DES 211

CREATIVITY AND CONCEPT IN DESIGN

FINAL PROJECT

REPORT

SMART STREETLIGHTS

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ACKNOWLEDGEMENTS

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1. Objective (Problem Identification)

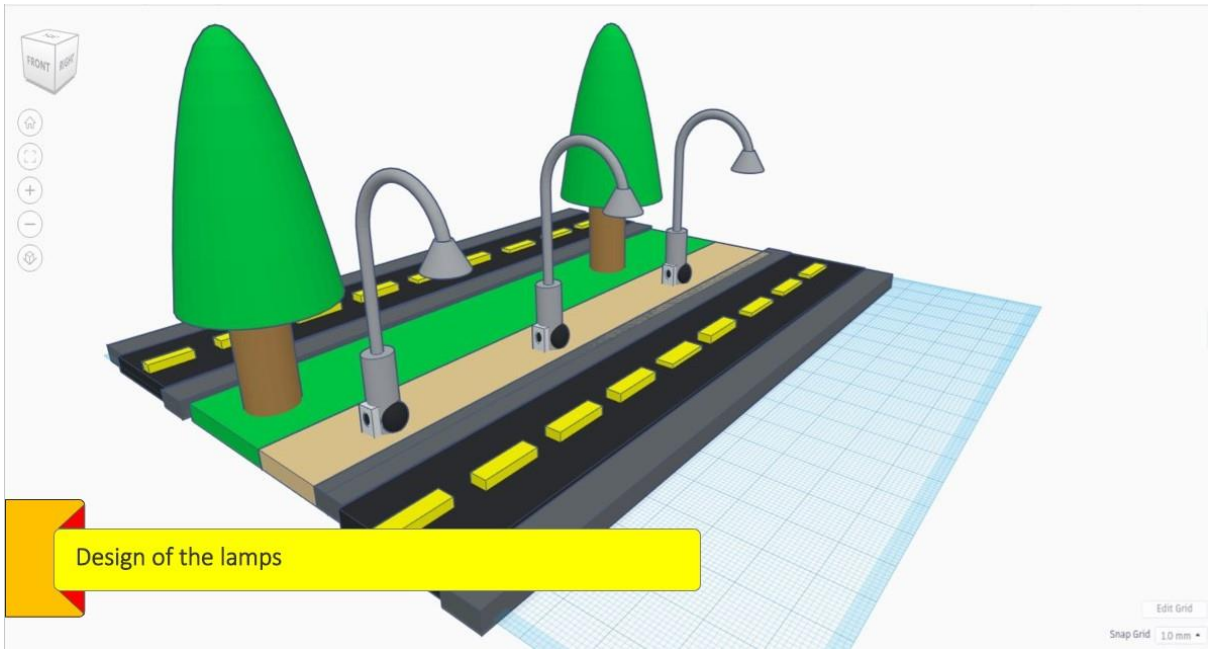
Every day, an enormous amount of energy is wasted at night in the form of light. A plethora of streets and highways have streetlights that remain switched on during the entire night, even when there is not a single person who is walking or driving a car on that street.

We propose a model which shall utilize a simple method to switch on only the necessary streetlights for only the necessary amount of time. We propose to use a 4-pin ultrasonic sensor connected to an Arduino Uno. The setup shall provide energy only when a sensor is tripped.

Our setup shall have sensors at every 250m intervals of highways and shall

turn on the streetlights for the next 500m once a vehicle is sensed. The duration of the streetlights remaining on shall be 1 minute.

To demonstrate our model, we will make an online prototype that shall use a model car, an ultrasonic sensor, and an Arduino Uno. Once the sensor detects a vehicle, it will turn on the next 3 LEDs which is analogous to turning on the next 17 streetlights on an actual highway.



2. Technologies Used

- ## Tinkercad

  Tinkercad is a free online collection of software tools that help people all over the world think, create and make. It is the ideal introduction to Autodesk, the leader in 3D design, engineering and entertainment software. **[I]**

- ## Arduino

  Arduino is the world's leading open-source hardware and software ecosystem. The Company offers a range of software tools, hardware platforms and documentation enabling almost anybody to be creative with technology.

  The first Arduino board was introduced in 2005 to help design students — who had no previous experience in electronics or

microcontroller programming — to create working prototypes connecting the physical world to the digital world. Since then it has become the most popular electronics prototyping tool used by engineers and even large corporations.

Arduino is the first widespread Open Source Hardware project and was set up to build a community that could help spread the use of the tool and benefit from contributions from hundreds of people who helped debug the code, write examples, create tutorials, supports other users on the forums and build thousands of groups around the globe. We are eternally grateful for being supported by such an amazing community.

