Vehicle Queue Management System

Group Number 13

Group Members

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Motivation

We all face situations of leaving campus hastily and entering campus exhausted. Then comes the rule of checking license of driver succeeded by entering details of ourselves and the cab driver and waiting for all vehicles before us to leave. This is even severe at the time of holidays and vacations.

There are similar systems like tollbooth which address this problem in an efficient manner. Why can't we improvise and make it robust enough to adapt it to our scenario.

So, we opted to develop a hassle-free service for the campus junta to avoid all the mundane work.

Description

Vehicle Queue Management System addresses this pre-existing problem of high waiting time and reduces it.

It also reduces the effort of security guards in maintaining all the records and makes their searches in records easier.

Features

1. Reduces effort of security guards to write down every number plate of the vehicles.
2. Machine learning algorithm automatically detects the vehicle number and gives the security personnel an option of editing the number if the detected number is wrong.
3. The gate opens only when the security personnel approves the car details and then only the car can enter the campus.
4. Reduces burden of maintaining bundles of records for security personnel and makes their search process very easy in data base.
5. Buzzer notifies the security personnel that a car has come and is waiting for the gate to open and to enter the campus. Buzzer beeps are activated by the ultrasonic sensor which is placed near the gate if the car comes too close.
6. If a person forcefully tries to open the gate, buzzer beeps continuously and then the security becomes alert and takes the required action.
7. After the car has entered the campus the gate closes automatically and is opened only when another car arrives.
8. Deployed a website which uses Python, PHP, Bootstrap, MySQL to get the requests from the users, for entering the details of the vehicle, and to store them in a database for future purposes.

Equipment Used:

1. Raspberry Pi 3
2. HMDI-VGA cable
3. LAN cable
4. Keyboard and Mouse

5. Power adapters and chords
6. Sensors

Sensors Used:

1. Ultrasonic Sensors - 2
2. Buzzer
3. Servo motor
4. IR sensor
5. 16 X 4 display sensor
6. Logitech webcam 640 X 480

Working:

Working of Project:

1. When the car arrives, the ultrasonic sensor will detect the car arrival and then the buzzer beeps informing that a car is waiting in front of the gate.
2. Then a confirmation from security guard initiates the following:
3. After a very small amount of time webcam takes the picture of the car's number plate.
4. The image is sent by using MQTT and then by using a machine language python code car's number is detected and is stored in the database.
5. If the security approves the request, then the message is sent by using MQTT and immediately the gate opens to allow the car to enter the campus.
6. Another ultrasonic sensor detects that the car has entered the campus and then the gate closes accordingly.
7. If the security guard does not approve, then the gate does not open and car has to wait and then everything has to be done manually.

8. An IR sensor is used to detect if a person forcefully tries to open the gate and if this happens buzzer sensor will alert the security guard to take the required action.
9. Servo motor is used to implement the gate and the angle is set 0 and 90 degrees for the closing and opening of the gate respectively.

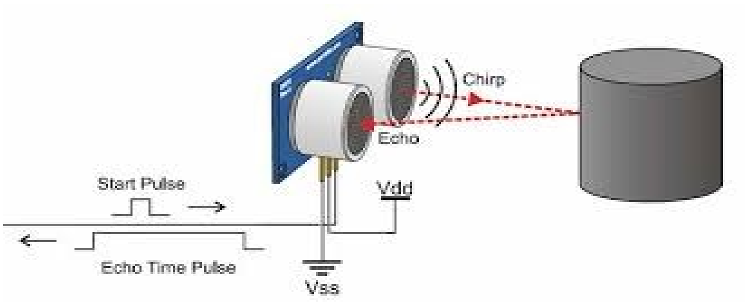
The whole system had been integrated by the use the Raspberry Pi 3.

Raspberry Pi 3:

We have used the Raspberry Pi 3 to connect all the peripherals using the GPIO (General purpose input-output) ports. We have individually checked every sensor used in this project using Pi. We have used the Raspbian OS as the operating system in the Pi. Python had been used as the programming language to give commands to the sensors.

