

Contactless Attendance Marking System with Thermal Screening using Arduino

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Abstract - one of the criteria to measure the student performance is checking his regularity. Normally in schools and colleges attendance is marked by calling their names or register numbers and marking the attendance in register book. In laboratories log book is maintained to track the students and utilization of laboratory components. In both the cases it is time consuming and requires more paper work. Therefore institutes started using student attendance marking systems based on wireless technologies or biometric information such as finger print reading; face recognition along with RFID tags. In the present situation created by Covid-19 pandemic, the thermal screening is also very important to allow the student to attend the class. We propose an idea where along with face recognition temperature screening is also added to the attendance marking system. This system is designed using ultrasonic sensors, IR temperature sensor, camera module which is interfaced with Arduino. In this way attendance can be marked automatically and at the same time system can scan individual student to identify potential patients of Covid-19.

Keywords - biometric; finger print, face recognition, RFID tag, Covid-19

I. INTRODUCTION

Attendance plays more important role in student's academic performance. This shows student's commitment towards studies. Almost all the universities and educational institutions pose strict rule based on attendance. Student has to maintain said percentage of attendance to take end exam. So in each class the faculty or lecturer has to mark attendance. In most of the educational institutions manual attendance marking is still in use. Calling individual student's name and marking his/her presence is common. The problem with this method is it takes time to call each and every student. Another problem is authentication, where a student can answer for his friend's roll call. Alternate method usually practiced in class room or a laboratory is passing student's name list on which they have to sign. As stated above, here also the same authentication problem arises. Many smart attendance marking systems were developed. Few of them require mobile applications and other based on biometric information. Even though we have different choices as mentioned above, still new requirements are arising. Along with attendance tracking or marking, outbreak of Covid 19 imposed another concern of temperature screening on these systems. The Universities made it compulsory to scan everyone before entering the school or college. Hence, smart attendance marking system need to be implemented in place of traditional attendance marking. The objective of this paper is to propose a

biometric based attendance marking system with temperature screening for schools or colleges.

II. RELATED WORK

Several attendance marking systems have been developed and are in use. These systems are designed either using wireless technology standards such as blue tooth low energy (BLE), Wi-Fi and Radio frequency identification(RFID) or technologies like finger print matching, face recognition, speech recognition.

In Bluetooth based attendance marking systems mobile applications were implemented. The Mac Ids of student's device was mapped to fetch their identity. [1] A lecturer can take attendance by clicking the application installed in his mobile. Before starting the lecture the web service will be initiated and the session will remain active till lecture ends. Hence, lecturer can take attendance multiple times during the lecture hour and find the proxy attendance.

Using Bluetooth low energy beacons a smart attendance marking was proposed. [2] Beacons are small, low power transmitters which periodically broadcasts signals. These signals are universally unique identifiers recorded by mobile applications and then delivered to the web services. In each lecture student acquires a unique token upon login and mobile application sends the request for the scheduled lecture. From the beginning to end of the lecture, mobile application tracks student and device id as well as timestamp, later it is delivered to the web service. The problem with these Bluetooth based systems is students must carry Bluetooth enabled devices. If student does not have device then again we have to go back to manual attendance marking for such students. Even though some security measures were taken into consideration but still by sharing the mobile device student can give proxy.

The attendance system with finger print matching has been proposed [3]. This system had two modules; enrolment and verification. A biometric finger print reader was interfaced with Arduino UNO. At very first time student has to enrol his fingerprint to store biometric information in database. In the later time finger print of the student was verified. A web application was used to store and access the attendance. To transmit the data to the attendance system Ethernet shield was used between Arduino and database. In this system main concern was reducing power consumption and storage as well as to provide reliable attendance marking system

Another attendance marking system was proposed based on event tracking [4]. Two passive infrared sensors were used to identify the entry and exit of the student. On recognizing an event webcam is activated and captures the picture. Attendance records are updated in the cloud and email notification will be sent to the faculty.

In RFID based systems, RFID tag is integrated with the student ID card. Whenever students enter into the classroom, they are asked to swipe their id card. RFID reader will fetch the information and verifies their identity by comparing it with college database. The disadvantage of this system is identifying the misuse of RFID tags. To address this issue another attendance system was proposed where face recognition was added to the existing system. When student swipes his id card and it matches with the stored data then camera will be activated and it captures the image and identifies. To enhance security, finger print sensor is also used after face recognition [5][6].

