

SMART TRAFFIC CONTROL SYSTEM USING LI-FI

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of
Bachelor of Science in Computer Science and Engineering.

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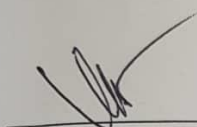
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APPROVAL

This Project/internship titled "SMART TRAFFIC CONTROL SYSTEM USING Li-Fi", submitted by **M. A. Masud**, Id: 153-15-6516 and **Raqibul Islam Chowdhury**, Id: 153-15-6346 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on May 03, 2019.

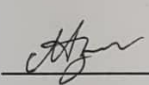
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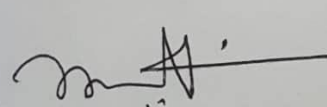
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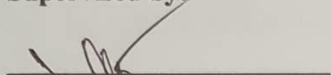
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DECLARATION

We hereby declare that this project has been done by us under the supervision of Dr. Syed Akhter Hossain, Professor and Head, **Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

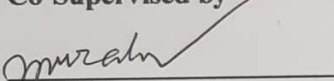
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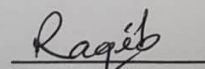
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ABSTRACT

Li-Fi, or light fidelity is an emerging technology which is bidirectional and fully networked wireless communications medium. Li-Fi uses light from light-emitting diodes (LEDs) and provides transmission of data through illumination by sending data through a LED light bulb that varies in intensity faster than the human eye can follow. Li-Fi can transmit at multiple gigabits which are under implementation process and most probably available 3rd quarter in 2019 but now li-fi may transfer signal which is more reliable, virtually interference free and uniquely more secure than radio technology such as Wi-Fi or cellular. It can provide connectivity within a very large area and with higher data rates and high speed than data that can be transmitted through Wi-Fi. It uses visible light communication or infra-red and near ultraviolet spectrum which works by switching bulbs on and off within nanoseconds. By using Li-Fi technology traffic control is possible by transmitting and receiving data through LED head-lights of lamp post. In this paper we propose a system that uses Li-Fi enabled LED lamp post, traffic signal light that can be used for traffic management and road safety by using lamp post LED to lamp post LED data transmission. The aim of designing this system is to reduce road accidents and managing traffic more accurately, smartly with less manpower.

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CHAPTER 1

INTRODUCTION

1.1. Introduction

In today's world internet is a must need things for every people. Internet is very famous for satisfying people with various services related to various different fields. Actually people are using internet for data transfer and data receive. So for quick response people want high speed data transmission. For efficient and fast data transmission wireless communication between the devices is used. The wireless data is transmitted by the electromagnetic radio waves.

Now Wi-Fi is the main wireless communication medium which uses electromagnetic radio waves. Wi-Fi is used in all the areas with all supported device. But the main problems of Wi-Fi are scarcity of electromagnetic radio waves, non-stop depletion of bandwidth, RF interferences, expense of bandwidth and the use of repeaters. Other portions of electromagnetic spectrum include X-rays, Gamma rays and Ultraviolet lights but they are not suitable and workable for wireless communication as they are very dangerous for human body. Mainly, the extensive usage of radio frequency waves is getting blocked and the capacity is decreasing. In order to change the scenario in future, light fidelity (Li-Fi) technology was invented in 2011 by Dr. Harald Haas which transmits the data through visible light instead of Wi-Fi.

Li-Fi uses LED lamps as the main principle source of visible light which can be mounted in streets, houses, cars, shops, offices, etc. These LEDs are often referred to as energy savers. Li-Fi also overcomes the security, hacking of networks or miss use of data problem. Li-Fi is a next generation technology that offers a relatively easier, cheaper, faster and more secure means of data transmission.

Li-Fi technology has an impactful use in road safety and traffic management. Li-Fi enabled LED lamp post light and traffic signal light can be used for traffic management and road safety using lamp post to lamp post data transmission. In this paper we propose a method to manage traffic

and to maintain the safety of a road using Li-Fi technology. We assign each lamp post a unique number against which information is stored in the database. Whenever any car breaks the traffic signal or crosses the limit of its speed the information against the unique number of the car goes to the central server through Li-Fi. The information from the server will help to take charge against the vehicles.

