IoT based Touch-free Attendance System (ITAS)

Tamilselvan S1,5, Ramesh R2,5, Niveda R3,5, Poonguzhali P4,5, Dharani S6,7

1Assistant Professor, Department of Electronics and Communication Engineering
2Second Year M.E, Department of Electronics and Communication Engineering
3,4Second Year, B.E, Department of Electronics and Communication Engineering
5Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu 638401
6Assistant Professor, Department of Electronics and Communication Engineering
7Dr. Mahalingam College of Engineering and Technology, Pollachi, Tamil Nadu 642003

tamilselvans@bitsathy.ac.in

Abstract. In this paper, we are proposing a contactless temperature measuring and attendance monitoring system because of the pandemic COVID-19. This design is developed using Node MCU, MLX90614 Infrared Thermometer, RFID Reader, and Ultrasonic Sensor. It measures body temperature with an infrared temperature sensor without any physical contact. An RFID card reader is used for scanning the identity card. The ID number and the temperature of students are uploaded into the webpage. This webpage can be monitored over the internet. The details such as Entry time, ID number, No. of students and temperature measurement are stored in the server and displayed in webpage. An Ultrasonic Sensor is used to measure the distance between the sensor and the person. The temperature sensor can measure the temperature when the distance between the sensor and person is around 10 cm for better accuracy. This system is essential in this pandemic situation to avoid the infections.

1. Literature review

Sarmad Hameeda, et al.3 presented their paper in a journal named Social and Behavioral Sciences 195 (2015) 2889 – 2895 and the name of the paper is “Radio Frequency Identification (RFID) Based Attendance & Assessment System with Wireless Database Records”. This paper focuses on RFID technology which uses automatic wireless identification with the help of electronic pass and active tags for suitable readers. The model uses an application of RFID and wireless data for recorded entries. It reduces time consumption in manual attendance as well as maintains the record of entries which can be used for statistical purposes like attendance score allocation and exit administrative tasks.[1]

Vaishali Ghodekar, et al.4 presented their paper in International Journal of Engineering Research & Technology (IJERT) which is named as “Automated Attendance system with RFID through SMART CARD”. This paper proposes a system based on the IOT application RFID for attendance marking. This system is implemented in classroom where a RFID reader is kept. When the student enters the classroom the reader detect the RFID tag ID and save the student’s last position. Students absence is intimated to parents [2]
B. JoshanaDevi, A. Godavar presented their paper in International Journal Of Innovative Technology And Research implemented Intelligent Attendance System Using RFID with IOT readers. This paper illustrates attendance system which uses RFID tag and Webcam. Students have unique RFID tag which is identified by the when it is within the reader’s range for individual identification. Also number of attempts to swipe is recorded. If the tag is not proper warning is given. This system is used in halls to switch off and on lights. After all students enter the room it is programmed to switch on lights using IR sensor for count detection and after all the students leave the hall lights are switched off automatically [3]

Mahesh Sutar, et al.3 Presented their paper in International Journal of Advanced Research in Computer Engineering & Technology (IJIACET) implemented a Smart Attendance System Using RFID In IOT. This system uses RFID technology to solve the issues in the regular attendance monitoring system in developing countries. This IOT application can save time which is wasted in manual attendance and the system also provides ways to capture data face to face for proper attendance count[4]

Hicham El Mrabet, Abdelaziz Ait Moussa presented their paper in International Journal of Interactive Mobile Technologies (ijIM) implemented paper “IoT-School Attendance System Using RFID Technology”. This paper illustrates the IOT application in attendance system which uses Ultra High Frequency readers and RFID tags (attached to the students id) which are passive. UHF readers can detect tags upto 6 metres range. It collects information of students such as their ID and compares it with the information in the database. For attendance and send the information to the web page at the administrator end via arduino and notify parents through Email or message. It also checks student’s absence and send the notes to them automatically [5]

Joseph Dedy Irawan, et al.3 their paper in MATEC Web of Conferences 164 presented their paper named RFID and IOT for Attendance Monitoring System. This system focuses on a monitoring system for student attendance using RFID by Internet of Things (IoT) and Cloud technology, it is a time attendance monitoring system which can be accessed by various parties, such as lecturer, campus administrators and even parents. The advantage of this system is easy identification of absentees and can help active attendance roll.[6]

Hasanein D. Rjeib, et al.4 presented their paper in International Journal of Advanced Computer Science and Applications implemented Attendance and Information System using RFID and Web-Based Application for Academic Sector. In this system RFID tag is scanned by the reader. This scanned information is sent to the wamp server via Ethernet shield by cable. It searches for the ID of individual student and if found it fetches all information such as Name, stage, class timetable, administrator task and instructions and display it on the LCD. Login page is created separately for students, teachers. [7]

Arulogun O. T., et al.4 presented their paper in the International Journal of Scientific & Engineering Research in the name of RFID Based Students Attendance Management System. This paper aims to provide cent percent attendance during recurrent lectures using the help of RFID technology. The advantage of this system is that it can reduce time consumption, stressful and laborious attendance process during valuable lecture time and make it simple and easy.[8]

