Table of Contents:

Abstract:

Road accidents are a human tragedy. They involve high human suffering and monetary costs in terms of untimely death, injuries and social problems. Although we have undertaken many initiatives and are implementing various road safety improvement program the overall situation as revealed by data is far from satisfactory. India had earned the dubious distinction of having most number of fatalities due to road accidents in the world. Road safety is emerging as a major social concern around the world especially in India because of infrastructure project works. Hence, this paper presents a model to avoid road accident near road turns, Schools & Colleges.

The basic aim of this system is to reduce accidents on the roads where the other end cannot be seen by driver. This problem occurs also at curved roads and mountain roads, thousands of people lose their lives because of this. The solution for this problem is a double feedback alerting system. The system works by alerting people crossing the road about whether a vehicle is approaching their way or not and also informing the driver if there's any one on the road. This is done by keeping ultrasonic sensors on both side of the road and keeping a LED light at optimum position so that if vehicle comes from one end of the road, sensor senses and LED light glows at the opposite side and pedestrian is informed whether it is safe to cross or not.

Introduction:

During the calendar year 2010, there were close to 5 lakh road accidents in India, which resulted in more than 1.3 lakh persons. These numbers translate into one road accident every minute, and one road accident death every 4 minutes. Unfortunately, more than half the victims are in the economically active age group of 25-65 years. In India 137,000 people are killed because of road accidents. That is about 377 people per day. In that 3.7% because people failed to look at the road.

The solution for this problem is alerting the driver about the obstacle or pedestrian crossing road. Usually horn is used for this purpose. But in the rainy seasons horn will not be heard. Some people will not use horn itself. So horn is not a good solution to solve this problem. These are the major reasons for accidents.

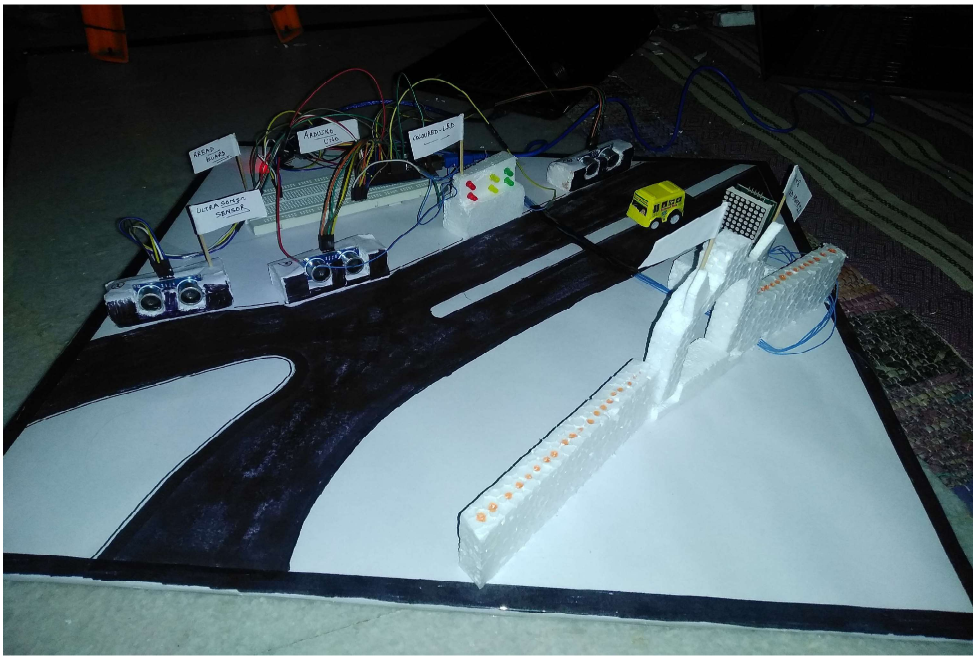
To avoid these problems in roads we are introducing sensor based accident prevention system. We are keeping ultrasonic sensors in one side of the road and keeping a LED light after some distance. When a vehicle crosses the ultrasonic sensor at that time light will glow at the other side of the road. In the absence of the vehicle the signal will not be received by the sensor and the light will not glow. We'll be using two sensors which will be used to both track how many vehicles are crossing that point and what is the speed of these vehicles. Based on these data, microcontroller will decide whether it is safe to cross the road or not. For road being safe to cross, it will glow Green Led. For road being unsafe, it will glow Red Led and for moderately safe roads, it will glow Orange Led.