1.2. Motivation

One of the most danger problems in Dhaka city is the traffic jam. Nearly twice a time are killed to go one place to another. As the population is very high now-a-days in Dhaka city traffic jam is must happening subject. For overcoming this unwanted problem we need a proper systematic solution. The most advance traffic system is based on Wi-Fi which are implemented many smart city's like Dubai. But there are some drawbacks of Wi-Fi which can make real time problems. But Li-Fi can be an advance solution of traffic control system which has almost no drawbacks. So, we decide to build a traffic control system for Dhaka city which is based on Li-Fi.

1.3. Rational of the Study

In computer science and technology embedded system is one of the key topics to do work with. After establishment of embedded system it becomes inseparable part of our life. In home, office or on move we are always surrounding by embedded system. Embedded systems are those system they are combination of hardware and software to make specific purpose devices to fulfill specific need. Intelligent techniques can be designed to manage power consumption of embedded systems. So we try a fulfill use of embedded system to achieve our goal which is "Smart Traffic Control System using Li-Fi.

1.4 Research Question

During our research work, we were facing different kinds of questions. Some types of questions are –

- How a light become communicator?
- Which light sensor can send data?
- Which light sensor can receive data?
- How sensor read the data?
- How sensor can pass through the traffic light?
- Which database is used?
- Which procedure is followed for collecting data?
- Is database separate for different source of light?
- Can it able to show 100% accurate result?

1.5. Expected Outcome

The outcome of Li-Fi traffic control system project is given simultaneously:-

- Vehicle would count down by use of counter sensor.
- Counter result pass through the Li-Fi communication and send it to server
- Server will choose which road side will be opened and which side will be closed and given a signal according to its decision.
- Server decision is depend on counting vehicles, emergency vehicle passing and one by one open and closing road side system.

1.6. Report Layout

Chapter 1:

Introduction - We discuss about the motivation, objectives and expected outcome of the project in this chapter.

Chapter 2:

Background - In this chapter we have discussed all the research and their work and also discussed the scope of problems and which challenges that we faced.

Chapter 3:

Research Methodology - This chapter is about the workings methodology such as which methods are used in for this project and also discussed the logic of our method and provides a statistical analysis about the project.

Chapter 4:

Design Specification - This chapter provides a clear idea about the internal and external work.

Chapter 5:

Experimental Results and Discussion - In this chapter we provide the experimental result of all expressions and discuss the process of controlling the traffic in descriptive analysis part.

Chapter6:

Summary, Conclusion and Implication for Future Research - In this chapter we have discussed all the process in short and our target in future on this project.

CHAPTER 2

BACKGROUND

2.1. Introduction

Now-a-days Bangladesh is called as “Digital Bangladesh”. Among the cities, Dhaka is the capital. Last 10 years all big projects which were happened in Dhaka city based on digitalization. Government was trying their level best to build up a smart and rich on technology country. As one of the biggest problem of Dhaka city is traffic jam, so we are trying to find out a smart and handsome solution of this problem. We think a smart traffic control system could reduce this problem intelligently.

In this section, we will discuss Li-Fi related works, research summary and challenges. We also try to discuss about other’s research paper and their works, their thinking, their methods, their simulation and accuracy which are related to our work. In research summary section we will give an overview of our related works. In challenges section, we will discuss how we deal with the sensors and many embedded system kits which will give a better understating about our project.

2.2. Related Works

LI-FI technology changes the way to access the internet, videos, audios, emails and many more and the base of it is visible light communication (VLC), which includes for transmitting information is transmitted by using electromagnetic spectrum. Since 1990 the idea of sending information using LED’s began and experiments showed that transmitting data wirelessly by using LEDs.

