International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 07 | July 2021 www.irjet.net p-ISSN: 2395-0072

AUTOMATIC SOCIAL DISTANCING SYSTEM USING THERMAL SCANNERS IN HUGE AUDITORIUM OR CONFERENCE HALL ENTRANCES

Akhila S[1], Vaishnavi R[2], Varna Murali[3], Dr. R J Anandhi[4]

[4]*Head of Department, Dept. of Information Science and Engineering, New Horizon College of Engineering, Bangalore, India*

[1,2,3]*Students, Dept. of Information Science and Engineering, New Horizon College of Engineering, Bangalore, India*

Abstract - *COVID-19 caused by SARS-Cov-2 virus which originated in China has caused a pandemic all across the world. The common symptoms of this disease includes fever, dry cough, tiredness and loss of taste and smell. The virus is mainly transmitted through an infected persons cough or sneeze. It is vital that safety measures such as wearing mask, maintaining social distance and constant sanitization of oneself is followed. Automatic social distancing system is a prototype developed which can be used at entrances of auditorium and conference halls during the Covid-19 pandemic. The gate automatically opens based on thermal sensors' input and permits individuals based on the headcount and their temperature. The aim is to build a device that automates the screening process at the entrances of huge halls and auditoriums. If the person's temperature is greater than normal body temperature, then the gate will remain closed. Room occupancy is also kept in check so that more number of people do not gather violating the social distancing norms. If the number of people entering the room exceeds the capacity, the gate will remain closed. The people trying to enter must follow social distancing. A buzzer will ring if someone is trying to violate social distancing if the distance between two is less than 2 meters.*

Key Words: Covid-19, Contactless temperature sensing, Automated gate, Room occupancy, Social distancing.

1. INTRODUCTION

Kerala reported the first case of covid-19 in India on January 27 2020. Later Covid-19 cases started increasing and spread to the whole of India. One of the symptoms of covid-19 is fever so there is a need to monitor the temperature of people before they enter a public building. And all the people are supposed to maintain social distancing to avoid the spread of disease. Lockdown in India was announced on 25th March 2020. Symptoms of covid-19 are variable but mainly include fever, cough, headache, breathing difficulties. This gave rise to the need for a system that checks the temperature of the people entering public buildings and a system that urges people to maintain social distancing. Covid-19 cases are increasing day by day. It is very important to follow all safety measures such as wearing a mask, social distancing and constant sanitization of oneself. The project aims to build a device that automates temperature sensing at the entrances of huge halls and auditoriums. The gate automatically opens based on thermal sensors' input and permits individuals based on the headcount and their temperature.

This project is developed to reduce the spread of the virus among people. The aim is to build a device that automates the screening process at the entrances of huge halls and auditoriums. If the temperature of the person entering is greater than normal body temperature then the gate will remain closed. It also calculates the occupancy of the room. If the number of people entering the room exceeds the capacity, the gate will remain closed. The people trying to enter must follow social distancing. A buzzer will ring if someone is trying to violate social distancing that is if the distance between two is less than 2 meter.

There are many problems with the existing system. Manual checking of temperature happens at the entrances of buildings. The security guard checks the temperature of the person entering the building. This may not be an efficient way as it can be violated easily if many people are entering the building or if the person checking the temperature moves away. There is no system to calculate the real-time occupancy of the room due to which the people entering the room may exceed the capacity of the room and cases may increases. Social distancing is usually followed using devices. These devices may be expensive and not everyone can buy them.

To build a system that automates temperature checking at the entrances of large halls and auditoriums. Some features of the project are: There will be an automated temperature sensor at the entrance that will check the temperature of the person entering inside. The gate will open only if the temperature is in the given range. If the number of people entering the room exceeds the capacity of the room then the gate will remain closed. The people trying to enter the room must follow social distancing and wait in a queue to enter the room. The buzzer will ring if social distancing is violated. Advantages include reduces the manual effort of checking temperature and is a safe and more efficient way, saves time, forces the people to follow social distancing, room will not be overcrowded.