Working of Sensors:

Ultrasonic Sensor:



Ultrasonic sensors work by **emitting sound waves at a frequency** too high for humans to hear. They then wait for the sound to be reflected, calculating distance based on the time required. This is like how radar measures the time it takes a radio wave to return after hitting an object.

If you need to measure the specific distance from your sensor, this can be calculated based on this formula:

Distance = ½ T x C

(T = Time and C = the speed of sound)

At 20°C (68°F), the speed of sound is 343 meters/second (1125 feet/second), but this varies depending on temperature and humidity.

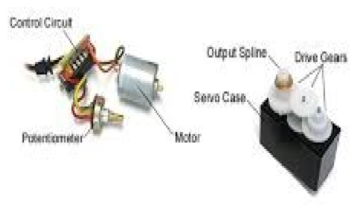
Buzzer:

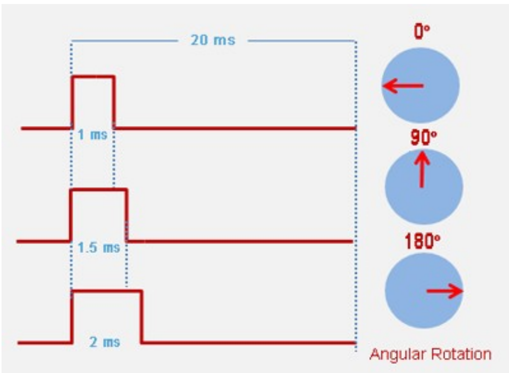
The buzzer consists of an outside case with three pins to attach it to power, signal and ground.

Inside is a **piezo element**, which consists of a central ceramic disc surrounded by a metal (often bronze) vibration disc.

When signal pin is triggered it causes the ceramic disk to contract or expand. This then causes the surrounding disc to vibrate. That's the sound that you hear. By changing the frequency of the buzzer, the speed of the vibration changes, which changes the pitch of the resulting sound.

Servo motor:

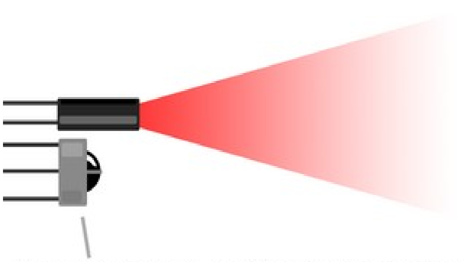




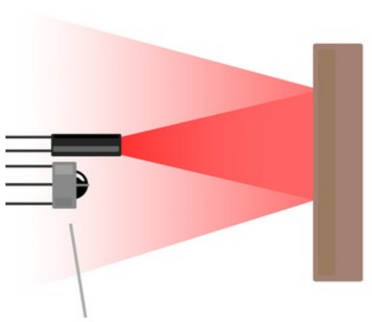
Servo motor is controlled by PWM (Pulse with Modulation) which is provided by the control wires. There is a minimum pulse, a maximum pulse and a repetition rate. Servo motor can turn 90 degree from either direction form its neutral position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position, such as if pulse is shorter than 1.5ms shaft moves to 0° and if it is longer than 1.5ms than it will turn the servo to 180°.

Servo motor works on **PWM (Pulse width modulation)** principle, means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. Basically, servo motor is made up of **DC motor which is controlled by a variable resistor (potentiometer) and some gears**. High speed force of DC motor is converted into torque by Gears. We know that WORK= FORCE X DISTANCE, in DC motor Force is less and distance (speed) is high and in Servo, force is high and distance is less. Potentiometer is connected to the output shaft of the Servo, to calculate the angle and stop the DC motor on required angle.

IR sensor:



No object present - no IR light detected by sensor



Object present - reflected IR light detected by sensor

IR Sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. By using an LED which produces light at the same wavelength as what the sensor is looking for, you can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor. This results in a large jump in the intensity, which we already know can be detected using a threshold.

