking attendance of five students using RFID to conclude results. The proposed research does not cover the loopholes of RFID tag system. The proposed system needs further validation to test in a real time environment to check its effectiveness.

An analysis, of barcode and RFID technologies, was provided in the industrial context [5]. The intent of the proposed research was to identify the commonalities and differences of both technologies. White et al. [5] conducted a case study in a warehouse to conclude the results where both barcoding and RFID technologies were already practiced. The parameters used to report the case study were quantity and type of mistakes associated due to the implementation of barcoding and RFID technologies. White et al. concluded that RFID technology performed better having less mistakes and possessed high performance as compared to the bar coding technology in an operational environment. The reliability of data was low in case of RFID based technology whereas it is high in case of barcoding technology. It is suggested to practitioners that by amalgamating barcode and RFID technologies could provide better results by eliminating the limitations of both technologies but it would be expensive and complex to implement.

Schapranow et al. [6] conduct a research to highlight one of the main limitations of RFID technology that is security. It is illustrated that the security breaches in RFID technology make it easy for hackers to attack the system. A number of attacks are reported using RFID technology such as man-in-the-middle, RFID cloning and spoofing and replay attacks. Controlled signal interferences and data encryption systems can control the vulnerability of RFID technology.

An information management system is developed to take attendance of the students in an academic institute [7]. The student attendance management is using the web interface to mark attendance to replace the paper based traditional style to record present and absent. The main benefits of the web based attendance management systems is that the record of attendance is accessible to the top management of academic institution in the form of detailed, summary and exception reports. These reports can be shared to the parents and guardians to take corrective actions. The information system is developed using model view controller (MVC) architecture. Ajax technology is used to provide the front end interfaces and MySQL database is used to store the data. The main limitations of the attendance management system are time, cost, effort and resources consumptions. The proposed attendance management system is failed to address the problems of the paper based attendance method. It is recommended as a future work to address the main limitations of the paper based attendance marking method.

Srindhi and Ramil [8] conduct a research to address the main limitations of manual attendance marking method. A computerized system is developed by integrating RFID and biometric technology to take the attendance of the students, faculty and administrative staff. The proposed system has two versions that are web and mobile. A student is always needed to register at the time of admission in the institution. A RFID tag is issued with a distinctive code to each registered student and his/her figure prints are also recorded. All the classes are equipped with RFID readers and scanners and the campus is also equipped with the hotspots. The RFID reader will read the tag of each student and scanner will be used to match the figure prints to avoid the fake attendance. There are several advantages of the proposed web based attendance management system such as automation, detailed, summary and exception reports, time saving, less errors, alert status of the students to management, parents and guardians through emails and simple mail message (SMS). The mobile version helps the students about campus events, crowded area, and campus locations using Google map and check the status of attendance in all classes to avoid fines and disciplinary notices. The proposed research addresses most of the problems of existing manual attendance taking method but it is costly to implement. The use of scanner to detect the figure prints of all students is time consuming at the beginning of each lecture especially if the class strength is thirty or above [8].

Sajid et al. [9] propose a conceptual model to mark attendance automatically. The proposed conceptual model uses face recognition technology to mark attendance of each student. Each class room will be equipped with a camera to take pictures of all students from different angles. The proposed automate attendance system will use two databases i.e., temporal and permanent. The temporal database will store the pictures that are taken in each lecture. The pictures will be taken thrice during a lecture i.e., at the beginning, middle and by the end. Gabor Filters or Jets is a popular image analyses tool. The filtering software will analyze the facial features of each student from the group photos. The permanent database will contain the previously stored photos of all students at the time of registering them in an

institution. The permanent database contains the mask information that is calculated by facial fiducial points of the students such as nose, lips and eyes. The input photo of each student will be matched with the previously stored photo of a student. The attendance of a student will be marked present if both photos are matched otherwise absent in case of mismatch. The proposed conceptual model is hard to implement, complex, expensive. The proposed model is inaccurate in case of female students wearing veils. The proposed research is a theoretical model and it needs to implement and test in a real scenario to conclude the results [9].