The idea of Li-Fi was first introduced by Harald Haas, the teacher of University of Edinburgh in Scotland and he brought the idea of "Wireless data from every light". Haas and his re-search assistant, MostafaAfgani, first sent data by using light signals in 2007 [1]. The term Li-Fi was first established by Haas in his TED Global talk on Visible Light Communication. He referred this light signal as D-Light which can be used to produce data rates higher than 10 megabits per second which is much faster than our average broadband connection [2].

Several research works have been carried out on working mechanism of Li-Fi, on how it provides better bandwidth, efficiency and better availability and security, on how it has immense possibilities, on how Li-Fi differs from other wireless communication mediums [3] [4] [5]. But the practical implementation of Li-Fi has been carried out by a few researchers.

Researches have been done to show how Li-Fi can be used in Indian Railways, how Li-Fi can be used to park vehicles with intelligence is shown in [6], the procedure of detecting the position of a moving person and updating the location in his device using Li-Fi is illustrated in [7], how Li-Fi in conjunction with PIC microcontroller can be used for traffic management and road safety is shown in [8], how vehicle to vehicle transmission can be used to reduce accidents and the decoding of transmitted data by microcontrollers is shown in [9].

2.3 Scope of the problem

By researching a lot of problem about traffic control system and other researcher's report about Li-Fi technology we achieve a clear concept of our working scope. This is really very difficult to overcome all the problems of Li-Fi technology because this technology concept is very much new in all around. We figure out some basic Li-Fi technology faults. Such as –

- Led need to be kept ON even during the day for Li-Fi to work but the intensity can be maintained at a minimum level.
- Li-Fi works efficiently when the transmitter and receiver are placed in the same line of Sight. Any kinds of deviation from this position can lead to miscommunication.

- During the day, intense sunlight may interfere in Li-Fi communication. Also, other light sources, such as normal light bulbs, may also be the cause of miscommunication.

We try our level best to overcome the deviation problem by using the IR sensor along with Laser light so that IR could pass the data when laser light faces the deviation problem.

2.4 Challenges

As we try to build up our project at a real scenario, we face a lot of challenges to fulfill our dream project. Some challenges are mentioned here –

- We try our level best to give a real look of Dhaka scenario in our project so that we could solve familiar problems of Dhaka's traffic jam. We choose Karwanbazar cross road for implementing our project. Given a real view of the location is a big challenge to us.
- Finding all the equipment is a challenge.
- Building a new device with a new design is difficult.
- Data collection is one of the key challenges of all research. We need to test our project in terms of doing the simulation by own.
- Bi-directional Li-Fi technology implementation.
- Communication of Li-Fi.

CHAPTER 3

REQUIREMENT SPECIFICATION

3.1 Introduction

The technology of Li-Fi is much simple in one thought but on the other thought it is very much complex to implement. The Li-Fi technology field opens by forming with the new generation of high brightness LED which can be switched on and off very fast. If the LED is on binary data 1 is transmitted and if it is off binary 0 is transmitted [10]. The receiver consists of a data converter and the converted data is then sent to a server or mobile which takes the necessary action [8].

We proposed the procedure of traffic management, and road safety by using lamp post to traffic light transmission based on Li-Fi but we used Arduino microcontroller to encode and decode data because it is much more effective than PIC microcontroller which is only a chip but the former is a platform. Arduino is much simpler in quick prototyping and it is safe.

3.2 Research Subject and Instrumentation

Research subject can be called as research area that was the main studied for clearing concepts. Not only for implementation but also for design model, implement model, install project equipment, collecting data, implement or process data and training the model. On the other section is Instrumentation that is which technology and method of system we used.

We used two types of sender into our project. One is the laser light bulbs which are another form of LED and second one is IR sensor.

A light source or LED bulbs act as transmitter on one end and on the receiver end there is a LDR sensor. When a LED flashes it behaves like a trigger which is then detected by a LDR sensor. In

order to build up a message, the LED is flashed numerous times or an array of LEDs of a few different colors is used to obtain data rates in the range of hundreds of megabits per second [11]. Depending on what the LED bulbs sense, photo detector(LDR sensor) will give output in the binary format like 0 or 1 [12]. Figure 1 gives a clear picture of working mechanism of Li-Fi.