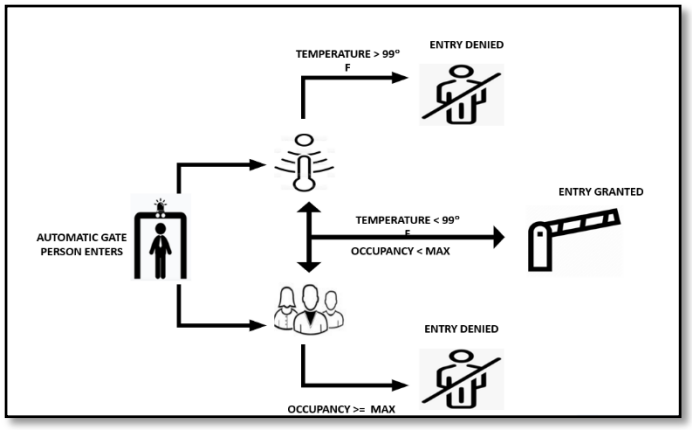

Figure 1: Scope of Project

2. LITERATURE REVIEW

Several existing works makes use of dataset for face mask detection using semantic segmentation based on fully convolutional networks. However, performance-wise, it is too heavy for low-power IoT devices, such as Raspberry Pi. Arduino was used for temperature sensing visualization using MATLAB. But it doesn't allow non-contact temperature sensing. The main goal of this paper is to provide a cost effective solution for Covid-19 safety monitoring which can be affordable and easy to use.

This paper focuses on developing an IoT based system to prevent the spread of the virus. The common indoor measures include a person with abnormal body temperature must stay at home, wearing masks when in contact with an infected person and a distance of 2 meters from one another. The temperature sensing is achieved using a non-contact infrared thermometer sensor connected to Arduino Uno. Detection of masks and social distance check makes use of Raspberry Pi equipped with camera.

When people try to enter a building or a conference hall, their temperature is checked at the entrance. To check the temperature, an infrared thermometer sensor (MLX90614) equipped with Arduino Uno is used. Using the MQTT Protocol, abnormal temperature is recorded and sent to the application used by the security guard ensuring such people don't enter the building. An individual with normal temperature will be allowed as the Arduino will send signal to open the door. The next step is to detect the face mask. It is detected by the Raspberry Pi. Security guards will be alerted through MQTT message when the camera detects a person without a face mask. If a person has been detected wearing mask, door will be opened. Once the person enters the building, the Raspberry Pi will check if social distancing is maintained at certain locations. If the social distancing norms are violated, the MQTT message will alert the security guards to take appropriate measures.

MASK DETECTION ALGORITHM

For detecting the face mask, 3 OpenCV library classifiers are used. 1) Detecting human face from frontal side, 2) Recognizing the human mouth with the given image, 3) to detect the nose. The frame is converted to a gray scale image. A new copy with additional black and white version of the frame is created. Face detection is performed against both these images. If a face is detected, mouth and nose detection is applied. If the mouth and nose area isn't detected, the person is wearing the mask correctly. However, if the mouth and nose area is detected, the person is warned to wear the mask properly.

SOCIAL DISTANCING CHECK ALGORITHM

Social distancing algorithm makes use of OpenCV's haarcascade_fullbody classifier for human body detection within the captured image. The camera frame is converted to a grey scale image and body detection is applied. If more than one human body is detected, the distance between each two persons is calculated and compared against a given threshold distance. If the distance between each two bodies is greater or equal to threshold, then social distancing is applied correctly in a given scenario. Otherwise, if this condition does not hold for at least one pair of bodies, then the message will be sent to the server and security operator notified.

TEMPERATURE MEASUREMENT

The temperature of an individual is measured using the non-contact infrared thermometer sensor. If the temperature of an individual is greater than human body temperature, the gate will remain closed. Only individuals with right thermal conditions will be allowed.

The experiment performed shows that there is an accuracy of 84-91% in mask detection, 65-73% accuracy in social distancing check and an error rate of 0.5°C in temperature measurement using IR sensor. The proposed solution can be used under certain performance limitations by making use of hardware and open source software. The future scope would be to use various deep learning and computer vision framework to detect the objects with higher accuracy. The main goal is to integrate this system with the environment as it can be an efficient resource during the pandemic.

3. PROPOSED SYSTEM

Automatic social distancing system is a prototype developed which can be used at entrances of auditorium and conference halls during the Covid-19 pandemic. During this crisis, it is very much necessary that one should follow all the safety protocols when they are in public places. The temperature of an individual is checked at the entrance. If the temperature is above the normal body temperature, the automated gate will not open. Room occupancy is also kept in check so that more number of people do not gather

violating the social distancing norms. Social distancing is also achieved using the motion detection sensors which will check if there is a distance of 6 feet between two people.