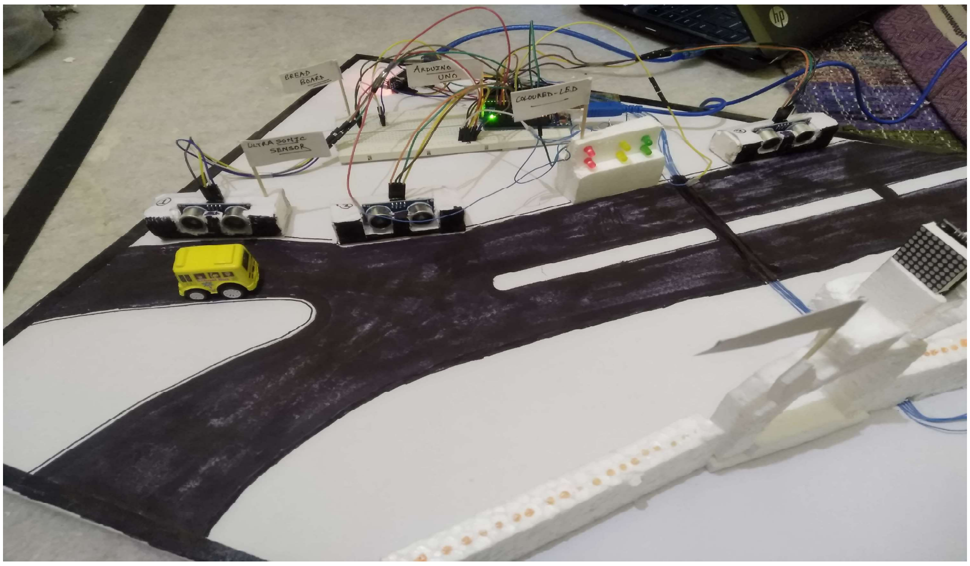
GSM & GPS technology based prevention models have also been proposed.

This paper presents an Arduino based model to prevent accidents and to provide road safety.

ACCIDENT PREVENTION MODEL:

The Accident prevention model presented in this section is as simple as shown in Figure 1, yet reliable. It is designed in such a way that it uses DC power supply for its functioning. Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the human audible range. They are based on three physical principles: time of flight, the Doppler Effect, and the attenuation of sound waves. Ultrasonic sensors are non-intrusive in that they do not require physical contact with their target, and can detect certain clear or shiny targets otherwise obscured to some vision-based sensors. On the other hand, their measurements are very sensitive to temperature and to the angle of the target.





To detect the moving vehicles, ultrasonic sensor (HC-SR04) is employed. This sensor can be operated at +5V.
We are using two HC-SR04 which will be used to calculate both speed and amount of traffic crossing through that area. Based on this data, our predefined algorithm burned into Arduino will give output on LED matrix display about whether it is safe to cross the street or not.

Project Objective:

Overall Objective:
To design an Arduino based accident prevention system capable of minimising accidents and saving human lives.

Specific Objectives:
To design a low cost and an effective Atmel 328 MCU based model to prevent accidents by alerting both pedestrian and driver.
To incorporate a LED matrix display to show when it is safe to cross the road.

Project Justification:
In India 137,000 people are killed because of road accidents. That is about 377 people per day. In that 3.7% because of failed to look the road or unable to see vehicle coming toward them because of some reason. Unfortunately, more than half the victims are in the economically active age group of 25-65 years. The loss of the main bread winner can be catastrophic. This project is a little effort to minimise the losses of important human lives because of road accidents.

