ARIES PROJECT REPORT

RAILWAY ALARM SYSTEM

Team Members

1. Akash Jha
2. Malay Kalavadia
3. Mritunjay Choubey
4. Shivanshu Kumar
5. Vidhi Khosla

Key Features -

1. Railway crossing barrier
2. Object detection on track
3. Fire alarm system in train

ROADMAP

1. First, we will design the sensor system for each of the above key features.

   This includes a gas alarm system placed inside the train, an ultrasonic system for railway crossing barrierand object detection on track.

   The railway crossing gate consists of ultrasonic sensors

   a) The sensors detect the train and close the barrier.

   b) This is done using an Arduino system that takes input using an ultrasonic sensor. In response tothis, the barrier motors rotate and close the gate when the train approaches the railway crossingjunction.

   Object detection on track is done using an ultrasonic sensor (HC-SR04)

   a) The sensor detects an object on track and sends a signal to the system.

   b) In response to the signal, the train stops.

   The gas alarm system detects smoke and alert passengers on three levels-

   a) Level 1- smoke level is indicated by LED. (SAFE)

   b) Level 2- smoke level indicated by a buzzer. (ALERT)

   c) Level 3- At this level, the train stops for evacuation. (DANGER LEVEL)

2. After that, we will do mathematical analysis regarding the distance at which the ultrasonic sensor will detectthe object and close the gate in response. Furthermore, it will stop the train. We will also analyze the ranges for 3 levels of smoke alarm.

3. Then, we will create those circuits on Tinker CAD and check their working

4. Next, we will design the project environment on an online simulation platform and integrate the circuits intothe environment.

5. If possible offline, we will make a train model with the above-specified smoke and object detection systemand the model of an automatic railway crossing junction with features as specified above.

Components-

1. Railway crossing barrier-

Arduino uno

Jumper wires

Ultrasonic sensor

Motors (Stepper)

LEDs

Resistors

Breadboard

Potentiometer

Arduino uno shield

2. Object detection on track

Arduino uno

Jumper wires

Ultrasonic sensor

IR sensor

LEDs

Resistors

Breadboard

Arduino uno shield

3. Fire alarm system in train

Arduino uno

Jumper wires

Gas sensor

LEDs

Resistors

Breadboard

Potentiometer

LCD board

Arduino uno shield

4. Train Model

Arduino uno

Arduino uno shield

Motors with tyres (DC)

Breadboard

Potentiometer

Resistors

Technical specifications

Object detection on railway track:

The object detection system uses the ultrasonic sensor and checks the presence of any object in the range of the ultrasonic sensor on the railway track. The ultrasonic sensor emits radiations of 40 kHz, which, after reflecting back from any object or any obstacle in the line of radiation, is received by the sensor. The time duration between the emitted and received radiation is used to calculate the distance of the obstacle from the sensor. Duration is converted into distance (Distance = 0.5 * Time * Speed of sound). Thus, using the ultrasonic sensor, we can detect the presence of any obstacle in the range of the ultrasonic sensor, along with the approximate distance of the obstacle from the sensor.

In our model, we have used an ultrasonic sensor on the front end of the train, which detects the presence of any obstacle on the track in the range of the sensor. When the object is in close proximity, we wish to stop the train and blow horn. This is shown in the tinker cad circuit.

In our tinker cad circuit, we have mounted an ultrasonic sensor on the top of our representation of train (using motors only). A lcd screen is attached to the Arduino which shows the distance of any object in the proximity of the sensor on the track. For our circuit, we have set the threshold to stop the train and turn on the buzzer at 250 cm from the sensor attached at the front. When the distance of the object is less than the threshold value, train stops and blows horn until the object is removed from the track. When the object is removed from the range of the sensor, the horn stops blowing, and train starts again.

Railway barrier crossing:

Railway barrier crossing system uses the ultrasonic sensor to detect the train passing through the train road junction, and accordingly sends signal to the Arduino which in turns rotates the motors of the barrierthereby closing it. A force sensor is also used in this system to detect the pressure on track, this helps in closing of the barrier only when train crosses the junction. When the train crosses the first ultrasonic sensor i.e., when the first coach of the train crosses the ultrasonic sensor, and the reading of the force sensor is high enough such that a train can be considered passing over the track the gates get closed by rotating the servo to 90 degrees. (We do this to avoid closing the gate in cases when a normal obstruction is present in front of the ultrasonic sensor rather than the train). When the last coach of the train crosses the ultrasonic sensor i.e... when the train has crossed the junction completely the barrier opens again by resetting the servos to the original configuration.