The openness and ease-of-use of the project has led to mass adoption of micro-controller based electronics projects and was a catalyst in the creation of the Maker Movement. Arduino has become the number one choice for electronics makers,

especially for developing solutions for the IoT marketplace, which has been predicted to become a $6 trillion market by 2021. **[II]**

- **Ultrasonic Distance Sensor**

Ultrasonic distance sensor determines the distance to an object by measuring the time taken by the sound to reflect back from that object. The frequency of the sound is somewhere in the range of ultrasound, this ensures more concentrated direction of the sound wave because sound at higher frequency dissipates less in the environment. A typical ultrasonic distance sensor consists of two membranes. One membrane produces sound, another catches reflected echo. Basically they are speaker and microphone. The sound generator generates short (the length is a couple of periods) ultrasonic impulses and triggers the timer. Second membrane registers the arrival of the sound impulse and stops the timer.From the timers

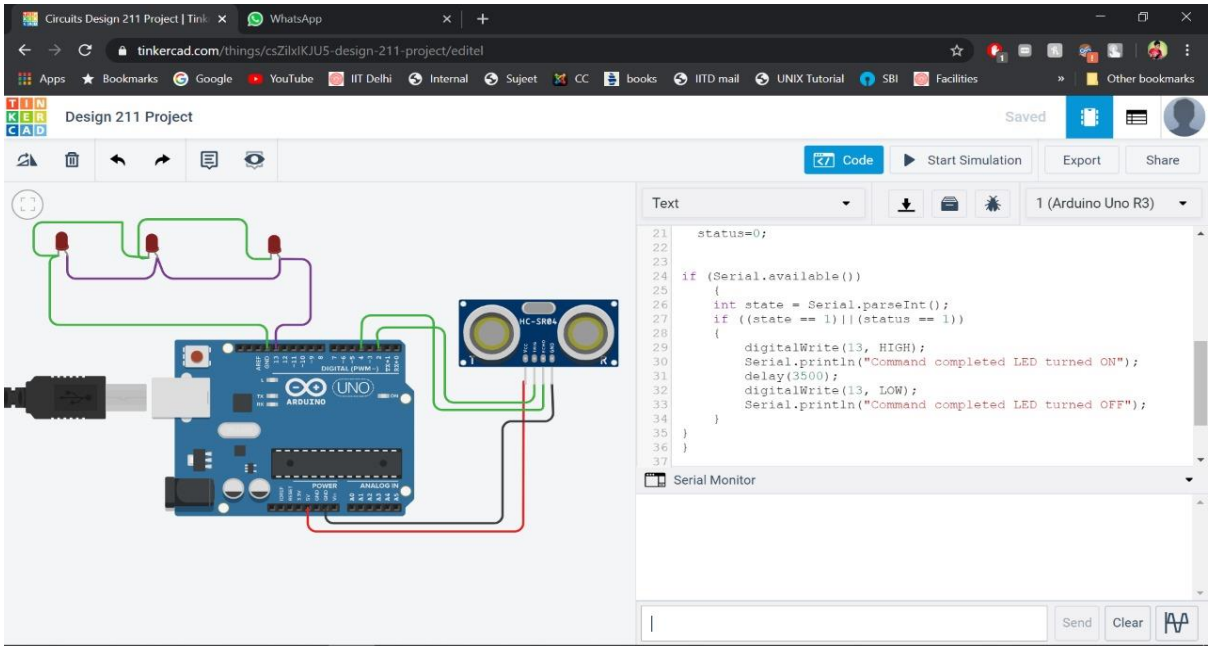
time it is possible to to calculate the distance traveled by the sound. The distance to the object is half of the distance traveled by the sound wave. **[III]**

