Arduino UNO Based Visitors Counting System for Vaccination Rooms

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Abstract – *With the era of social distancing, there is a need for maintaining a specific threshold for the number people be it in a vaccination room or public gatherings. Visitors Counting System is used to count and keep track of number of people in the room and can effectively be used for the halls or rooms during vaccination drives and any form of gatherings, we can set a maximum limit of people that can enter room once the maximum limit reaches people needs to wait until the count gets decreased. Here we aimed to implement such a system that maintains the correct count of visitors inside the room. To do that two infrared sensors are used one at the entrance which increases the count value when visitor passes through the sensor and other at exit of the room which decrements the count of visitor when they pass through exit door. This system can be implemented anywhere with simple components and can be accessed online through a smartphone or a computer enabling everyone to follow the COVID norms.*

Key Words*: *Visitors Counting System, Arduino UNO, Infrared LED, ESP32, LCD.

1. INTRODUCTION

Internet of Things is a fast growing technology and has revolutionized every field in the past decade. The idea of IoT is so adaptable, flexible, and universal. In this work, IOT components have been used to build a visitor counter which can be monitored online. This visitor counter can be part of few automation systems or smart home system. The other important application we are focusing on is its use in vaccination rooms to monitor the number of people i.e. patients and medical staff so as to practice good medical health hygiene. This is an essential in the present era of social distancing. It can also be used to maintain the threshold, maximum number of people allowed, for public and social gatherings and follow the protocols.

There are various other numerous areas in which such a technology would come to play. With the increase of population, management of this vast number has been becoming difficult year after year. There are many existing methods used by different sectors to count visitors effectively without hindrance. But each method has its drawbacks like effectiveness or cost or both of them. Here, after going through some prominent papers on this topic, we aim to present a simple yet effective visitors counting system that can be accessed online through a mobile or web application from anywhere in the world. This can help anyone who wants to keep a count of their visitors and follow the COVID norms for any public gathering, be it small or big.

The visitors counting system is built on Arduino UNO. Arduino UNO is the popular prototyping boards. The Arduino is interfaced with an ESP32 Wi-Fi modem to connect with an internet router and access the cloud server. The counter circuit is designed using Infrared sensors. The Arduino based IoT device passes the count of the visitors in the room to the cloud. As the data will be updated on the cloud, it can be accessed online using any smartphone or computer.

The ESP32 Wi-Fi Module is used to connect with the Arduino with a Wi-Fi router, so that it can access the cloud. It's a self-contained SOC with integrated TCP/IP protocol stack which can access a Wi-Fi network. The ESP32 is capable of hosting an application or offloading all Wi-Fi networking functions from different application processor.

1.1 Components Used

1. Arduino UNO R3 development board
2. Sensor module (infrared LED, photodiode)
3. Jumper wires
4. Potentiometer
5. Bread board
6. 16 X 2 LCD
7. ESP32 Wi-Fi module

2. LITERATURE REVIEW

[1] Research work presented in this paper proposes an IoT person counter implemented with two different technologies, motion and ultrasonic. The information count by a person counter device can be used in different scenarios, such as to ensure security of access to a room, or to maintain and regulate the temperature of a room. Algorithms have been suggested to carry out the management of the information provided by the sensors. As a result of the proposal, this experiment concludes that in controlled environments, where there are not many people transiting, both methods had a considerable accuracy. In contrast, in scenarios in which the flux of people is significant.

[2] This work incorporates the following, a PIC 16F877A microcontroller, IR sensors, transistors, resistors, diodes, LEDs, LCD, and a buzzer. The two pairs of infrared sensor (IR) which consists of a transmitter (TX) and a receiver (RX) is mounted face to face across the doorway. Both sensors are positioned at the entry with distance apart. This infers upon the approach of a person the installed two pair sensors are triggered by the obstruction. The direction

of the person is determined by which sensor is obstructed first before the other sensor follows.