We detect the first and last coach by the difference of the readings of sensor at two instants, when the first coach crosses the sensor the difference of distances (final-initial) is negative and when the final coach crosses the second sensor the difference of the distances is positive.

Gas detection system:

Gas detection system is used in our project to detect the presence of fire or any harmful gas insidethe train. The gas sensor uses a chemi-resistor, whose resistance changes with the extent of harmful gases or fire present in its proximity. There are various gas sensors which detect the presence of different gases, which depends on the property of the chemi-resistor used in the gas sensor. In the presence of any harmful gas or fire in proximity of the gas sensor, the resistance of the chemi-resistor changes due to which the current in the gas sensor changes slightly. This current is passed through a load resistor inside the gas sensor. The gas sensor gives the voltage across this load resistor as an analog output. It can also give a digital output, stating whether gas is present or not as high or low, using a particular threshold value.

In our system, the gas sensor gives the analog voltage output, which signifies the concentration ofthe gas in the proximity of the sensor. We have chosen different threshold values for safe limit, alert, and danger limit.

Gas detection system-sensor output depends on the smoke level in the atmosphere. the sensordetects the change in smoke level. When the smoke level becomes more than a certain threshold the alarm gets triggered. In the safe zone the buzzer is off, and the LCD board attached to the Arduino board gives output of SAFE, as the limit of 70% of the maximum safe limit is reached the buzzer starts producing sound at certain intervals as defined in the code and the LED changes to red while the LCD board gives an ALERT output. When the smoke levels cross the threshold, the buzzer starts beeping continuously and the LED is red, the train comes to a complete halt and the LCD board displays ALERT Stopping train.