- **Light Emitting Diodes**

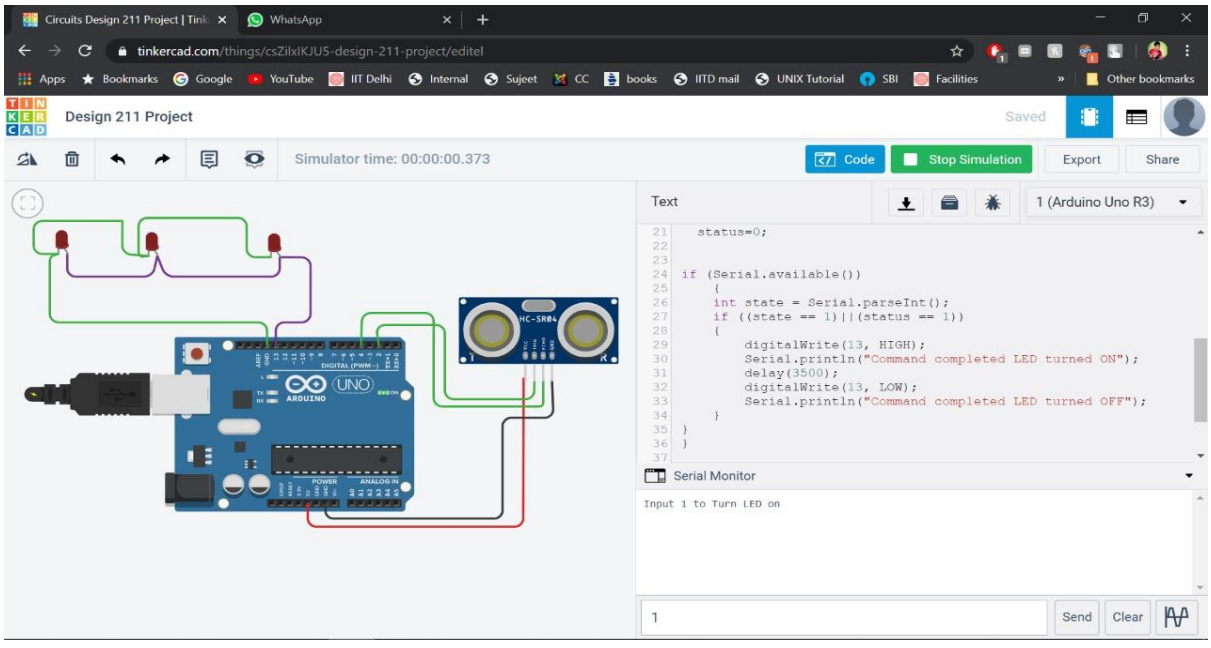
In the simplest terms, a light-emitting diode (LED) is a semiconductor device that emits light when an electric current is passed through it. Light is produced when the particles that carry the current (known as electrons and holes) combine together within the semiconductor material.

Since light is generated within the solid semiconductor material, LEDs are described as solid-state devices. The term solid-state lighting, which also encompasses organic LEDs (OLEDs), distinguishes this lighting technology from other sources that use heated filaments (incandescent and tungsten halogen lamps) or gas discharge (fluorescent lamps). **[IV]**