RKAR. Kariapper, MS. Suhail Razeeth presented their paper in SSRN Electronic Journal- A RFID BASED (IoT) AUTOMATIC ATTENDANCE SYSTEM: A SURVEY ANALYSIS. This paper discuss about the RFID system, its working advantages over conventional systems where time is
wasted for monitoring students attendance and also speed of transmission of information to the web.[9]

D. E. Mshelia, et al.5 presented their paper inIOSR Journal of Computer Engineering (IOSR-JCE) implemented a project titled “An RFID and Fingerprint Automated Attendance System”. This paper is about an attendance monitoring system in which each individual is assigned with a RFID tag ID and their fingerprint is stored in the database. Students have to place their finger on fingerprint sensors which capture the fingerprint and compare it with the fingerprint in the database and once it is matched the individual is prompted to swipe their RFID tag with the reader. If Id matches with the ID stored in the database attendance for that individual is marked and displayed in the Liquid Crystal Display(LCD)[10]

2. Introduction
The global pandemic COVID-19 had drastically affected the health and economy of the people all across the world. Schools, colleges, small to large manufacturing industries and firms were shut down to stop the further spread of the disease. The impact of corona virus is highly disruptive both in terms of economic growth rate and human survival rate. The economic slowdown was already worse before the full force of the pandemic hit India than the one the Indian economy went through in 2011-12. It was estimated that India’s GDP had contracted by 23.9% for the April to June quarter. This was the first instance of negative growth where India has never experienced an economic contraction in at least four decades. In order to revive the economy it is necessary for a comeback with proper safety measures taken by both government and individual. We have decided to contribute our part in improving the safety measures by designing contactless attendance and temperature monitoring system. Attendance is mandatory to ensure the presence of individuals in an already scheduled event, schools and workplaces. This system uses a infrared temperature sensor to measure the temperature without contact and RFID card reader to check the attendance of each individual. Roll number and temperature of the individual along with the time are sent to the webpage and gets stored in the cloud for future reference

3. Existing Work
3.1 Traditional attendance:
Traditional attendance or manual attendance is based on the person who takes the attendance on registers or sheets. Even though this is practiced for a long time it is prone to errors, switching of data of different individuals, and it takes a lot of time. Rectification of these errors can also be tedious if there are so many users. These may end up with inaccurate data entry because the person who enters data may not be perfect all time. The major drawbacks of this are a high possibility of human error and no integration with other systems.

3.2 Biometric Fingerprint attendance system:
Biometric Fingerprint attendance systems are widely used in colleges, offices, and other workstations. It is the most commonly used in this digital world as of now. A thumbprint of an employee is used to mark attendance. A major drawback of this system is seen only during this Pandemic. Continuous sanitization and monitoring of every individual are difficult in this kind of attendance system.

3.3 Time card:
Time card is also a type of attendance system which is largely used in corporate companies. This attendance system is one of the least expensive and advanced versions of old mechanical punch clock. Time card is similar in size to a credit card. The users are issued with a time card and users mark their attendance by swiping these time-cards in a machine which is similar to a Card Swipe POS Machine. While they are swiping their card, the data is transferred automatically to the computer generated timesheet. However, this system may be high tech but there is always some error in human inventory. Drawback for this system is that it is easy for someone to swipe other acquaintance’s who might not be present in that expanse.
3.4 Proximity Cards/Badges/ Key Fobs:
These types of systems are few examples of contactless attendance systems. Proximity cards are smart cards which are used for marking attendance. These cards are touchless which can mark attendance without any swiping as in time cards. We can also describe proximity cards as evolved versions of time cards. When these cards are held near a reader for marking attendance, they enable the identification of an encoded number. The electronic reader usually produces a sound such as beep to indicate the card has been read. Drawback for this system is that it is easy for someone to take their acquaintance’s badge to mark fake attendance that might not be present in that expanse.

3.5 Web-Based Login Stations:
Web based login stations are also known as digital punch in. These types of attendance system are used in companies where staff works mostly on personal computers. A static IP address is whenever employees log in to their personal computers for work purposes. Staff can punch in and out from their computer or mobile device. Mobile punching disabled can be for staff when they can't use their computers. Employees have options to view their time cards, request PTO and more.

4. Proposed Work

![Flow chart of the ITAS working](image)

Figure 1. Flow chart of the ITAS working

NodeMCU is an open-source platform developed for IOT applications. It uses a firmware which runs on ESP8266 Wi-Fi Module and a hardware which uses a ESP-12 module. It uses lua programming language. It is a better option when it comes to power consumption since it uses specialized chips which have power saving features such as deep sleep mode. It does not require additional modules for Wifi because it has integrated ESP-12 Wifi module. Overall Board size and cost is low. EM18 RFID Module uses radio waves for activating the tag when it comes in close proximity to the reader module.
After being activated it transfers the information to the reader in the form of binary data which can be accessed by the microcontroller or PC through UART communication. A MLX90614 Infrared Thermometer is used for measuring the temperature by using the IR energy emitted by the individual. An Ultrasonic Sensor is used to measure the distance of the individual from the temperature sensor by emitting ultrasonic waves. The NodeMCU, MLX90614 and the ultrasonic sensor are connected to the internet (WIFI) through the user ID and password.