CONTROL PANEL

INSIDE LAYOUT

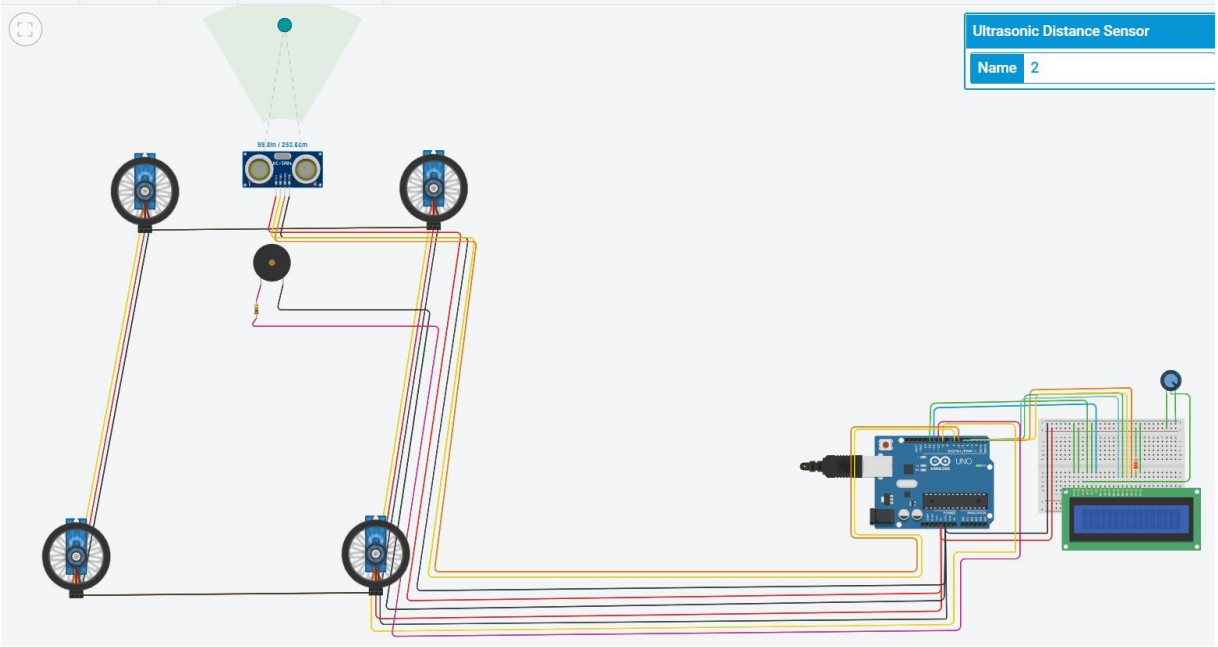
FEASIBILITY IN ONLINE MODE

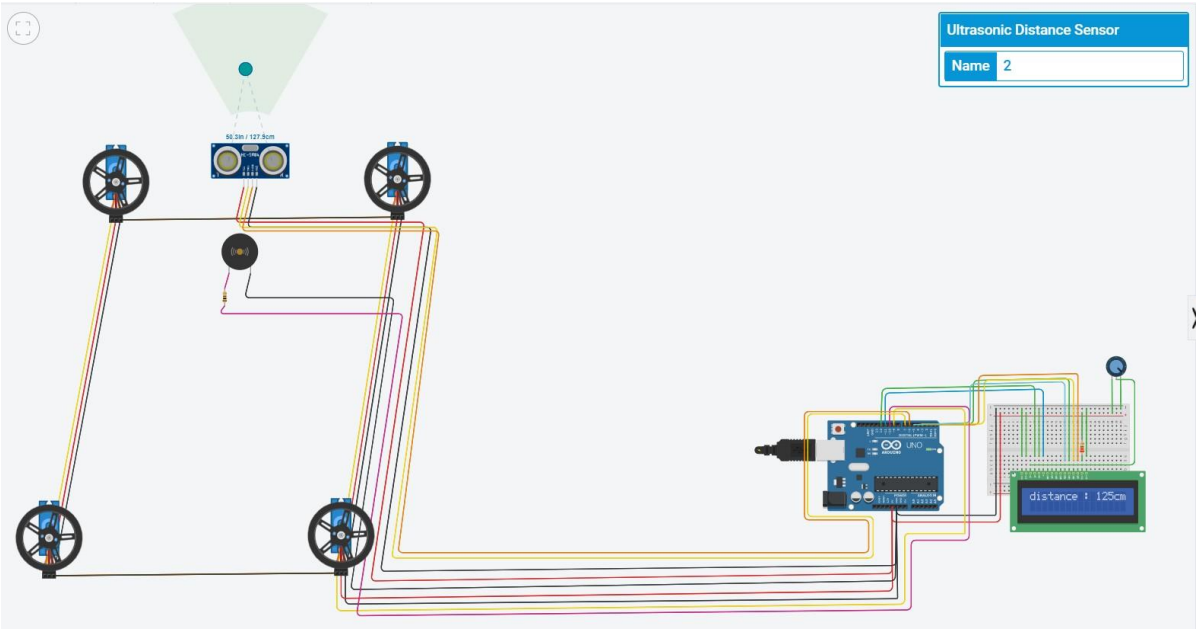
Feasibility of this project in online mode depends on availability of simulation platforms, and their ability tocombine working environment and circuits.

Since the project uses many hardware components so it is difficult to represent the model in online mode,but we are trying to find simulations for proper representation of working of our model.