Near field communication (NFC) technology is used to implement an automated attendance management system [10]. NFC is a wireless short range technology but its frequency is high. The communication between NFC enabled devices will only occur if they are in contact or within a close range. The research is conducted to eliminate the limitations of manual attendance marking system. The proposed automated attendance system is composed of three main components i.e., NFC tag, NFC enabled mobile device and a web server. There are three ways to implement the proposed system. In first case, the instructor carries NFC enabled mobile in the class room. Each student is issued an id card with a built in NFC tag. ID card of each student needs physical contact to the instructor's mobile device to mark the attendance. In second case, the student carries a NFC enabled mobile device and NFC smart tag is attached to a poster paper that is displayed in each class room. The attendance is marked automatically as a student will touch his/her mobile device to the NFC tag based poster paper. The instructor and student both carry NFC enabled mobile devices. The attendance will be taken as a student will touch the mobile screen of an instructor. The attendance input is stored in the MySQL database over a web server for data manipulation. The NFC based proposed system is at its earlier stages and it needs testing in a real time scenario to check its effectiveness, economics, practicality and complexity [10].

1.1 Proposed System

There are several solutions proposed to automate the attendance in the last few years to address the limitations of manual attendance system. These solutions are based on automation of attendance system using state of the art technologies such as RFID, NFC, QR scanner, microcontroller and machine learning. After reviewing the existing solutions, this author has selected RFID technology to propose a System because it is cheap and easy to implement. The main advantages of the proposed system are flexible usage, no equipment costs, no wasted time, and easy accessibility. The classroom attendance system is based on face recognition technology, combined with RFID technology. It realized the identity confirmation of the students in the class effectively. Through the real-time test of the algorithm, it fully meets the requirements of the attendance time in the class, reduces the attendance cost of the classroom, and effectively solves the problem of signing and other issues. For the web-server platform, XAMPP software is used. XAMPP is the software that has complete PHP, Apache, and MySQL web development environment. XAMPP software is a free and open source web-server for local development of web-based applications. SQL is a special-purpose programming language designed for managing data held in a relational database management system. The MySQL tool in XAMPP is PHPMyAdmin. To store the unique ID in the student card, MySQL is required. The Arduino is also used as a central processor for the control of all other component including the other input/output units, thus making the system very smart, efficient, flexible for reprogramming and robust for access and identification control.

2. System Design

In the proposed system, we using automatic attendance system by using two step verification which shown in figure. This circuit contains two steps namely as;

1. RFID Tag
2. Face Verification.

In the system, we use the component of Arduino, GSM for short message, keypad, LCD display, and RFID reader for reading purpose. Arduino is an open source protocol. It is mainly used to reuse this. GSM used to variation of time division multiple accesses. A basic 12 button keypad for user input the buttons are set up in a matrix format. This allows a microcontroller to scan the 7 output pins to see which of the 12 buttons being pressed. LCD is a technology used for displays in notebook and other smaller computers. Radio frequency identification uses Electromagnetic fields to automatically identify and track tags attached to objects. The RFID tags having stored the information in electronically stored information. Passive tags collect energy from RFID reader interrogating radio waves. Radio-Frequency Identification system RFID works under the electromagnetic field to identify the tag automatically which is attached on an object. RFID contain two parts such as tags and reader. In the tag, it can be either passive or active tag. The other name for active tags is battery-assisted passive which in builds small battery on the boards and is activated at presence of RFID reader.

- EM-18 RFIR reader module

The EM-18 RFID Reader module operating at 125kHz is an inexpensive solution for your RFID based application. The Reader module comes with an on-chip antenna and can be powered up with a 5V power supply. Power-up the module and connect the transmit pin of the module to receive pin of your microcontroller. Show your card within the reading distance and the card number is thrown at the output. Optionally the module can be configured for also a weight and output.