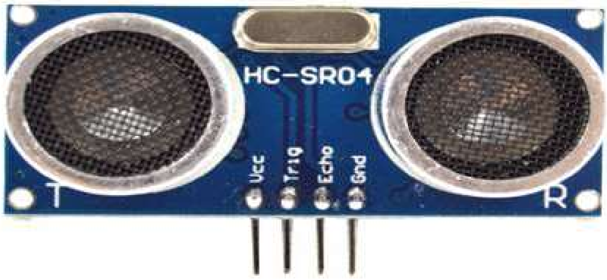
Hardware Requirements:

1. Ultrasonic Sensor HC-SR04
2. Arduino UNO
3. Arduino NANO
4.8*8 LED Matrix Display
5. Colored LEDs

Operating Principle of Ultrasonic Sensor:

The Figure shows a photo of Ultrasonic sensor. Ultrasonic sensors "are based on the measurement of the properties of acoustic waves with frequencies above the human audible range," often at roughly 40 kHz. They typically operate by generating a high-frequency pulse of sound, and then receiving and evaluating the properties of the echo pulse.
Three different properties of the received echo pulse may be evaluated, for different sensing purposes. They are:

- Time of flight (for sensing distance)
- Doppler shift (for sensing velocity)
- Amplitude attenuation (for sensing distance, directionality, or attenuation coefficient)



The three methods above make use of different physical principles, but they all employ the same measuring procedure. In each case, an ultrasonic sound wave is created, received, and evaluated. The main advantage of ultrasonic sensors is that measurements may be made without touching or otherwise impeding the target. In addition, depending on the distance measured, measurement is relatively quick.

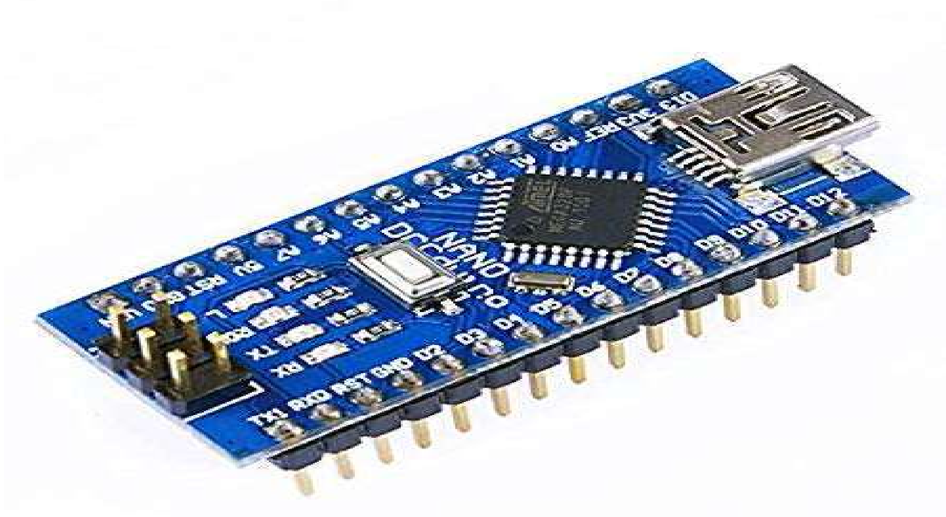
Arduino UNO:

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with an AC to-DC adapter or battery to get started. The power for Arduino can be derived from Non-conventional sources like solar energy.