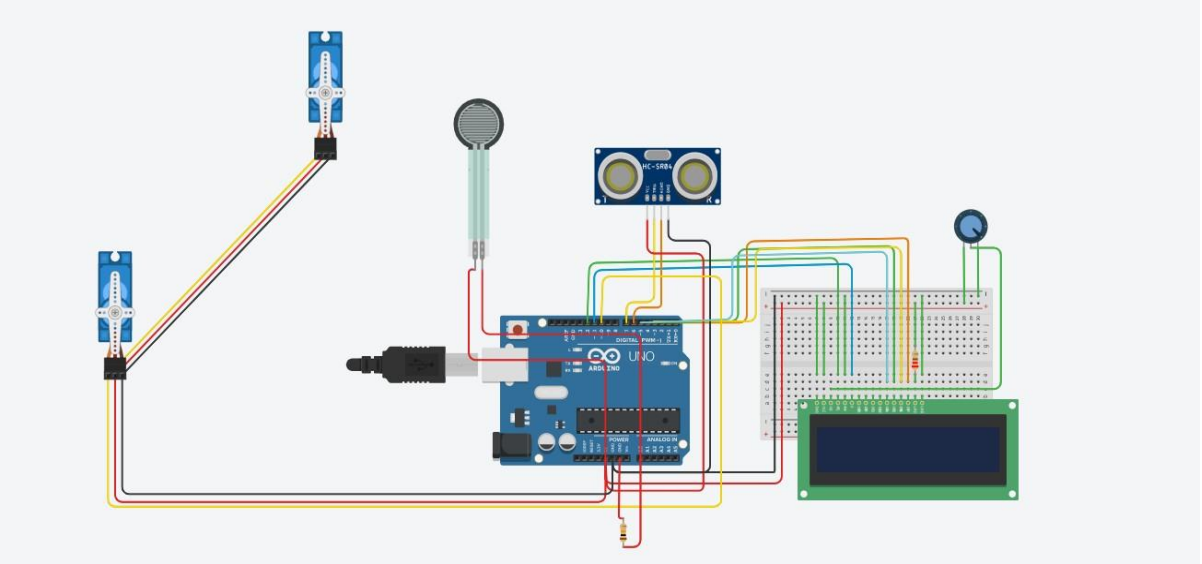
CIRCUITS

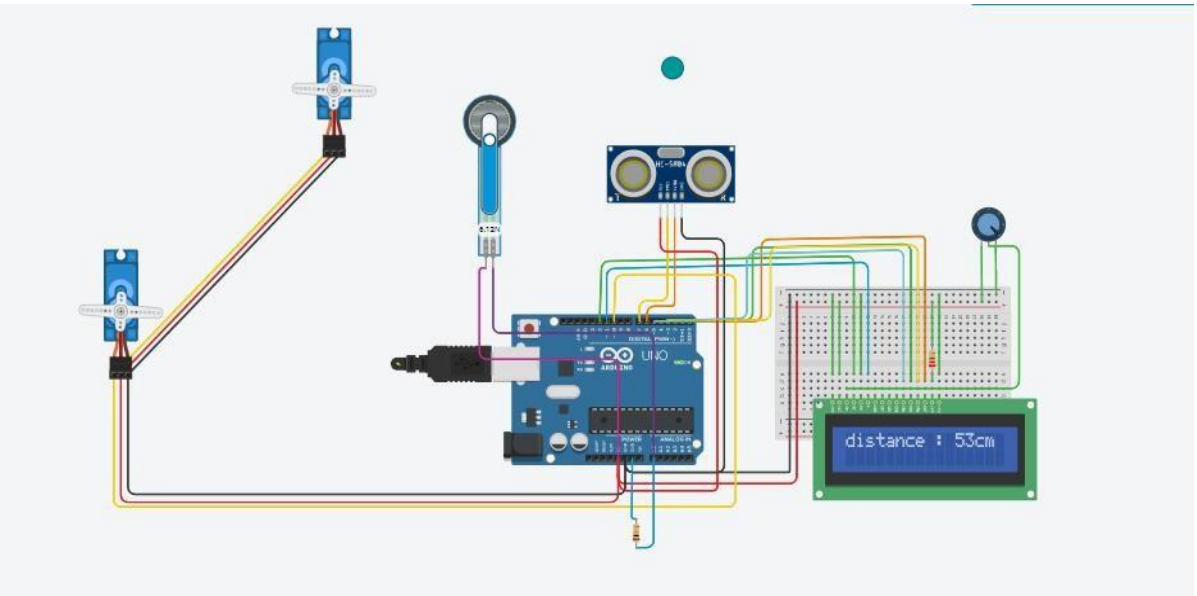
Object detection system using ultrasonic sensor