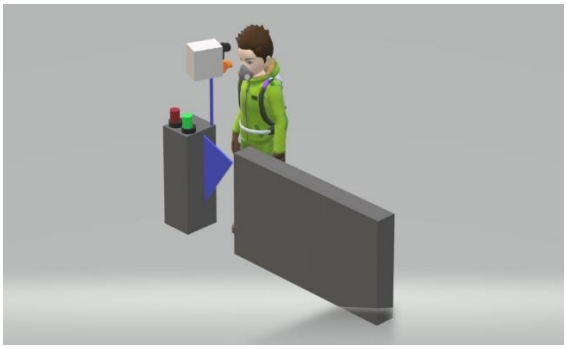

Figure 2: Representation of Proposed System

4. METHODOLOGY

I. SYSTEM ARCHITECTURE

A system architecture is essentially a modular representation of a fully functioning system. The figure above depicts the various modules of the project under development. A system architecture aids and guides the development team throughout the implementation phase of the project. It is a pictorial representation of the various stages of the system. It also gives a vivid understanding of the major functionalities and the integration of the multiple modules.

The above given system starts with detection of an object (person in real time application). This detection is done using the ultrasonic sensor and the proximity sensor. The ultrasonic sensor captures ultrasonic sound waves in order to measure the object distance and the proximity sensor detects the presence of an object prior to temperature check.

Based on the results generated by both sensors the next module of the system performs a social distance check in case multiple objects are present at the same time. The figure shows a continuous loop execution at the social distancing stage to imply that social distancing must be maintained at all times. Followed by this is the temperature check stage where the object's temperature is checked for an optimum value and based on this value the next stage of entry or no entry is decided.

Thus, a system architecture is extremely essential for the construction of any project. Any alterations reflected in this stage can prevent major faults in the implementation phase of the project.

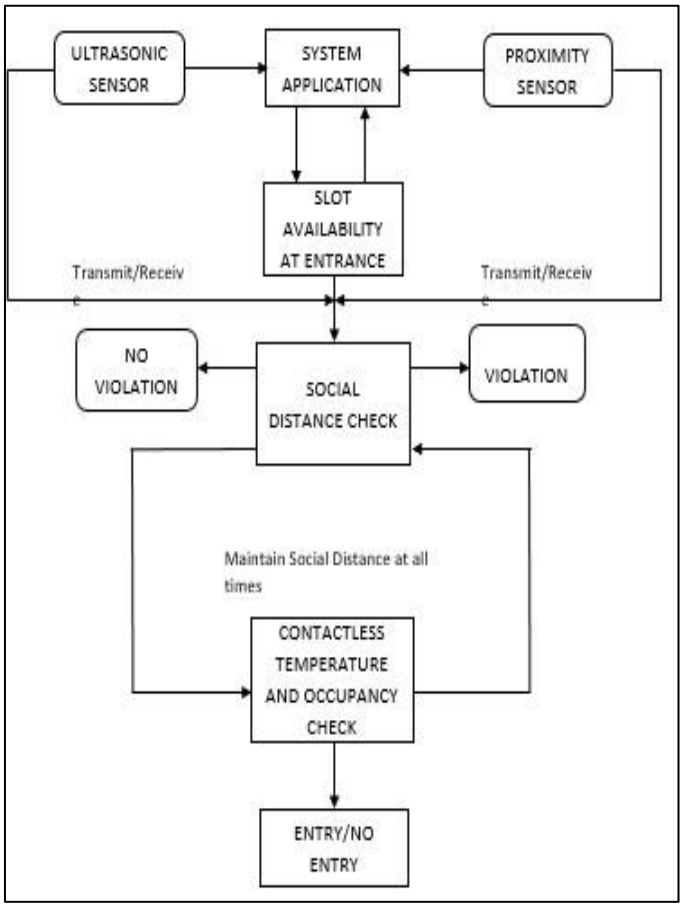

Figure 3: System Architecture

HARDWARE AND SOFTWARE REQUIREMENTS

The Hardware Requirements for this project include:

- Arduino UNO
- Jumper Wires
- IR Thermal Sensor
- Servo Motor
- LCD Module 16*2
- Buzzer
- Ultrasonic Sensor- HC-SR04
- Infrared Proximity Sensor

Software requirements define software resource fundamentals that need to be installed on a workstation to provide optimum working of a software. The following are required for optimal development and usage of the application.