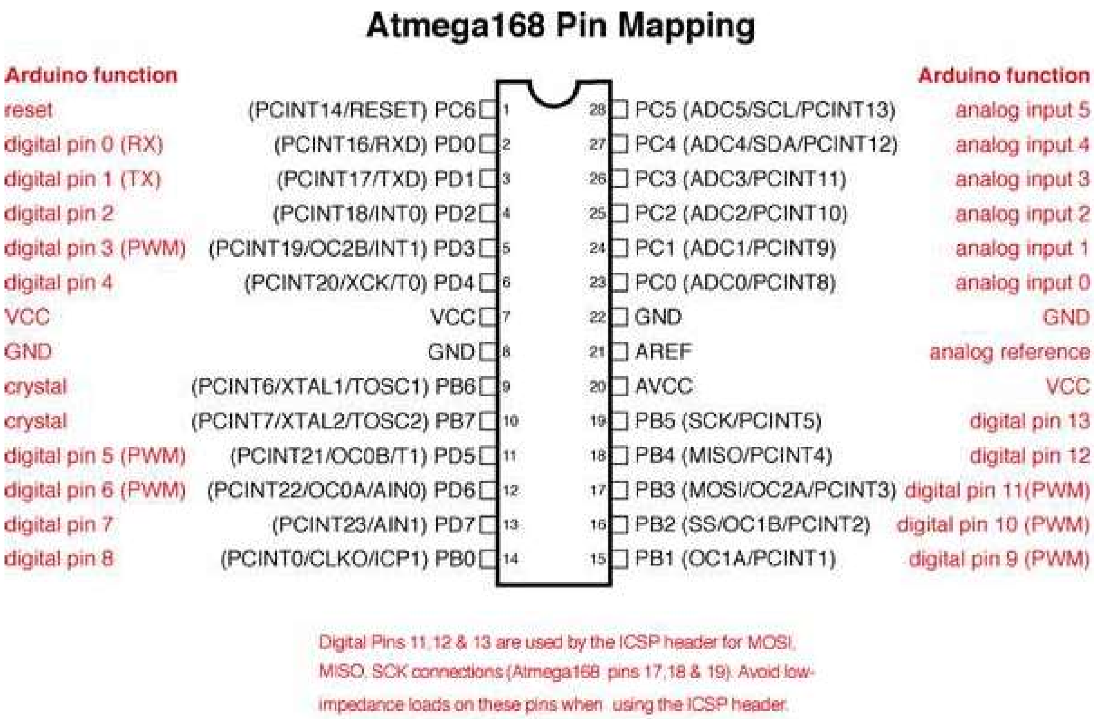
The Arduino Uno can be programmed with the (Arduino Software (IDE)). The ATmega328 on the Arduino Uno comes preprogrammed with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. We can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar.
The Arduino Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically.
External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery.
The board can operate on an external supply from 6 to 20 volts. It also has 2 KB of SRAM and 1 KB of EEPROM.

Arduino NANO:

The Arduino Nano, as the name suggests is a compact, complete and bread-board friendly microcontroller board. The Nano board weighs around 7 grams with dimensions of 4.5 cms to 1.8 cms (L to B).
Arduino Nano has similar functionalities as Arduino Duemilanove but with a different package. The Nano is inbuilt with the ATmega328P microcontroller, same as the Arduino UNO. The main difference between them is that the UNO board is presented in PDIP (Plastic Dual-In-line Package) form with 30 pins and Nano is available in TQFP (plastic quad flat pack) with 32 pins. The extra 2 pins of Arduino Nano serve for the ADC functionalities, while UNO has 6 ADC ports but Nano has 8 ADC ports. The Nano board doesn't have a DC power jack as other Arduino boards, but instead has a mini-USB port. This port is used for both programming and serial monitoring. The fascinating feature in Nano is that it will choose the strongest power source with its potential difference, and the power source selecting jumper is invalid.



Pin Mapping of Atmega 168/328:



Introduction to ATmega328:

ATmega328 is an eight (8) bit Microcontroller. It can handle the data sized of up to eight (8) bits. It is an AVR based micro-controller. Its built-in internal memory is around 32KB. It operates ranging from 3.3V to 5V. It has an ability to store the data even when the electrical supply is removed from its biasing terminals. Its excellent features include the cost efficiency, low power dissipation, programming lock for security purposes, and real timer counter with separate oscillator. It's normally used in Embedded Systems applications. You should have a look at these Real Life Examples of Embedded Systems, we can design all of them using this Microcontroller.

ATmega-328 is an AVR Microcontroller having twenty eight (28) pins in total.

VCC is a digital voltage supply.

AVCC is a supply voltage pin for analog to digital converter.

GND denotes Ground and it has a 0V.