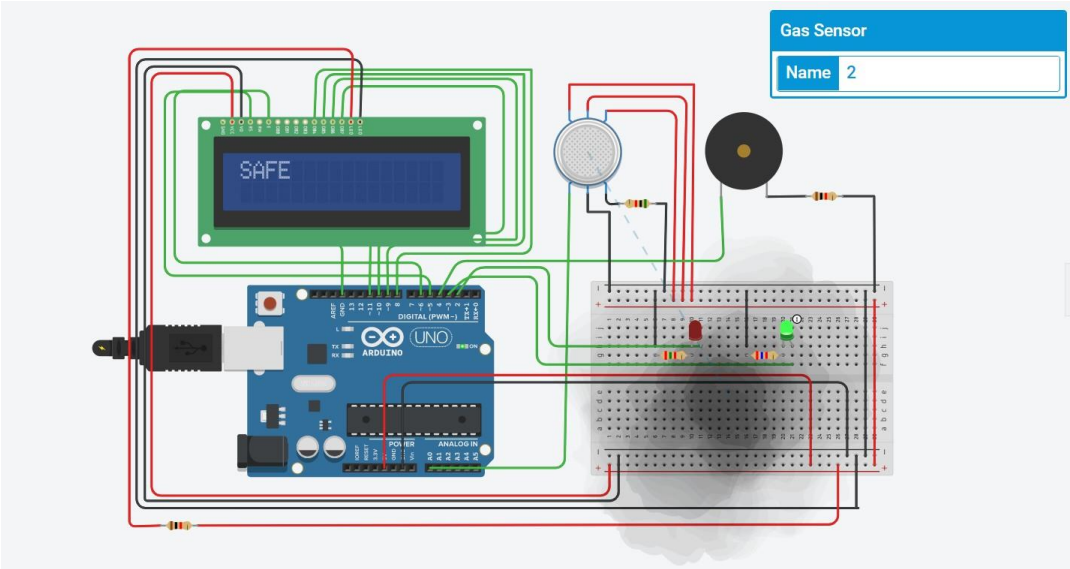


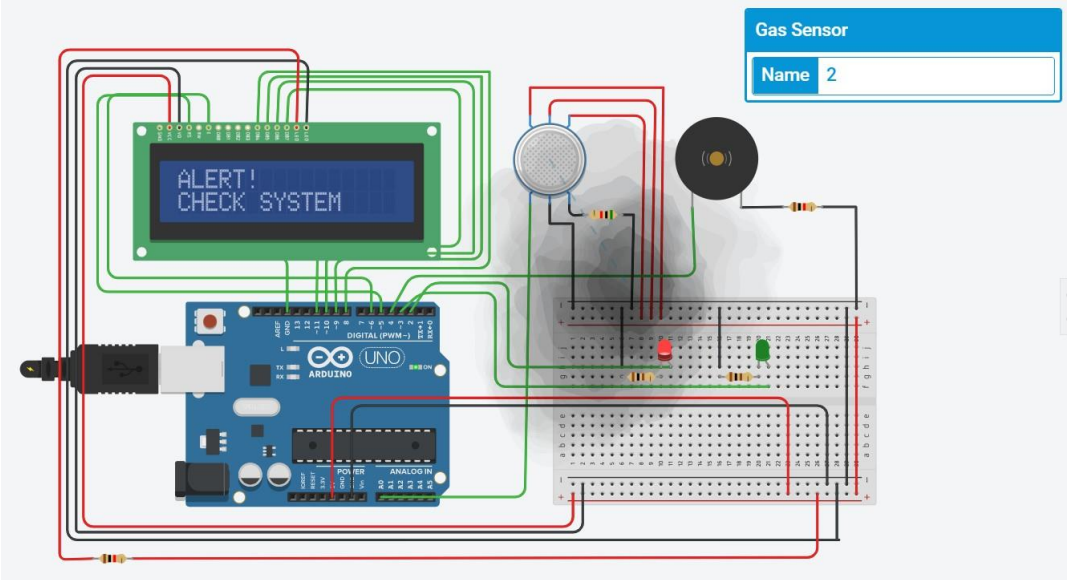
Railway crossing barrier system using ultrasonic sensor