[3] In this proposed work, Arduino UNO controls the light and fans according to the number of visitors in a room and automatically controls the lights based on the intensity. The infrared sensor-1 is used to count the incoming visitors whereas infrared sensor-2 is used to count the outgoing people so that the number of persons inside the room can be counted. The buzzer alarm is used for indicating the occurrence of fire. Two lights and fans are employed in this project if visitors count is zero, fans and lights are in off state. If the visitor list is between 1-5 then one fan and one light is switched ON else all the fans and lights will be ON. If visitors count, there will be 10 LCDs with no seats available. The IOT module collects the information about the visitors count and fire occurrence.

[4] In this study, a real-time system which counts the number of people with the help of camera was demonstrated. The system will send the count of people to a mobile application via Internet of Things and monitor the count. Background subtraction method was used here to recognize movement of humans on the visual field of the camera. According to motion information, a counter was used to count the number of people inside the saloon by determining whether to go inside or outside and gives an idea about what percentage of the room is empty. MATLAB and ThingSpeak combination help to send counter information to the internet environment. A mobile application is built to get the counter information from Android and iOS devices. The outputs were shown in the MATLAB environment and mobile application.

[5] This paper presents a novel people counting system with IoT via infrared sensor which detects the change in infrared radiation of warm-blooded moving objects. As infrared radiation changes, the sensor gives a output of 5V signal for a certain period when the sensor detects the presence of a person. The generated voltage is amplified and turns ON the webcam and lighting system. When the webcam turned on, start to capture and record the video and the video passed to the Raspberry Pi connect along with sensor and webcam. The remote server collects all the information and stores it to the corresponding tables in the predefined database for analysis. Once the person moves out of the detection range of the PIR sensor the light gets turned off.

All these papers gave us an insight in developing our own "Visitors Counting System" for vaccination rooms.

3. PROPOSED WORK

3.1 Problem Statement

To make a smart room sensor for vaccine rooms, public gatherings etc., which uses a sensor module that measures the number and direction of people traversing any entrance or a passage per unit time. The visitors counter is designed using IR sensors. The Arduino based IoT device sends the count of the visitors in the room or hall to the cloud. As the data is updated on the cloud, it can be accessed online using any smartphone or computer.

3.2 Motivation

The inspiration behind this project was real life situations. With the growing need and increasing demand for vaccine, hospitals have become crowded. This might be a problem in the era of social distancing. Especially in vaccine rooms it is important to monitor the number of people in the room. Also, with the end of lockdown people have started gathering publically but they still have to follow the COVID norms. As a result, there has been an increase in need to implement in many places such as:

1) Can be used in various supermarkets to help with the crowd and maintain order, also would be helpful to keep a check on the growth of the market.
2) Can be used in various places like seminar hall, where the capacity of the room is limited and should not be exceeded. This project can be used to display the actual number of persons inside the room.
3) In case of fire emergencies, the fire brigade can obtain the number of persons inside so that they can prioritize their actions and as a result they will be quick in dealing with the situation.
4) In museums we can restrict the number of people entering the museum, resulting in an increase of safety measures.
5) In places of government work, for instance, in passport making, it is always a crowded place where work is done systematically but could be increased to a great extent by limiting the number of people entering each room assigned with a specific task.

3.3 Methodology and Goals

The "Visitors Counting" model includes all those essential components which will sense the presence of any living being in a room. Visitor's counting system is a simple yet powerful concept which is an Arduino controlled circuit which uses IR sensor modules to detect the existence of a person and counts the frequency of the individuals. By this technique, manual counting works are 100% removed. It automatically counts the number of individuals in a compartment or room and reduces the chance of errors while manual counting. We'll be using IR sensor modules. Here the ESP32 Wi-Fi Module is used to connect with a Wi-Fi router, so that to get access to the cloud. It is self-contained SOC with integrated TCP or IP protocol which can have access to Wi-Fi network. The ESP32 is used for hosting an application or offloading all Wi-Fi networking functions from another application processor.