III. OBJECTIVE

In the present scenario contactless attendance marking is gaining more popularity because of covid-19 pandemic. As much as possible human contact must be avoided. In the previous section we have discussed about Bluetooth based attendance marking system. This system imposes using mobile devices and applications to be installed in their device. In majority of the universities a strict rule is followed which does not allow carrying mobile phones. If we use RFID based system there one can steal their id card and gain entry into the classroom. There arises authentication problem in both Bluetooth based and RFID based systems. The next choice is biometric authentication with finger print scanning. Here either the finger print reader is passed to each student or one by one student will come to the place where device is mounted and provide their information. The main objective "contactless" is not achieved in this method. To overcome from these aforementioned problems we propose contactless attendance marking system which applies face recognition for authentication and to check the temperature of student thermal sensors are added.

IV. METHODOLOGY

Contactless attendance marking and thermal screening system is designed using the concepts of IoT, Machine Learning and Artificial Intelligence. The entire system is divided into four major modules: Object's proximity module, face recognition module, temperature screening module, and alert module as shown in Fig.1.

A. Functional Modules of proposed system

1) *Object's Proximity Module*: This module identifies the student when he comes closer to the device. To find the distance from the attendance marking system ultrasonic sensors are used. An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and

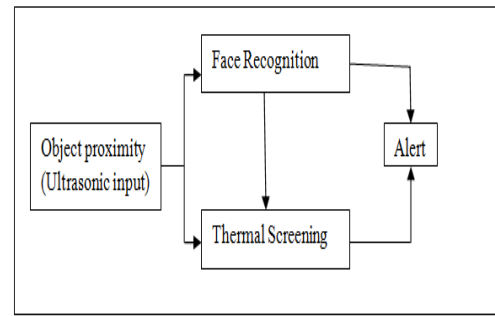


Fig 1: Functional modules of proposed system

receive ultrasonic pulses that relay back information about an object's proximity. In a single ultrasonic sensor there is a Trigger and Echo, trigger emits the sound waves and echo receives the sound waves which were emitted by trigger, so the data from the ultrasonic which we receive is the time taken for the sound waves emitted from the trigger to the sound waves received back by echo, by this time taken we can calculate the distance between the sensor and the object.

2) *Face Recognition Module* – when the distance between student and the device is within the proximity set by the system, image will be captured. The face of the person is checked and compared with the face of the previously stored images of the authorized person in datasets. If it matches with stored image then it will proceed with temperature screening. Otherwise an image and SMS will be sent to the faculty. *Selection*: Highlight all author and affiliation lines.

3) *Temperature Screening Module* – After face recognition is successful temperature screening will be done. Student's identity, time stamp information and the temperature readings will be recorded only if temperature is not more than normal body temperature. On recognizing temperature higher than the normal temperature, buzzer is activated and generates an alarm.

4) *Alert module*: As mentioned in the face recognition module, if capture image does not match with images stored in the database, and if temperature is high then warning message will be sent to the faculty. This Alert module takes advantage of some of the technologies that Mobile devices provide, technologies such as the Email and Short Message Service (SMS).

B. Workflow

Initially every student's image will be taken and updated in the database. Fig.2 shows the flow diagram of proposed system. Accordingly, whenever student comes to attend class he has go with automatic attendance marking system. The ultrasonic sensor module finds the distance of the student from the device. If it is within the specified range then image will be captured and compared with stored information. Once the student's face is recognized temperature will be read using thermal sensor and student's details like identity, timestamp and temperature will be recorded. It will continue to scan next student. In case some unknown person tries to enter into the class, SMS and email notification will be sent to the concerned faculty or admin. These notifications are also sent when

temperature of the student is above the normal body temperature.

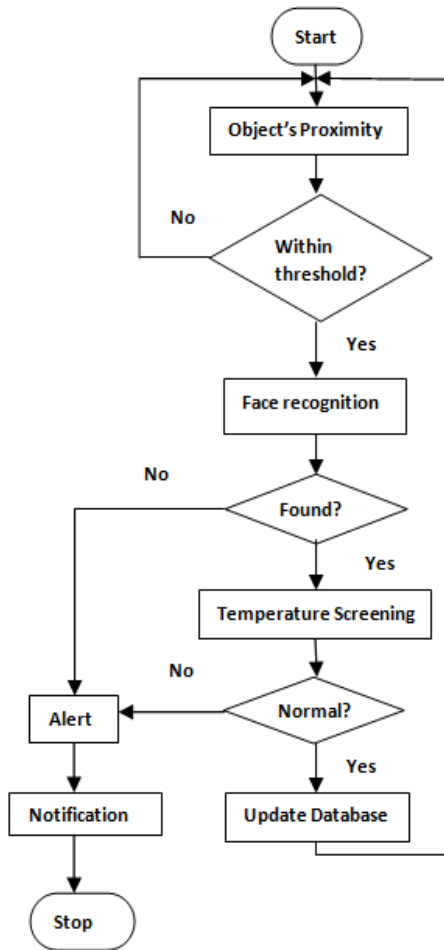


Fig 2: Flowchart of proposed system

V. PROPOSED IMPLEMENTATION

In this section we discuss how our proposed system will be implemented.