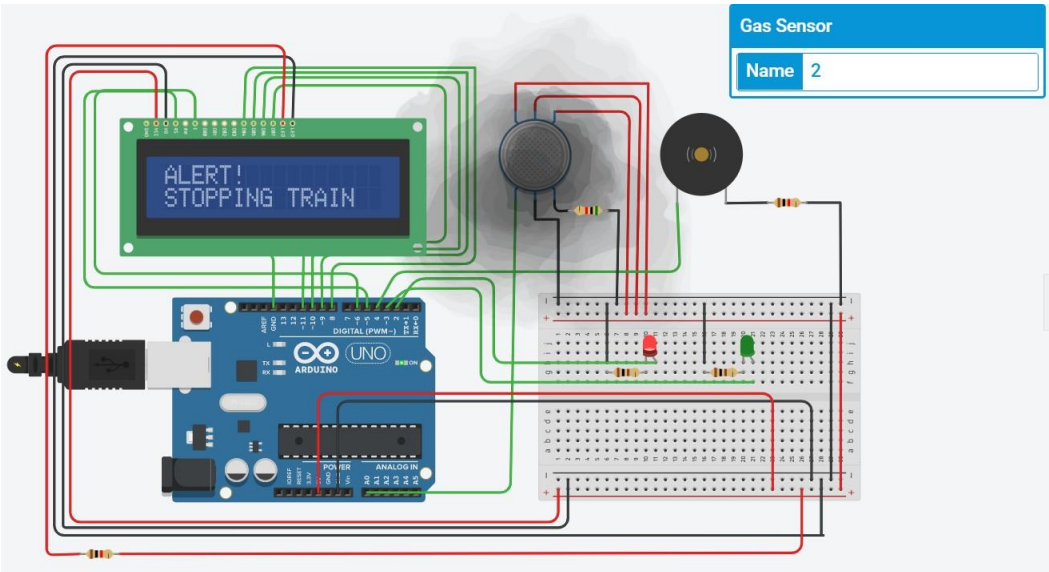




Fire Safety Alarm







Sensors used

Gas Sensor

(Chem resistors)

When the Gas comes in contact with the material in sensor there is change of resistance of the sensing material and detection is based on this change.

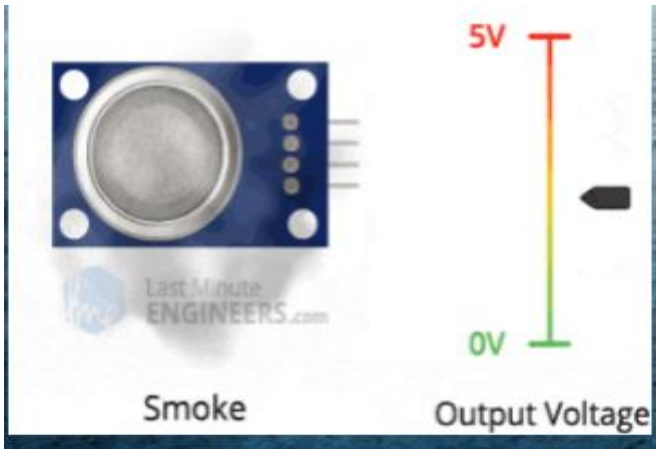
Gas sensor

1)works on 5V DC

2) Draws around 800mW.

3) Can detect- LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations anywhere from 200 to 10000ppm.

Structure-Enclosed in two layers of fine stainless-steel mesh called Anti-explosion network. It ensures that heater element inside the sensor will not cause an explosion, as we are sensing flammable gases.



Force sensor

is basically a variable resistor which changes the resistance when pressure is experienced by the sensor.

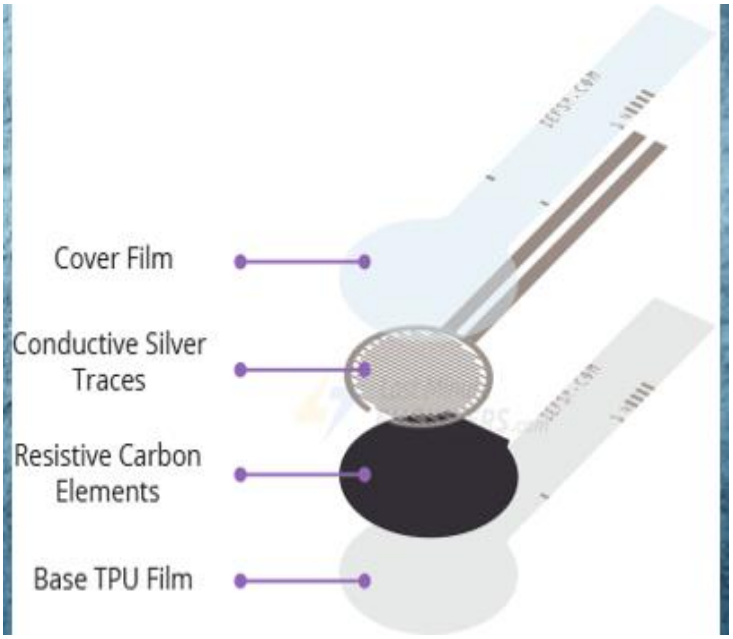
It is made up of multiple thin flexible layers. As the sensor is pressed the greater number of carbon elements touches the conductive traces, due to this resistance reduces.

There are two type of force sensor:

1) Circular sensing area: Small circular sensor provides greater accuracy to the sensing field.

2) Square sensing area: Large square sensor provides broad area sensing.