The user has to place the ID tag over the RFID scanner, the ultrasonic sensor measures the distance between person and temperature sensor. The ultrasonic sensor measures the distance and checks if the person is within 5-10 centimeter range. If the person is not within the range then an OLED is used to display the comment “come closer”. When the temperature between the sensor and the person is less than or equal to 10 centimetres and if the card is valid, data from the scanner is checked with predefined Tag ID and if it matches temperature is measured by the MLX90614 Infrared Temperature Sensor without any physical contact. If the measured temperature is greater than 98.7°F then an intimation is sent to the higher authorities in the management and also the particular student’s details get stored in the database and displayed with red marking table. But if the temperature is within the 98.7°F then the student’s basic details get stored in a database and displayed with green marking. ID number, Roll Number, temperature data and other basic details are then sent to the web server. Then by entering the IP address in the web browser which is displayed in the serial monitor, a request will be sent for receiving the data from the server. The Basic details of the particular student is then displayed in the Web page along with the time and the data is stored in the cloud for future use. Students and faculties will be able to check their data and also generate weekly reports.

4.1 PCB Design & Implementation:

![PCB Layout Diagram of the ITAS](image)

**Figure 2.** PCB Layout Diagram of the ITAS

The Printed Circuit Board was designed by using the OrCAD PSPICE tool. The figure 3 shows the schematic circuit diagram and figure 2 shows the PCB Layout Diagram of the proposed system.
5. **Output**
The below given figures shows the output and completed model of our project. This is how our model would scan the identity cards of the student or staff.
Figure 4. Scanning the RFID using ITAS

Figure 5. Measuring Temperature using ITAS
6. Advantages / Features

The advantages of the system are listed below

6.1. Contactless - In this COVID situation there is a need for social distancing and reducing contact with other persons. Here, in this system we use a RFID Tag that is assigned to a particular person which is an alternative to the fingerprint system used in the institutions that requires contact with the surface. By using the RFID tag one can mark their attendance and this is kept with them in order to reduce the contact and transmission of coronavirus. Hence this system becomes contactless and effective in COVID situations.

6.2. Temperature monitoring - The pandemic situation demands temperature measurement as it is a key aspect to detect whether the person is affected or not. Temperatures more than 99F are not allowed into the institution and are quarantined as they are suspected to have COVID. This process requires a minimum of 2 persons and they are supposed to wait the whole day either standing or sitting to monitor each and every individual entering the space. Our system contains an infrared temperature sensor that is capable of measuring the temperature of an individual, which is done by 2 humans otherwise, in one go. And finally they are uploaded in the webpage without any human intervention. This, thus, makes the workforce minimum and work more efficient.

6.3. Reduces time consumption in the attendance process - As we know that the traditional attendance system is time consuming, in order to reduce this time here in this system we use RFID tag and temperature sensor to update automatically in the webpage. In a swipe all the required data are uploaded automatically. If in case the temperature is more there is also an indicator that also makes this system effective.

6.4. Wide range of implementation- Our system can be used in a wide range of institutions which involve less to more people. All it needs is a database and RFID to work efficiently in this covid situation with social distancing.
6.5. Reduces repeated sanitization - This COVID situation requires continuous cleaning in order to prevent the transmission of coronavirus. It is even difficult to continuously sanitize the biometric sensor as it is sensitive. In order to reduce wear out our system will be very handy.

7. Result & Discussion

The below picture is the illustration of how the data will be recorded in webpage. The table contains 6 column and the verticals are named as serial number, registration number, name, temperature, time and date.

![Table Illustration]

Figure 7. The figure shows the data recorded in the webpage.
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Figure 8. The figure shows the data recorded in the webpage.

The tables shown in Figure 7 & Figure 8 are obtained as the output of the ITAS device and we could come to the following conclusions:
The table values that are marked in Green:
This is obtained only when the individual is standing between 5-10 centimetres from the system and also their temperature value is within the specified limit \(T < = 98.7\text{F} \). These data are recorded as such in the database.

The table values that are marked in Red:
This is obtained when their temperature is above the given range \(T > 98.7\text{F} \). This is then intimated to the authorities and is also updated in the database.

If the person is standing ahead or behind the range of 5-10 centimetres from the system, an indication is displayed in the screen and display like “Come Closer”.

8. Conclusion
The proposed model has great advantage over the existing system as it is an immediate and economical solution during and after the pandemic situation. In workplaces and institutions demanding human interaction our model can help in abiding to the safety norms of the government. As it is completely automated human interface can be reduced. Our system contains an infrared temperature sensor that is capable of measuring the temperature of an individual. This simple yet efficient model can be improved with the help of recent technologies to implement it in all organizations which involve the human workforce. For example, in competitive examination centers, the barcode of the registered candidate can be used for the attendance instead of RFID tags.
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