A. System components

The detailed component interfacing is shown in Fig.3. In this section only main components are discussed.

1) Ultrasonic sensor - To implement this system ultrasonic sensor is integrated with Arduino to detect the student. The ultrasonic sensors are fast and can produce precise results when we compared with other sensors. These sensors emit ultrasonic waves through trigger when an object or a person comes near to the device. The ultrasonic wave will hit and reflected back and later converted into electrical signal which will be received by Echo in ultrasonic sensor.

The distance can be calculated by the formula $Distance = Time * speed$. The ultrasonic sensor is the main input where the entire device will trigger and attendance marking process will be initiated. Here we use HC-SR04 Ultrasonic sensor. There are 4 pins in ultrasonic sensor in which 2 pins are connected to Trigger and Echo for sending and receiving the

signal, other 2 pins are connected to 5volts VCC and gnd (ground).

2) OV7670 camera module - When the student enters distance less than 40 centimeters the image will be captured through camera. This camera has 4 wires which are connected like this as shown in figure 3. *Red wire - RXD(in) *Brown wire-TXD(out) *Purple-GND *Grey-5volts vcc.

3) Infrared (IR) temperature sensors – These sensors emit an infrared energy beam focused by a lens on to a surface to detect the surface temperature. The reflected beam is received back in the sensor which converts the energy to an electrical signal that can be displayed on LCD in units of temperature. Buzzer is used to alarm if temperature exceeds normal body temperature

B. System implementation

First we need to create a dataset which stores the gray scale images of the person who is authorized to access. For creating the dataset the program uses the camera and records over 50 images and converts those images to gray scale and stores in the name of the person in a folder.

Arduino Mega 2560 board is used with HC-SR04 Ultrasonic Sensor for receiving input; the code for the input will be written and stored in Arduino board. Each time when serial monitor is run in Arduino, the code stored in the Arduino board executes and the data from the ultrasonic sensors are produced

We need to record the readings of the ultrasonic sensor, if the sensor values are less than the defined values provided by the Admin, then the face recognition and temperature sensing should work. Every time the face recognition checks for the arrived person, it checks for the face in the dataset. Face recognition can be implemented using OpenCV module.

A service provider twilio will be used to implement Alert module, these service providers provide a way to combine programming with SMS network module.

When a person is not recognized then his/her image will be captured, the captured image will be attached to the Email along with the timestamp and temperature and will be sent to the adman’s mail address.

For email transfer smtplib and MIME modules be used which offers a good security.

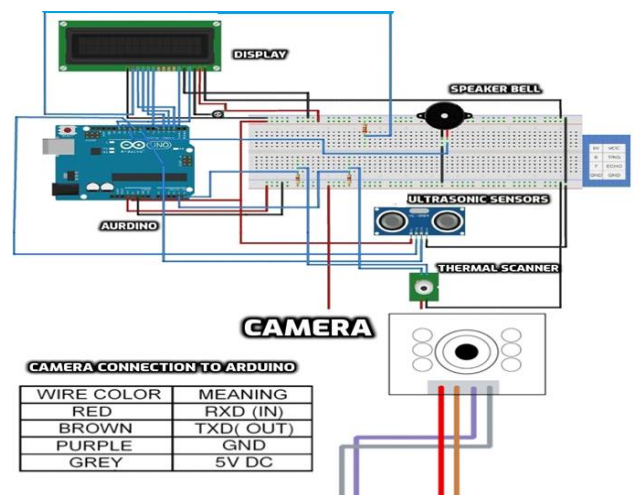


Fig 3: System components

VI. DISCUSSION

As face recognition is used, it acts as first layer of security and hence unauthorized people cannot attend. Students cannot give proxy attendance because the image and date time stamps are recorded. In this system non contact thermal screening will be done, so the person who is having high body temperature will not be allowed. Thereby spreading of infection to other students will be controlled. When student forget to bring ID card or lost his id card still his identity can be verified with face recognition. The device implemented in low cost, hence a cost effective system for contact less attendance marking and thermal screening can be developed.

VI. CONCLUSION

The above proposed system is designed based on health and multilayer security principle. As we have integrated face recognition and thermal screening technique and it is implemented by low cost; it can be affordable by all. This system is implemented on keeping security and health as main concerns so alert email and SMS will be sent to admin, the buzzer will ring. It can be used in schools, colleges and offices where security and health is almost important. As the proposed contactless attendance and thermal screening system using Arduino not only be used for attendance and thermal screening but also be used as pre security check. We use this system to check whether the student, staff is authentic or not, and there health care status too. In future it can be enhanced by adding admin's live voice call interaction to device when unknown person enters.

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