Port A consists of the pins from **PA0** to **PA7.** These pins serve as analog input to analog to digital converters. If analog to digital converter is not used, **port A** acts as an eight (8) bit bidirectional input/output port.

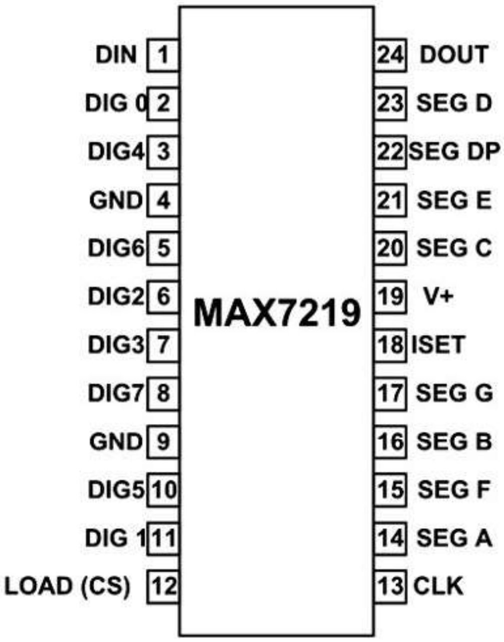
ATmega328 Pins			
Pin Number	Pin Name	Pin Number	Pin Name
1	PC6	15	PB1
2	PD0	16	PB2
3	PD1	17	PB3
4	PD2	18	PB4
5	PD3	19	PB5
6	PD4	20	AVCC
7	Vcc	21	AREF
8	GND	22	GND
9	PB6	23	PC0
10	PB7	24	PC1
11	PD5	25	PC2
12	PD6	26	PC3
13	PD7	27	PC4
14	PB0	28	PC5

Port B consists of the pins from **PB0** to **PB7.** This port is an 8 bit bidirectional port having an internal pull-up resistor.
Port C consists of the pins from **PC0** to **PC7.** The output buffers of **port C** has symmetrical drive characteristics with source capability as well high sink.
Port D consists of the pins from **PD0** to **PD7.** It is also an 8 bit input/output port having an internal pull-up resistor.

LED Matrix Display (MAX7219):

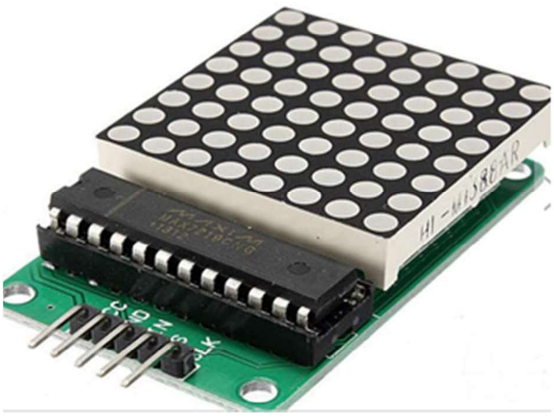
MAX7219 IC:

The MAX7219 are compact, serial input/output common-cathode display drivers that interface microprocessors (µPs) to 7-segment numeric LED displays of up to 8 digits, bar-graph displays, or 64 individual LEDs. Included on-chip are a BCD code-B decoder, multiplex scan circuitry, segment and digit drivers, and an 8x8 static RAM that stores each digit. Only one external resistor is required to set the segment current for all LEDs. The MAX7221 is compatible with SPI™, QSPI™, and MICROWIRE™, and has slew-rate-limited segment drivers to reduce EMI.
A convenient 4-wire serial interface connects to all common µPs. Individual digits may be addressed and updated without rewriting the entire display. The MAX7219/MAX7221 also allow the user to select code-B decoding or no-decode for each digit. The devices include a 150µA low-power shutdown mode, analog and digital brightness control, a scan-limit register that allows the user to display from 1 to 8 digits, and a test mode that forces all LEDs on.
For applications requiring 3V operation or segment blinking.