16 X 4 display sensor:

16x4 LCD display is an alphanumeric display. It is based on the HD44780 display controller, and ready to interface with most microcontrollers.

It works on 5V and has a Green Backlight which can be switched on and off as desired. The contrast of the screen can also be controlled by varying the voltage at the contrast control pin(Pin 3).

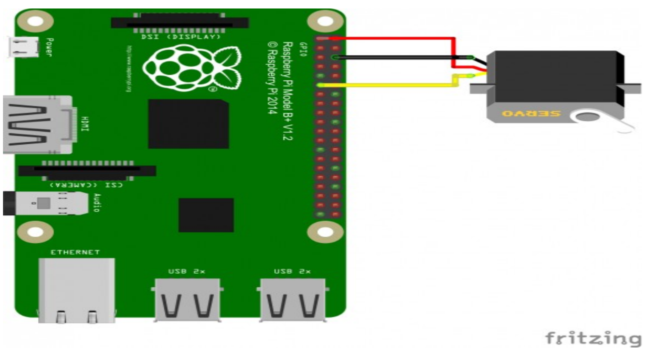
It is used along with Ada_fruit python library which converts our required message and send the required signals to lcd display.

Logitech webcam 640 X 480:

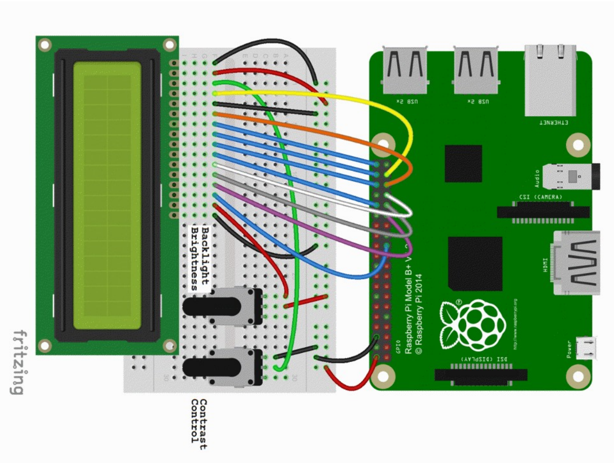
Just like a digital camera, it captures light through a small lens at the front using a tiny grid of microscopic light-detectors built into an image-sensing microchip (either a **charge-coupled device (CCD)** or, more likely these days, a **CMOS image sensor**). As we'll see in a moment, the image sensor and its circuitry converts the picture in front of the camera into digital format—a string of zeros and ones that a computer knows how to handle. Unlike a digital camera, a webcam has no built-in memory chip or flash memory card: it doesn't need to "remember" pictures because it's designed to capture and transmit them immediately to a computer. That's why webcams have USB cables coming out of the back.

Circuit Diagrams of sensor interfacing with Raspberry PI 3

Servo motor:



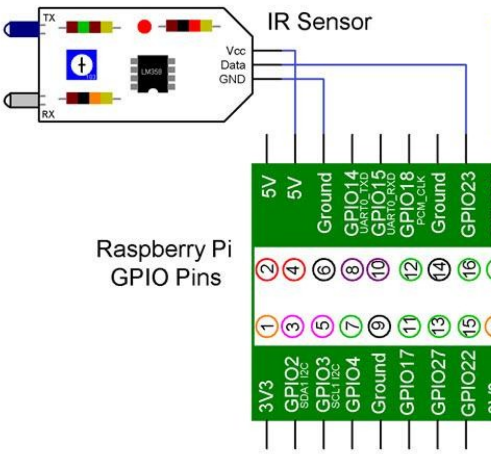
Display Sensor:



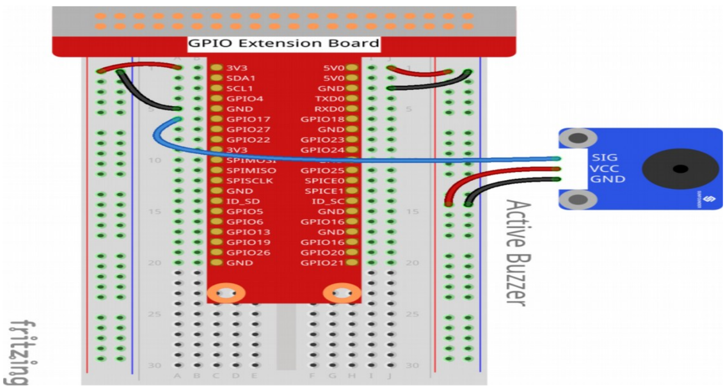
Webcam:

It is connected through USB interface to Raspberry PI 3

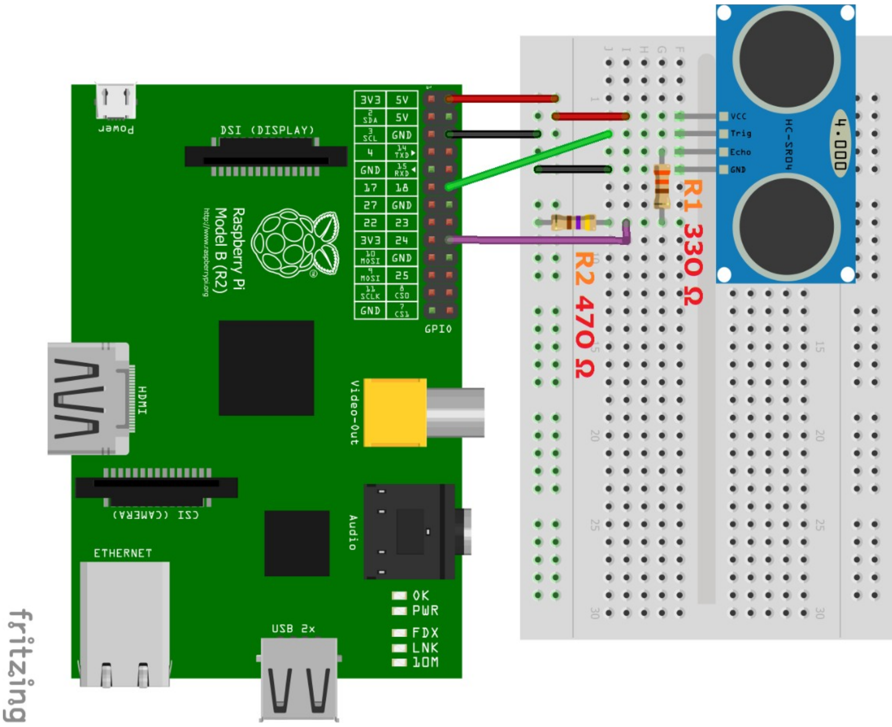
IR Sensor:



Buzzer:



Ultra Sonic Sensor :



Conclusions

- After working on this project for a month, we have realized that the prototype we were building to mimic the actions of an actual model which works on the same fundamental principles is a success to a great degree, but fails when many real-time problems are taken into account.
- More work should have been done at the site of deployment but due to the unavailability of the required equipment at the most needed hours stood against and discouraged us from building an actual prototype which would have been more practical than the prototype we have designed.

Drawbacks

- We have used MQTT service to facilitate the communication between pi and host server. But it is not always reliable. When the connection is weak it takes a lot of time to either establish the connection or to send the message which can create synchronization errors.
- A low-quality image generating camera has been used. The images taken by the camera wouldn't be clear if taken on a foggy day or a rainy day.

Scope of Future Work

- Currently we are working on localhost as a server but for it to be used by all web hosting has to be done.
- Making the machine learning algorithm more efficient by retraining the model on the faulty input images. If it becomes more efficient the security personnel's work would be reduced to a certain extent.
- We have used an IR sensor to detect if someone is trying to open the gate forcefully. But if the person stands in front of the sensor then it will not detect the intrusion. Instead we can use a clamping mechanism which is more reliable than this.