3.4 Design Approach

The IoT device designed for visitor counting is based on ESP32 Wi-Fi Modem and custom-built IR sensor modules. There are two sensor modules used in the project one sensor is used to track the incoming visitor and other is used to track outgoing visitor. This way, the actual number of current occupants in the room can be tracked perfectly. The data from the IR sensor is stored on ThinkSpeak which is an IOT analytics platform. It is used to analyze and visualize real time data. By using the API keys available, we can store data in the cloud. The stored data then can be fetched via a mobile application, thus making real time data easily accessible. An IR sensor is used to measure the heat of an object as well as detects the motion. IR sensor is an electronic device that emits IR radiation this helps to sense objects in the surroundings. Basically in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to human eyes, but can be detected by an ir sensor.

3.5 Working of IR Sensors

The IR sensor continuously senses the presence of any objects. If sensor 1 senses the visitor, it tells the controller that a visitor has entered so that the controller can increment the count value. At the same time, when visitor cross the sensor 2 the count value decreases so that the count is maintained correctly. When a visitor exits, the sensor 2 will inform the controller to decrement the count. The count of visitors will be displayed on the LCD by the controller.

4. CIRCUIT CONNECTION

4.1 Circuit for LCD

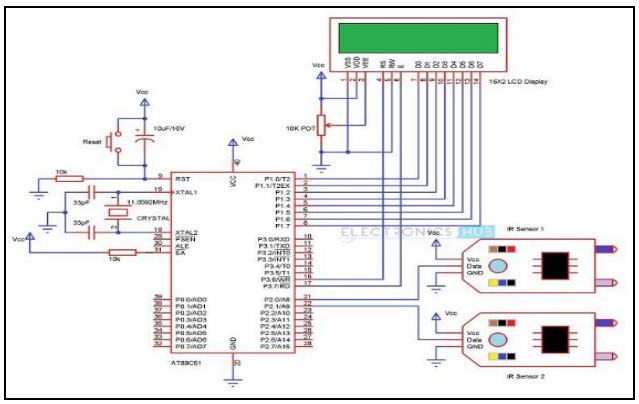

Fig - 1: Circuit for LCD

4.2 Circuit for ESP32 Module

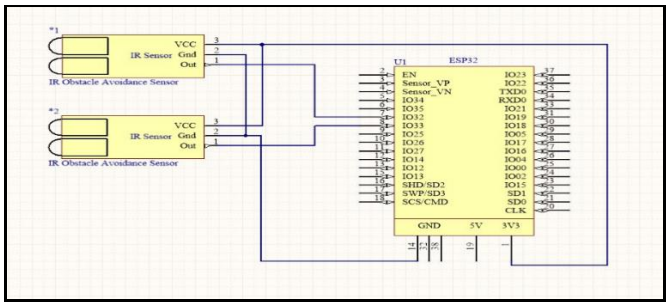

Fig - 2: ESP32 module

5. SUMULATION

5.1 LCD Circuit

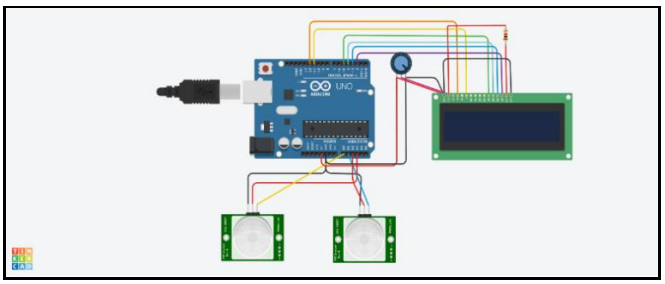

Fig - 3: LCD Circuit

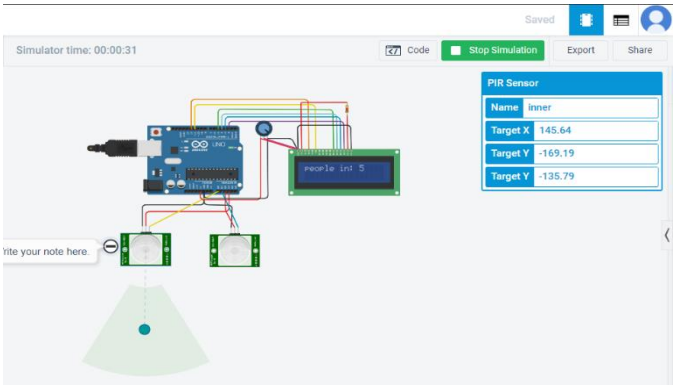

Fig - 4: Increase in count value as the person moves from sensor1

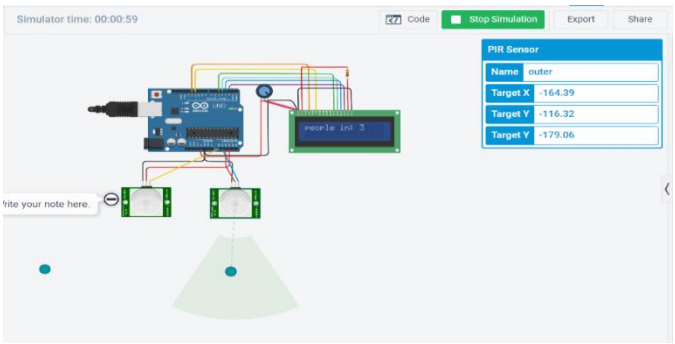

Fig - 5: Decrease in count value as the person moves from sensor2

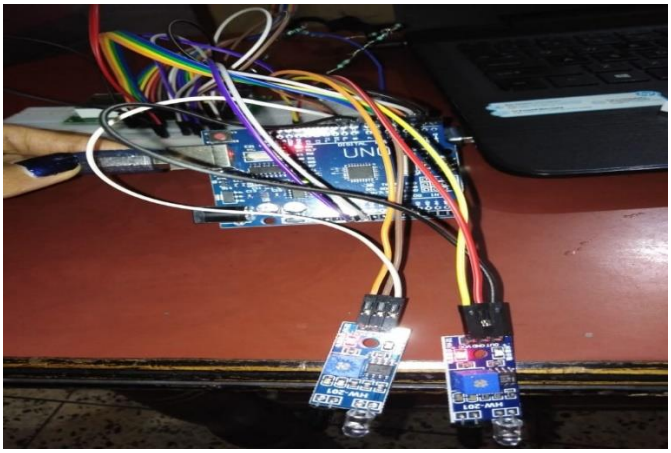

Fig - 6: Circuit connection

5.2 ESP Circuit

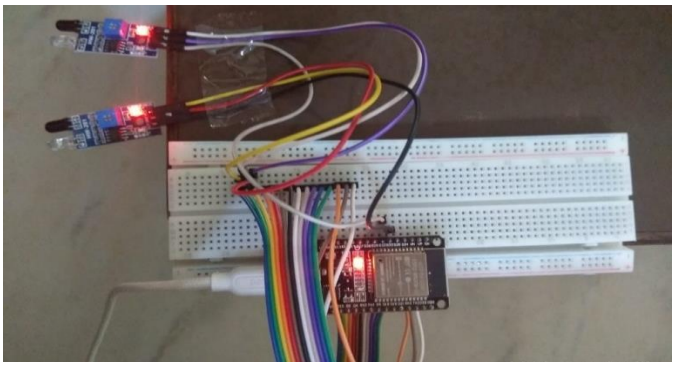

Fig - 7: ESP Circuit Connection

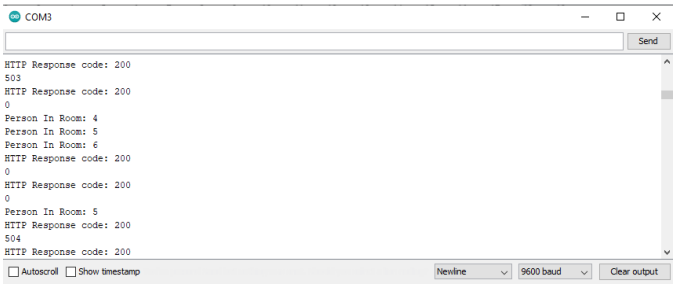

Fig - 8: Simulation Output (1)