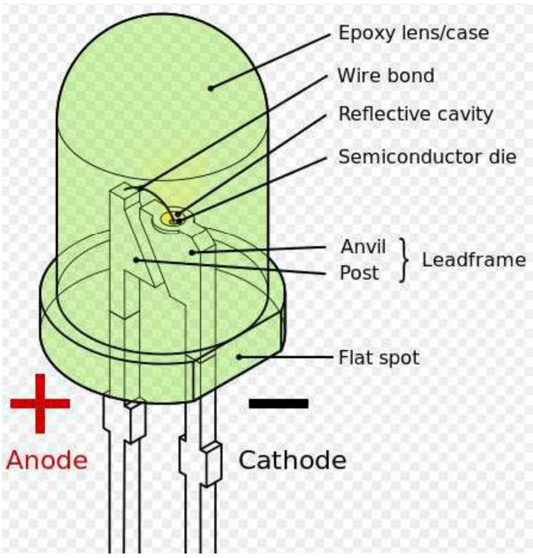
LED Matrix Display:

In a dot matrix display, multiple LEDs are wired together in rows and columns. This is done to minimize the number of pins required to drive them. For example, a 8×8 matrix of LEDs (shown below) would need 64 I/O pins, one for each LED pixel. By wiring all the anodes together in rows (R1 through R8), and cathodes in columns (C1 through C8), the required number of I/O pins is reduced to 16. Each LED is addressed by its row and column number. In the figure below, if R4 is pulled high and C3 is pulled low, the LED in fourth row and third column will be turned on. Characters can be displayed by fast scanning of either rows or columns. This tutorial will discuss the method of column scanning.
The LED matrix used in this experiment is of size 5×7. We will learn how to display still characters in a standard 5×7 pixel format. The figure below shows which LEDs are to be turned on to display the English alphabet 'A'. The 7 rows and 5 columns are controlled through the microcontroller pins.



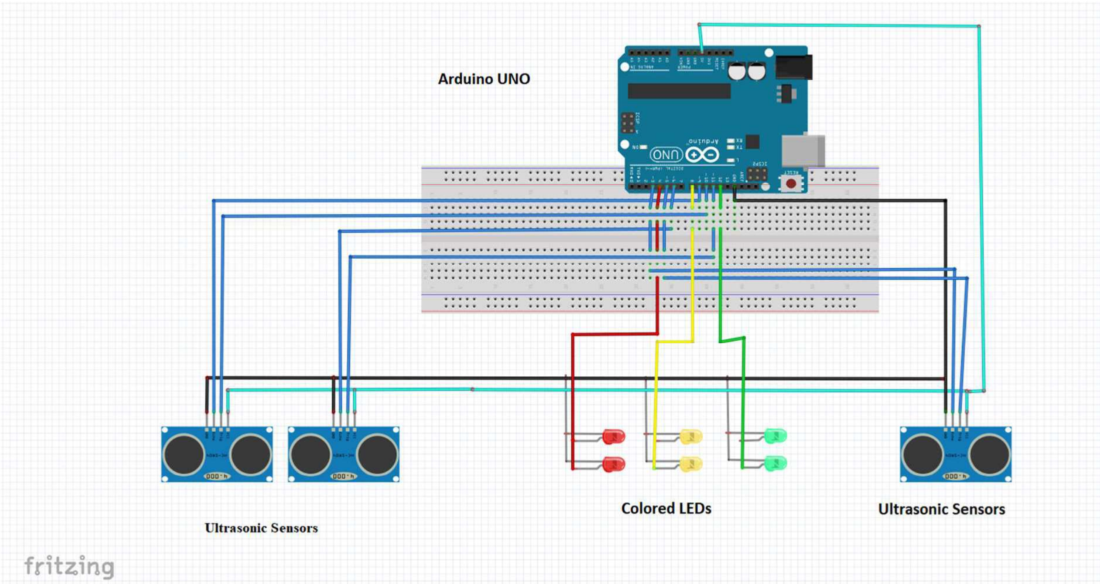
Light Emitting Diode (LED):