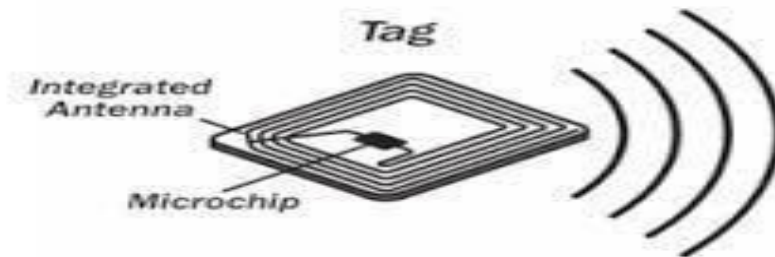


Fig.1. RFID Tag

In the face verification system, we were using MAT LAB algorithms for Face verification. The system waits for images, if the input image enters then searching in the document. Once the input image is gets succeed then moves to mark as attendance. If the system gets failure to input image then sudden move to next step of the system and marked as absentees for the unauthorized students.



Fig.2. Face verification input

2.1 The Arduino

The Arduino Uno is open source microcontroller board based on the microchip ATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USE cable. It can be powered by the USB cable or by an external 9-vot battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Common website. Attribution Share Alike 2.5 license AM.

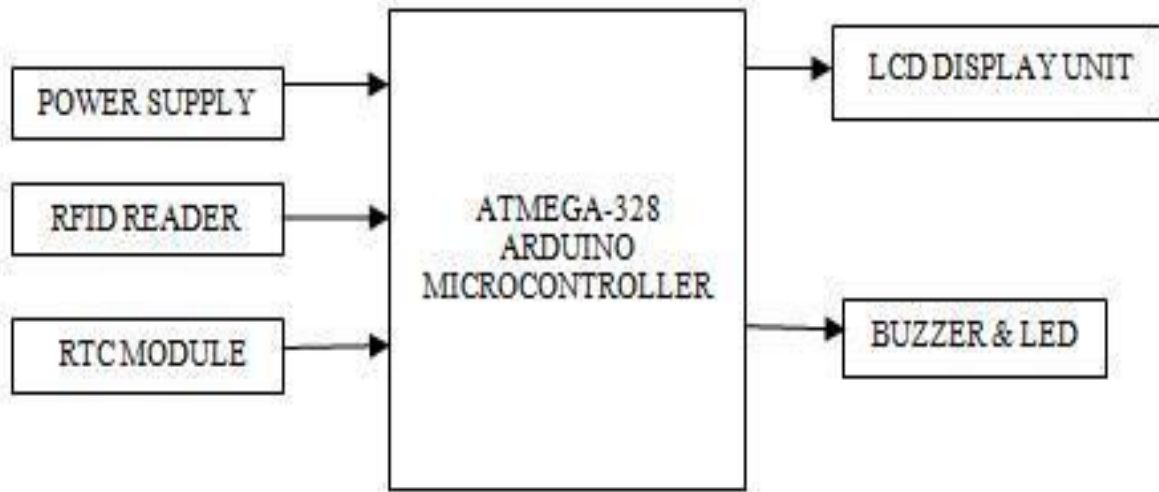


Fig.3. Input and output interface of the Arduino system

Here Arduino UNO acts a central processor for controlling all other components as input/output unit. We have used 5 volt power supply to power all the components used in this project. RFID Reader module is interfaced with Arduino to read the data from RFID Card/tag. Real Time Clock (RTC) Module DS3231 is used to display the current time and date on the LCD as well as arriving and leaving time of the users. LCD displays every output like current date & time, information of users, no of staffs present or absent and menu options from 1 to 4. Red & Green LED is used for the indication of arriving and leaving. Similarly buzzer produces sound whenever the interrupt is detected. The very important part of this block diagram is EEPROM part. EEPROM stands for Electrically Erasable Programmable Read Only Memory. It stores the data whenever the users swap the card over RFID reader.[11]