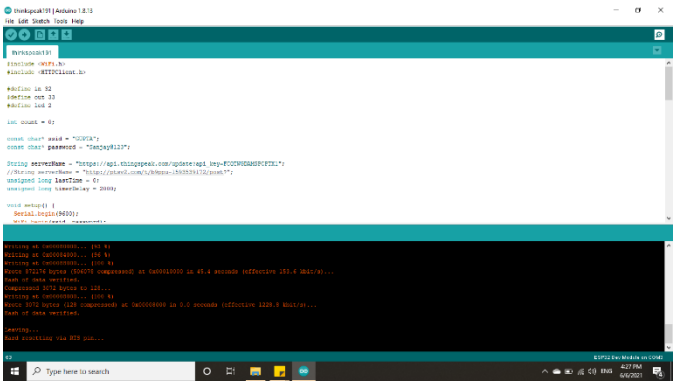

Fig - 9: Simulation Output (2)

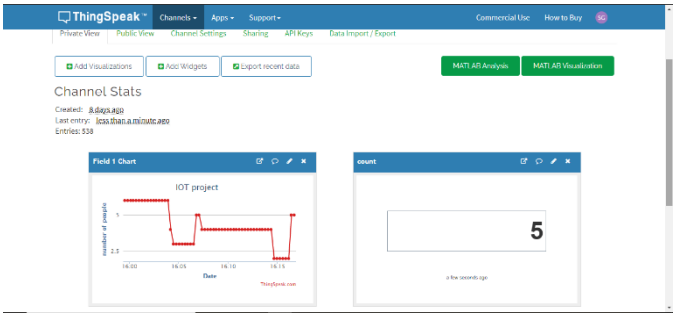

Fig - 10: Count as shown in ThinkSpeak

5.3 Mobile Application

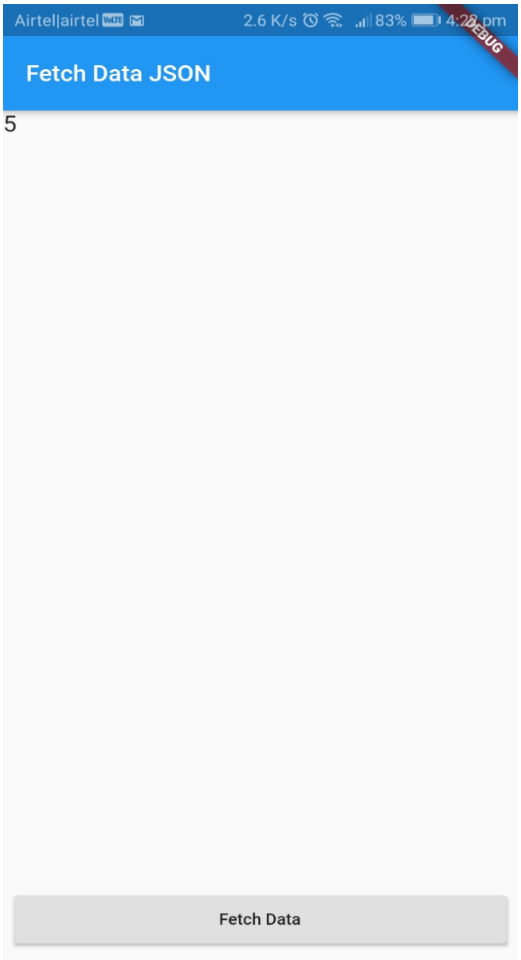

Fig - 11: Mobile Application

6. CONCLUSIONS

In this paper we implemented visitors counting system which is an Arduino controlled circuit which uses IR sensor modules to detect the existence of a person and counts the frequency of the individuals. The Arduino is interfaced with an ESP32 Wi-Fi modem to connect with an internet router and access the cloud server. As the data is updated on the cloud, it can be accessed online using any smartphone or computer.

This visitors counting system is really useful in vaccination rooms. We tested our model and were able to see the same number of people as in the room in both ThinkSpeak and the mobile application. We are aiming to improve the mobile app in future.

We can set a buzzer, which if the visitors count exceeds the limit activates and also the mobile application can be implemented with advanced features. This visitors counting system is simple and can be used by anyone when necessary with the required resources.

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