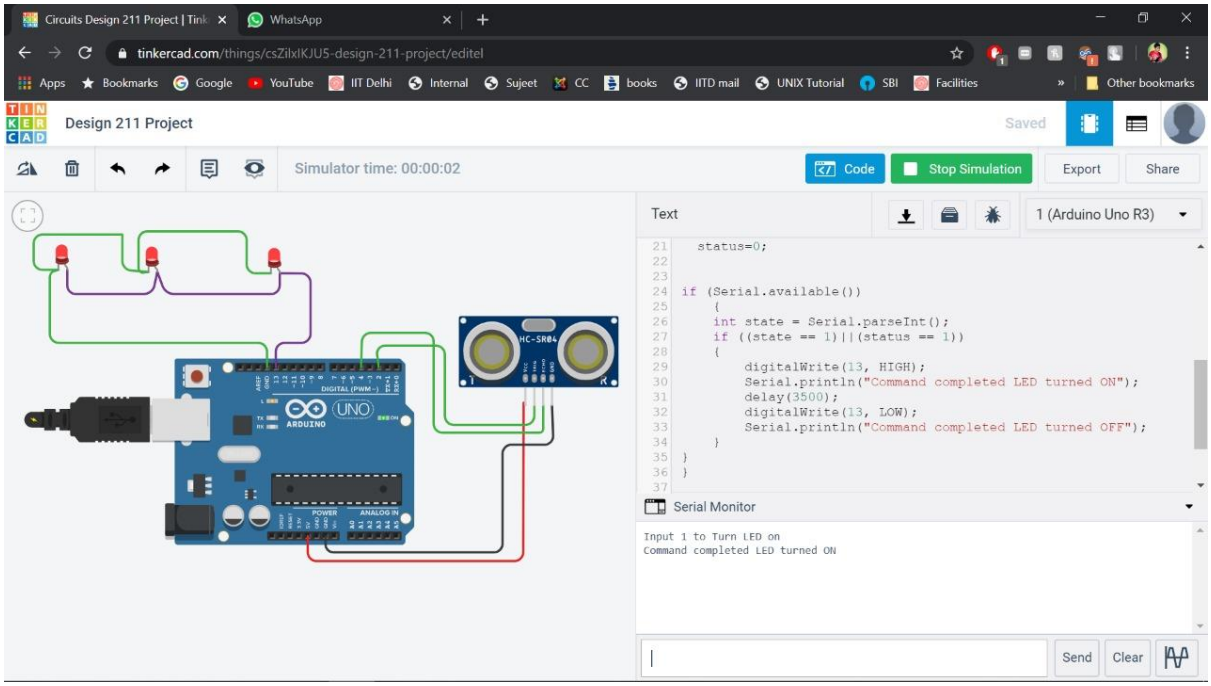
3. 3D Design



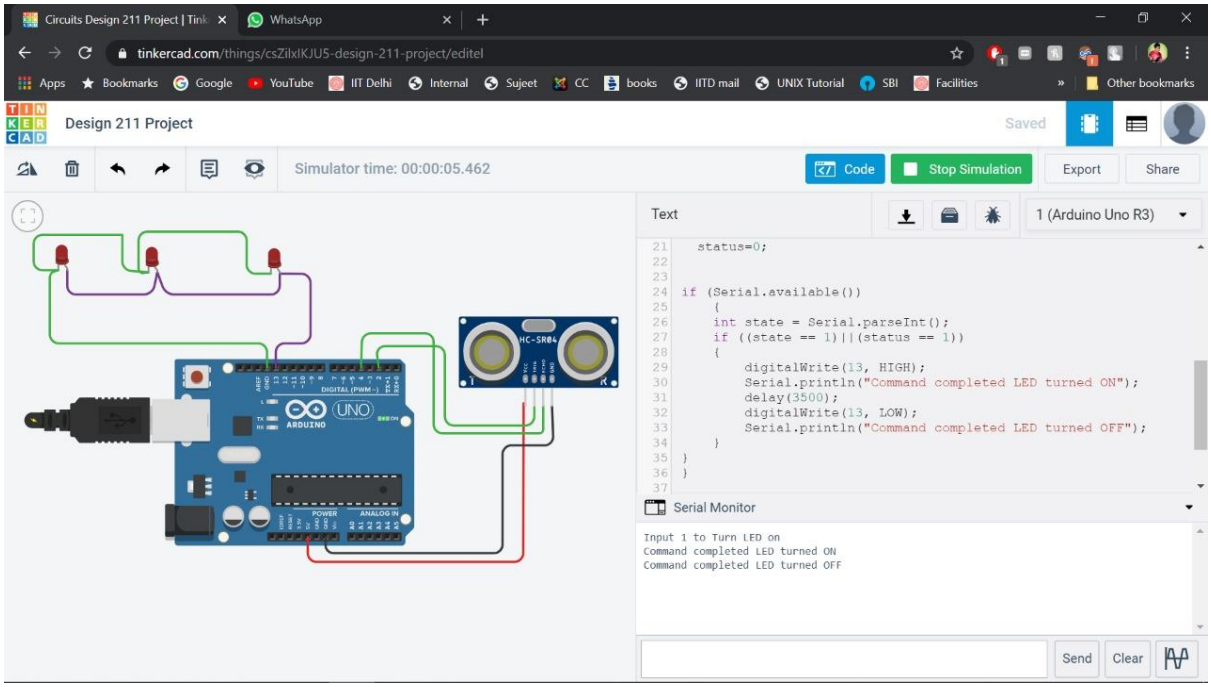
Launching Tinkercad



Sensor Detects a Vehicle (serial input = 1)



LEDs Light Up



LEDs Automatically Turn Off After Delay

4. Code Used

```
const int trigPin = 2;
const int echoPin = 4;

void setup()
{
        pinMode(13, OUTPUT);
        Serial.begin(9600);
        while (!Serial);
        Serial.println("Input 1 to Turn LED on");
}

void loop() {
long duration, inches;
  int status;
pinMode(echoPin, INPUT);
duration = pulseIn(echoPin, HIGH);
inches = microsecondsToInches(duration);
if(inches<591)
  status=1;
 else
  status=0;
```

```
if (Serial.available())
        {
        int state = Serial.parseInt();
        if ((state == 1)||(status == 1))
        {
        digitalWrite(13, HIGH);
                Serial.println("Command completed LED
turned ON");
                delay(3500);
                digitalWrite(13, LOW);
       Serial.println("Command completed LED turned
OFF");
        }
}
}

long microsecondsToInches(long microseconds)
{
return microseconds / 74 / 2;
}
```

5. Conclusion

Initially, our project comprised of a physical model using Arduino Uno R3, an Ultrasonic Sensor, LEDs and a model highway. Due to the COVID-19 Pandemic we could not make the physical model and instead had to make an online simulation of the same.

We used Tinkercad to make our online simulation. The ID and password of the account using which we made the model is given below:

ID: nofelax823@ismailgul.net

Password: nofelax8233

6. References

I. https://www.tinkercad.com/
II. https://www.arduino.cc/en/Main/AboutUs
III. https://home.roboticlab.eu/en/examples/sensor/ultrasonic_distance
IV. https://www.ledsmagazine.com/leds-ssl-design/materials/article/16701292/what-is-an-led