- **RTC module (DS3231 or DS1307)**

Real time clock is used to keep record off time and to display time. It is used in many digital electronics devices like computers, electronics watches, date loggers and situation where you need to keep track of time. RTC has a CMOS battery. Using DS3231 IC as the main component, several manufacturers developed DS3231 RTC Modules with all the necessary components. Almost all the modules available today consist of an additional IC, 24C32N (or something similar). This secondary IC is an EEPROM IC of 32Kb size. Since both RTC and EEPROM ICs are interfaced through I2C Protocol, you won't need any extra pins as both these I2C Devices can act as slaves while a microcontroller acts as a master. Since RTC is all about maintaining time irrespective of the power supply, you can connect a 3V CR2032 Lithium Battery to the RTC IC to keep the clock ticking. In the DS3231 Module, there is a provision for you to connect a battery using the battery holder provided on the back.[12]

- **PIN of DS3231 RTC module**

As mentioned earlier, DS3231 IC and 24C32 EEPROM IC are the main components on a typical DS3231 RTC Module board. Apart from that, there are a few other components like Power ON LED, few resistors, capacitors, a battery holder and pins for connecting with.

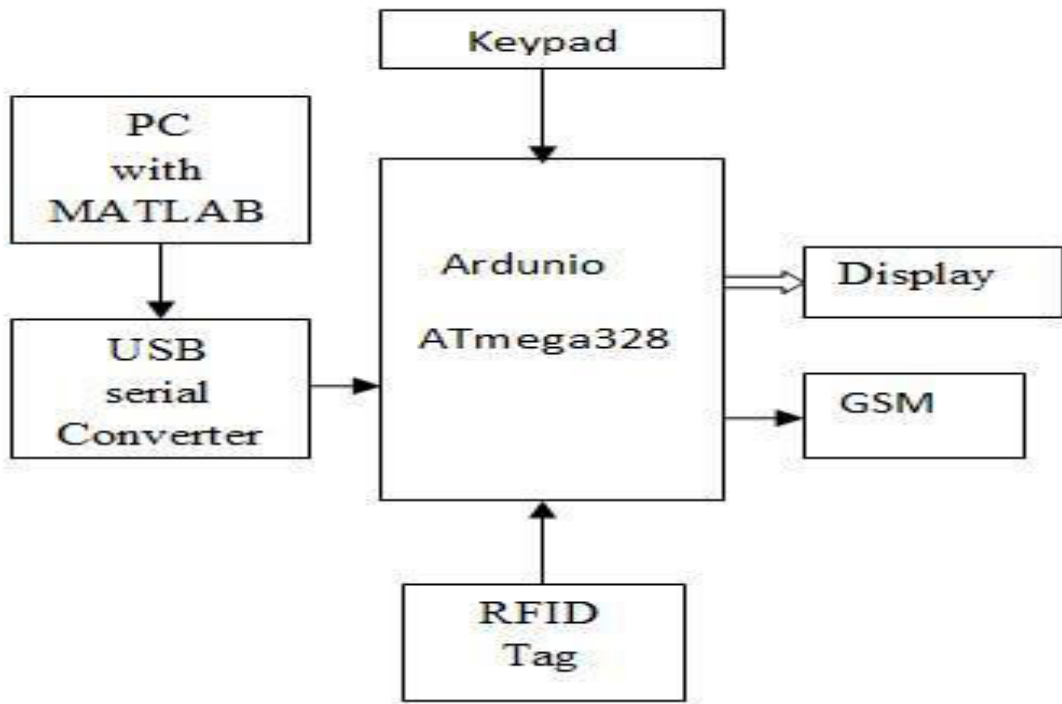


Fig.4. Block diagram of the Entire system

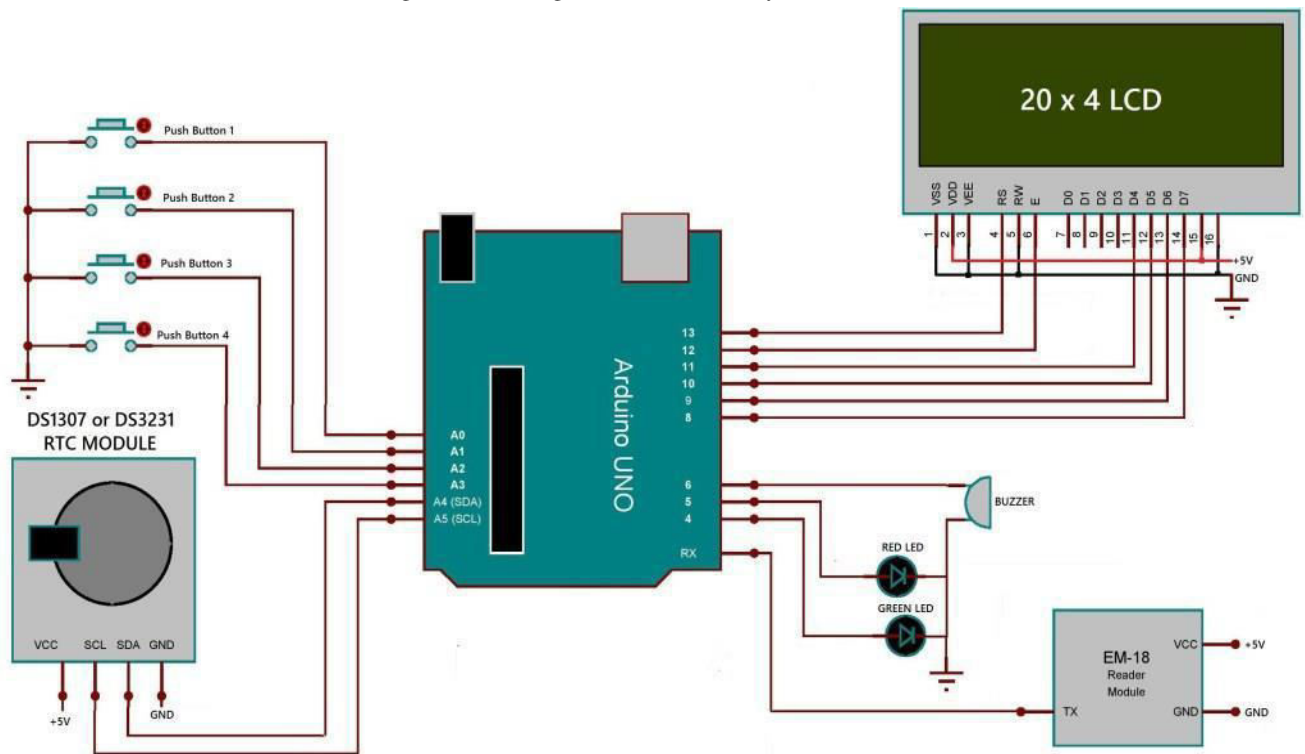


Fig.5. Circuit connection of the project

The RFID based smart attendance system is more secure and fast responded as compared to the other system like biometric. The main advantage of the RFID system is contact-less and works on non-line-of-sight. Tag works in any environmental condition. By using the Arduino platform system becomes more faster in response and while burning the code it is just like plug and play device. User can change the application accordingly by using Arduino. It is very easy to use and very accurate also. Hence this project can be very useful for implementing the real time application for recording the attendance and tracking system as well as providing the security benefits. This project can improve by increasing the range of reader in which the tag read. Further this project can be done by using a method in which the tag encrypts its ID and then send to the reader which can eliminate the capturing of the tag IDs.