When there is no pressure, the sensor behaves like an infinite resistor (open circuit). The harder you press on the head of the sensor, the lower the resistance between the two terminals will be, but as you remove the pressure it will return to its original value.



Ultrasonic sensor (HC-SR04)

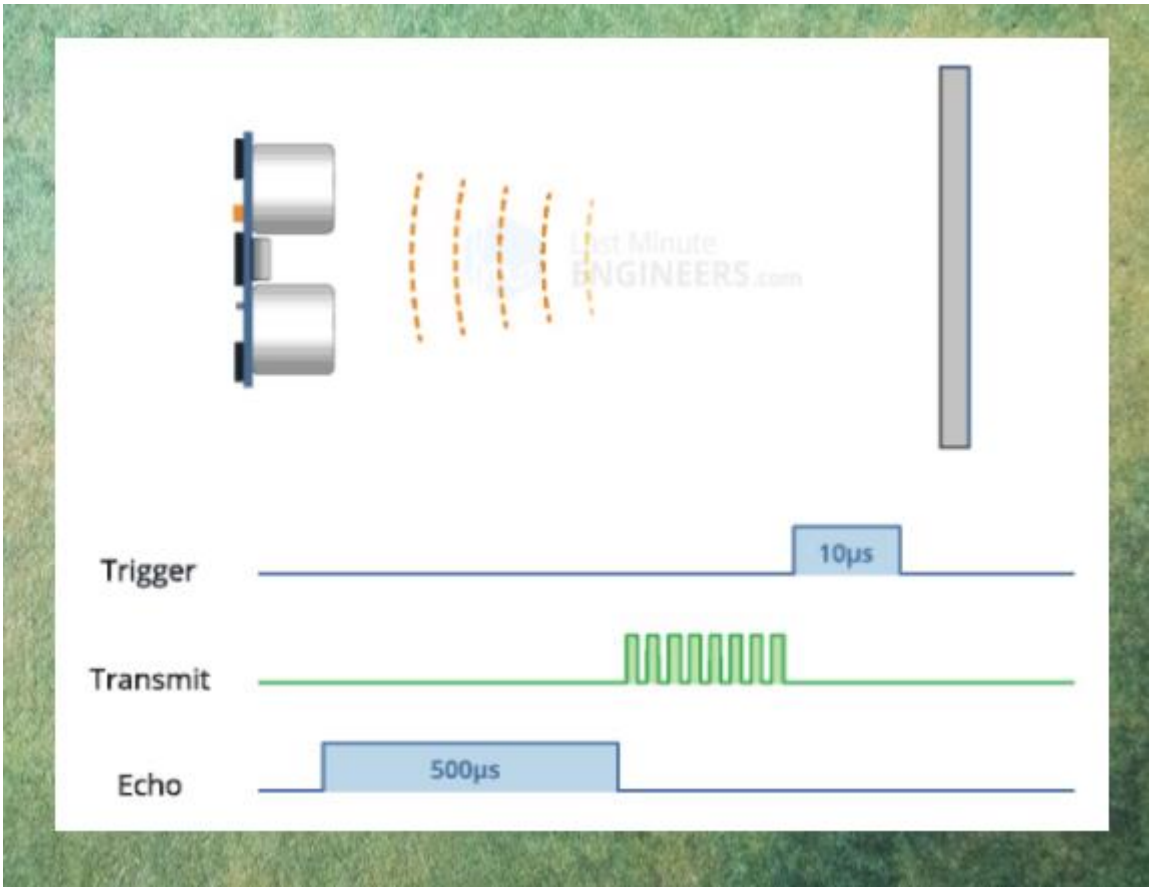
An ultrasonic sensor sends and receive ultrasonic pulse using a transducer, which gives the detail about the object's proximity.

A distinct pattern is produce using reflection of the high-frequency sound waves from the object.

Ultrasonic sensor has two main components:

1)The transmitter (emits the sound using piezoelectric crystal)

2) The receiver (detect the sound after it has travelled to and from the target)



Challenges

We faced many challenges during the project

1) The major difficulty we faced during project was to find a proper simulation platform for the project.
2) If any flying object is passed by the object detection sensor than it will detect it and stop the train.
3) Cost for the implication (Requires large scale testing before proper application)

Solution

1) With the help of machine learning we can use grid-eye sensor to detect the human so the problem of the flying object can be solved.