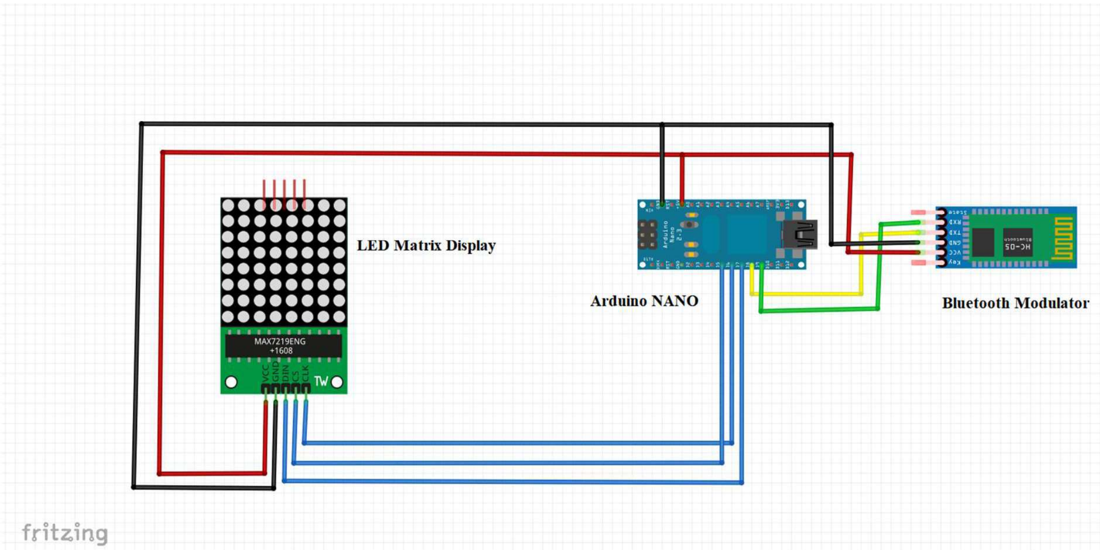
The lighting emitting diode is a p-n junction diode. It is a specially doped diode and made up of a special type of semiconductors. When the light emits in the forward biased, then it is called as a light emitting diode. The light emitting diode simply, we know as a diode. When the diode is forward biased, then the electrons & holes are moving fast across the junction and they are combining constantly, removing one another out. Soon after the electrons are moving from the n-type to the p-type silicon, it combines with the holes, then it disappears. Hence it makes the complete atom & more stable and it gives the little burst of energy in the form of a tiny packet or photon of light. The working principle of the Light emitting diode is based on the quantum theory. The quantum theory says that when the electron comes down from the higher energy level to the lower energy level then, the energy emits from the photon. The photon energy is equal to the energy gap between these two energy levels. If the PN-junction diode is in the forward biased, then the current flows through the diode. The flow of current in the semiconductors is caused by the both flow of holes in the opposite direction of current and flow of electrons in the direction of the current. Hence there will be recombination due to the flow of these charge carriers.



The recombination indicates that the electrons in the conduction band jump down to the valence band. When the electrons jump from one band to another band the electrons will emit the electromagnetic energy in the form of photons and the photon energy is equal to the forbidden energy gap.

Design Methodology:





CODE:

```
int trigPin1=11;    //sensor 1

int echoPin1=12;    //sensor 1

int trigPin2=8;     //sensor 2

int echoPin2=9;     //sensor 2

int rled=5;         //red signal

int yled=6;         //yellow signal

int gled=7;         //green signal

int flag=0;         //for detecting if someone has arrived at sensor1.

long t,t1,t2,t3;

long d;

long distance=100;  //distance between sensor2 and signal pole(in mts.)

long sp;            //speed of vehicle

long vlength;       //length of vehicle, yellow signal for bikes(which have
                    //length<200cms)

long normalDist1,normalDist2;//distance returned without any object in front by
sensors.

long newDist1,newDist2;//distance returned when any object comes in front of
sensors.


void setup(){

  Serial.begin(9600);

  pinMode(trigPin1,OUTPUT);

  pinMode(echoPin1,INPUT);

  pinMode(trigPin2,OUTPUT);

  pinMode(echoPin2,INPUT);


  digitalWrite(gled,HIGH);      //initially signal is green


  digitalWrite(trigPin1,LOW);

  delayMicroseconds(10);

  digitalWrite(trigPin1,HIGH);

  delayMicroseconds(10);

  d=pulseIn(echoPin1,HIGH);

  normalDist1= (d/2)/29.1;
```

```
  digitalWrite(trigPin1,LOW);
  delayMicroseconds(10);
  digitalWrite(trigPin1,HIGH);
  delayMicroseconds(10);
  d=pulseIn(echoPin2,HIGH);
  normalDist2=(d/2)/29.1;
}

void showSignal(int s,int len){

    t=(distance*100)/s; //time taken by vehicle to pass by signal in microseconds
    s=s*36; //converting cm/ms to kmph

    if(s>26 && len>200){
        digitalWrite(gled,LOW);
        digitalWrite(rled,HIGH);
        digitalWrite(yled,LOW);
        delayMicroseconds(t);
    }
    else if((s<26 && s>18) || len<200){
        digitalWrite(gled,LOW);
        digitalWrite(yled,HIGH);
        digitalWrite(rled,LOW);
        delayMicroseconds(t);
    }
    else{
        digitalWrite(rled,LOW);
        digitalWrite(gled,HIGH);
        digitalWrite(yled,LOW);
        delayMicroseconds(t);
    }
}
```

```
void loop(){
  digitalWrite(trigPin1,LOW);
  delayMicroseconds(10);
  digitalWrite(trigPin1,HIGH);
  delayMicroseconds(10);
  d=pulseIn(echoPin1,HIGH);
  newDist1=(d/2)/29.1;

   if(flag==1 && newDist1>normalDist1-20){
    //using plus-minus 20 to make sensor less sensitive.
    t2=millis(); //vehicles leaves at sensor1
    t=t2-t1;
    while(1){
         digitalWrite(trigPin2,LOW);
         delayMicroseconds(10);
         digitalWrite(trigPin2,HIGH);
         delayMicroseconds(10);
         d=pulseIn(echoPin2,HIGH);
         newDist2=(d/2)/29.1;
         if(newDist2<normalDist2-20){
              t3=millis();
              t=t3-t1;
              sp=distance/t;
              t=t2-t1;
              vlength=sp*t;
              showSignal(sp,vlength);
              break;
         }
    }
    flag=0;
    delay(10);
  }

  if (newDist1<normalDist1-20 && flag==0){
```

```
      Serial.println("entry");
      t1=millis();
      Serial.print(t1);
      flag=1; //for vechile arrives at sensor1
  }


}
```

CONCLUSION AND RECOMMENDATIONS:

Conclusion:

The objective of the project was to design and implement an Accident prevention model which can alert driver and pedestrian about potential accident threat. The vehicle detector has been designed that uses Arduino UNO and Ultrasonic sensors. The LED shows a green to show that there is no threat in crossing the road. When there is a threat (i.e. Vehicle(s) are approaching) flashes a red LED. We also have implemented LED matrix display to gain the attention of pedestrians so that they can actually make use of the system implemented. The accident prevention model is low cost. The components that goes into making the detector does not exceed Rs.2200. If this is done with mass production then the detector can go for a price of Rs.1500 which would very easily affordable and competitive in the market. The objective of designing low cost Arduino based accident prevention model has been well achieved.

Recommendations:

This project might look good it can further be improved. Despite being informed about vehicle coming, a person might still go on to cross the road or despite knowing that a person is on the road, driver may continue to drive fast. In both the cases, accident is bound to happen. The only way to avoid this is by placing a fence on both side of the road which will automatically rise when a vehicle is approaching. By doing this, in case of potential threat, no person can cross the road and it'll further increase the safety.
The inclusion of road fencing would greatly improve the performance of this accident Prevention model. There might also arise the case where the accident have already taken place, in such cases we can also take help of GSM technology to send and alert to nearest hospital and police station regarding the same. We can further implement IOT which will help us control the Arduino remotely with a help of a smartphone.

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