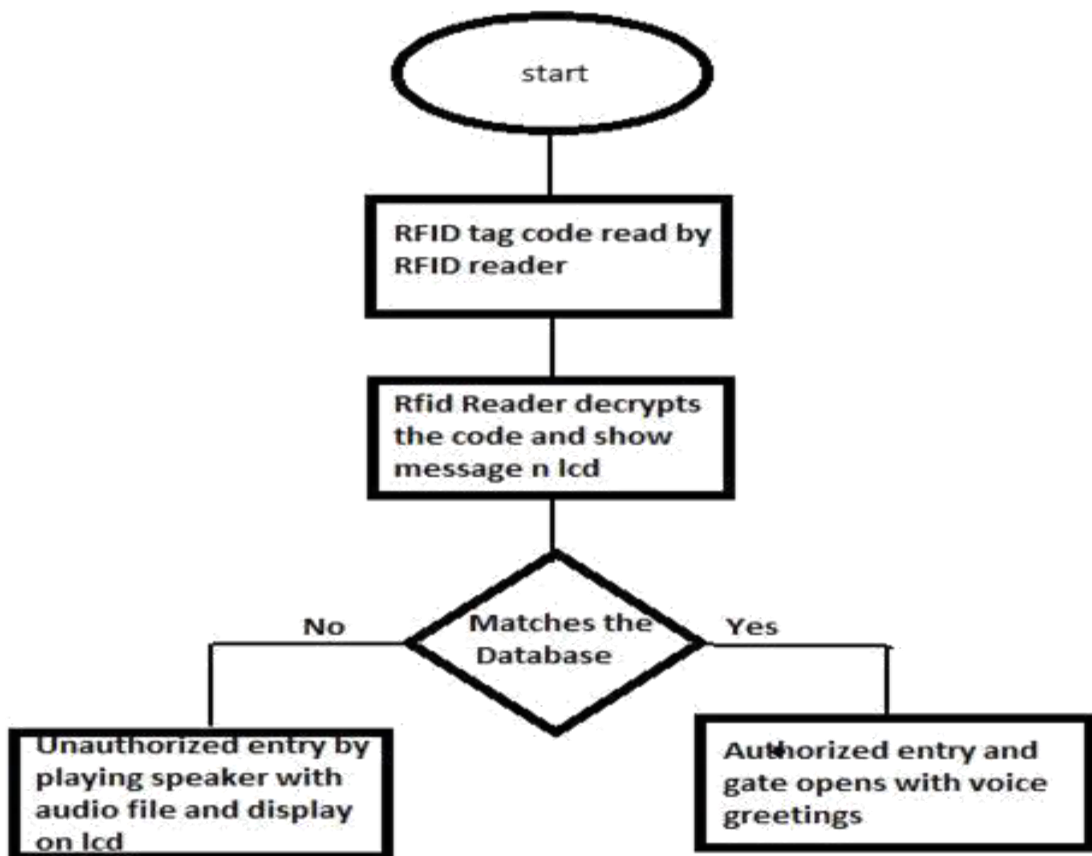


Fig.6.The System Flowchart

IV. TESTING/DEPLOYMENT

This system was tested by using RFID and facial verification .The RFID database contains for both the card number of tags as well as face poses of those captured. In case of encountering difference or ability to match both the tag number with the facial recognition of any one enrolled, or inability to have their card scanned at any particular time, a GSM message would be automatically sent to the mobile number of the one captured and to the officer in charge for confirmation and authentication. Once any one is registered, enrolled and captured, the information is stored in the proxy attendance, and additionally this method helps to find out the absent members. We identify some limitations and discuss future plans for our system. For this prototype, due to laboratory limitations, we invited just five volunteers to participate in our experiments and evaluated the system performance on this basis. However, when the number of people is increased, the detection accuracy may be affected. This is because the more people there are; the more likely they are to have similar body features, which will require that we obtain more refined features. In addition, real-time capability may also be a key consideration for further enhancing the robustness of our system. The figure 4 shows the experimental working of the circuit and also its gives the real time output of our project.