The Software Requirements include:

- Arduino IDE
- Fritzing

II. WORKING OF THE SYSTEM

- The Proximity sensor will detect if a new person is trying to enter an auditorium or conference hall.
- The ultrasonic sensor is set to high now. It will detect if another person is trying to violate the social distance.
- If the social distance is violated, a buzzer will ring alarming the securing guards for social distancing violation.
- If a distance of six feet is maintained between the first and second person, nothing happens.
- Next, the temperature of a person at the entrance is checked. If the temperature of a person is above normal body temperature, the buzzer will ring and entry is denied.
- If the temperature is below normal body temperature, room occupancy is checked. If the count is greater than the occupancy of the room entry will be denied.
- Only an individual with the right thermal conditions will be allowed even if the maximum occupancy has not reached.

5. EXPERIMENTAL RESULTS

Figure 4: Distance Measuring and Temperature Detection

The figure 4, depicts the detection of the presence of a new person at the entrance. The "Distance Maintained" statement indicates how far the person is from the gate. And as they move forward the distance value reduces. Once the person has arrived at the gate, their temperature is detected and displayed followed by "ENTRY GRANTED" message. The room occupancy for the given system is also displayed to ensure the capacity of the room is being maintained and monitored.

Figure 5: High Temperature Entry Denied to person

The Figure 5, depicts the detection of human presence at the gate followed by temperature estimation. The temperature detected is out of the specified range and thus the message "ENTRY DENIED" is displayed on the serial monitor. The servo motor operated gate does not move as well.

Figure 6: Maximum occupancy of room reached

The Figure 6, depicts that the maximum capacity of the room has reached. This is indicated by the statement "Occupancy = 3" and "ROOM FULL". Therefore, any new entries will not be permitted inside the premise as the second criteria for the system has been satisfied. Furthermore, the servo motor operated will remain in closed state.

Figure 7: Social Distancing Maintained

The above given image detects the presence of two individuals at the entrance of the developed system. The ultrasonic sensor and PIR sensor work together to detect the distance between the two persons. As shown, in the figure, social distancing is being followed and that information is being displayed on the serial monitor.

System components, externally observable attributes of those components, and linkages (e.g. behavior) between them can all be included in system architecture. It can provide a blueprint for obtaining products and developing systems that will operate together to implement the overall system.

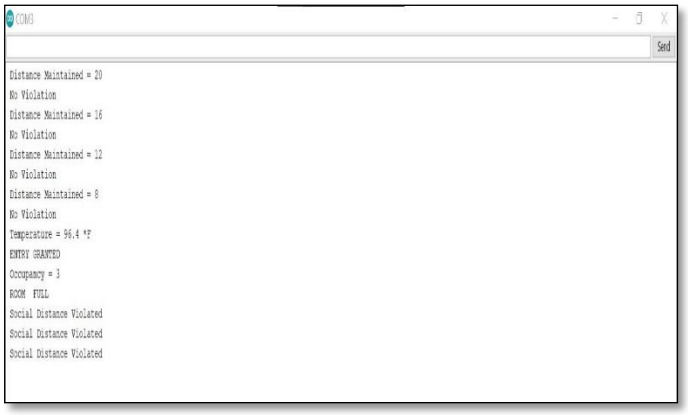

Figure 8: Violation of social Distance

The above figure 8, depicts that there are two individuals present at the entrance. There is a violation of social distancing as the distance between the two individuals is lesser than the recommended value. The message "Social Distance Violated is displayed" followed by buzzer sounds to alert the two individuals.

6. CONCLUSION & FUTURE ENHANCEMENT

This project was about improving the process of sensing the temperature of the person at the entrances of large halls and auditoriums. Instead of manually checking the temperature, this device can be used. There will be an automated temperature sensor at the entrance that will check the temperature of the person entering inside. The gate will open only if the temperature is in the given range. If the number of people entering the room exceeds the room's capacity, then the gate will remain closed. The people trying to enter the room must follow social distancing and wait in a queue to enter the room. The buzzer will ring if social distancing is violated.

As new technologies are available new features can be added. A few of the enhancements are:

- Connect a camera to the device and monitor social distancing using the camera.
- Deployment of the kiosk for at the entrance.
- System to collect and store data.
- Ensure social distancing inside the hall with multiple sensors.
- An app which will alert the security guards when there is any kind of violations.

7. REFERENCES

[1] IoT- based System for COVID_19 Indoor Safety Monitoring by Nenand Petrovic and Dorde Kocic

[2] Predicting room occupancy with a single passive infrared(PIR) sensor through behavior extraction byYordan P. Raykov,Emre Ozer ,Ganesh Dasika, Alexis Boukouvalas, Max A. Little

[3] Automated Social Distancing Gate with Non-Contact Body Temperature Monitoring using Arduino Uno by Gisselle Ann Alcoran Alvarez, Marc Brian Garcia, Dave Unabia Alvarez