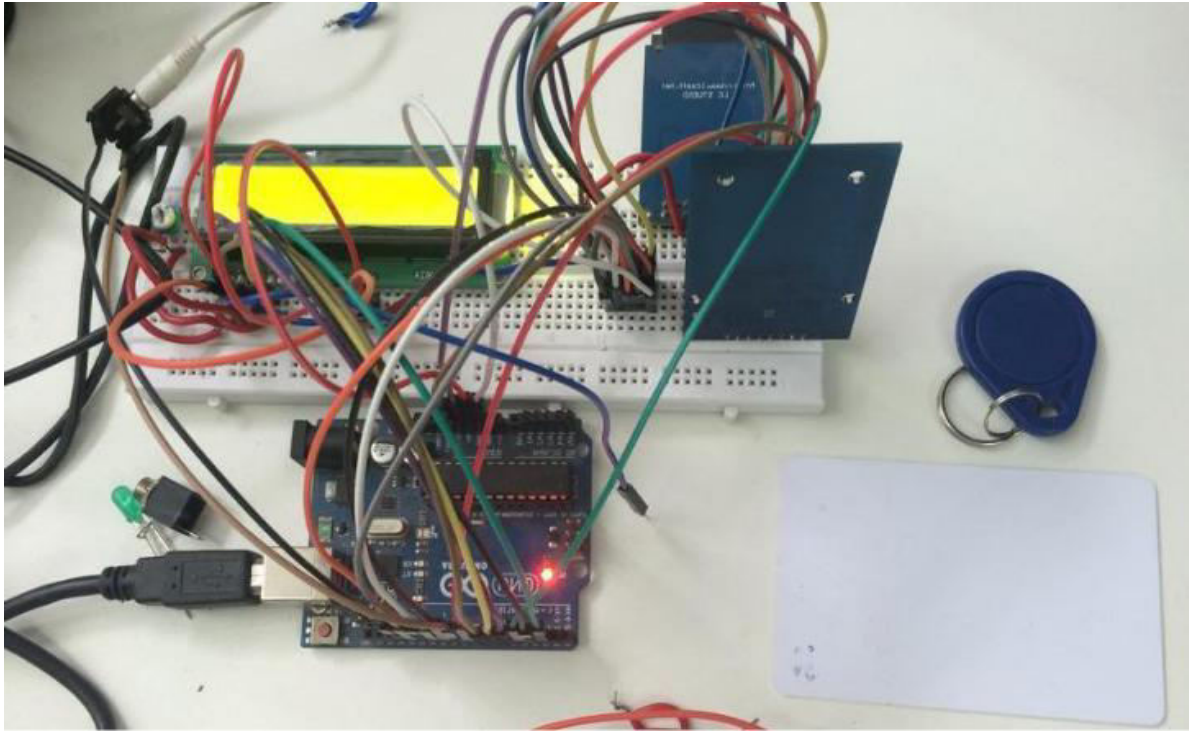


Fig.7. Working Circuit Diagram of Proposed Design

V. CONCLUSION

Our goal is to develop a secure, portable and ready to deploy RFID-based attendance. The system provides a practical and efficient solution for monitoring attendance on a large scale. This attendance system is proposed by using RFID, face verification and absentees record which supports the clients' recognition. This method can reduce the time when compared with another technology. It will record bogus attendance. The performance evaluation using KMN algorithm in Arduino. The main advantage of the RFID system is contact-less and works on non-line-of-sight. Tag works in any environmental condition. By using the Arduino platform system becomes more faster in response and while burning the code it is just like plug and play device. User can change the application accordingly by using Arduino. It is very easy to use and very accurate also. Hence this project can be very useful for implementing the real time application for recording the attendance and tracking system as well as providing the security benefits. In Future this system is would prove very useful and vital for all institutions and organization as the proposed attendance monitoring system uses the concept of IoT to log and fetch data on the server/cloud and make it available for the user anytime and anywhere. For future work, we would also like to give access to students about their attendance, so they can log in and check their attendance remotely. We would integrate the entire system with a mobile phone application so that all functionality is o the mobile itself. Also, we would like to integrate this system with Canvas or Blackboard using XML interface. The RFID based security and attendance system is more secure and fast responded as compared to the other system like biometric. This project can improve by increasing the range of reader in which the tag read. Further this project can be done by using a method in which the tag encrypts its ID and then send to the reader which can eliminate the capturing of the tag IDs.

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