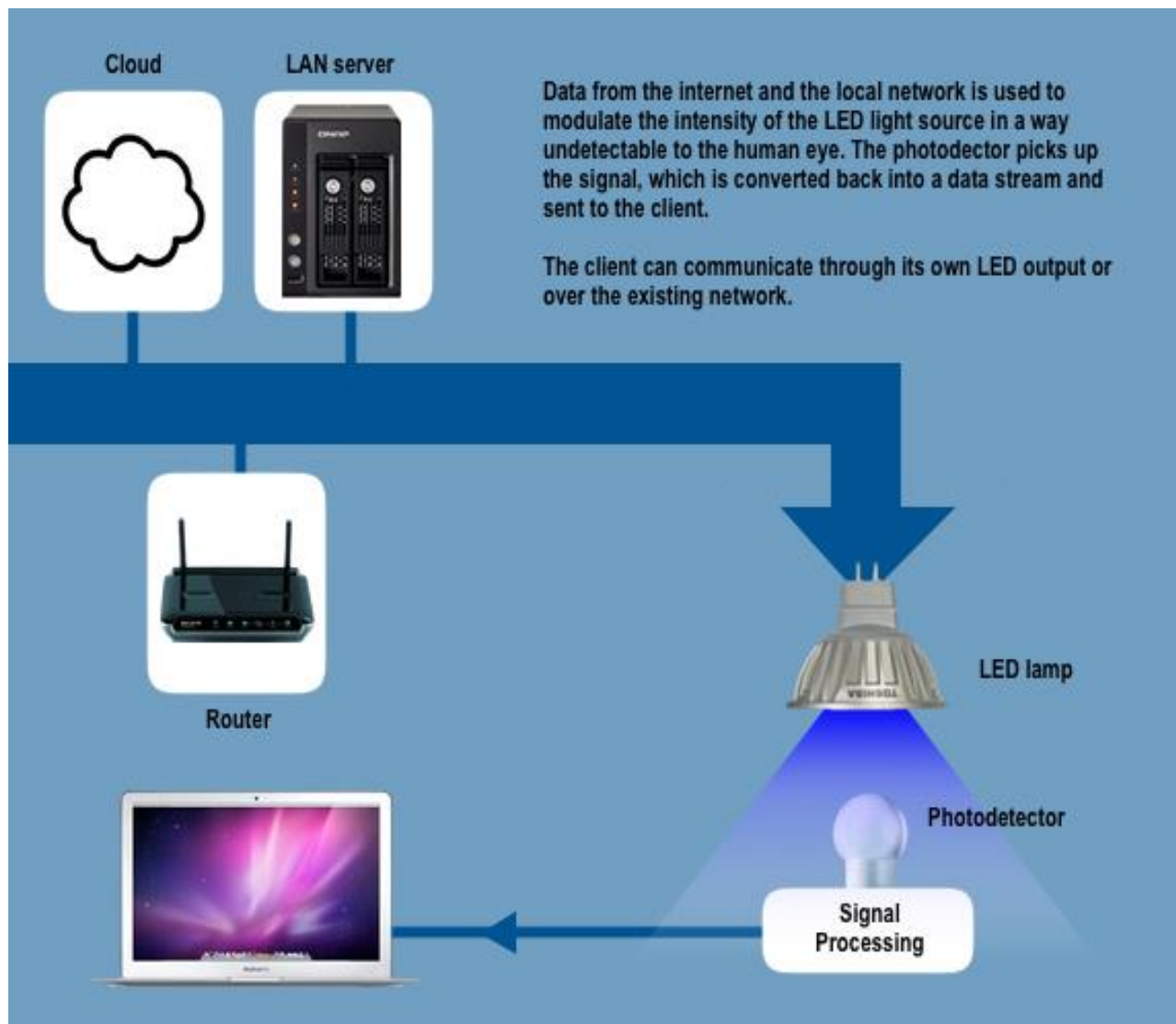


Figure 3.1. Working mechanism of Li-Fi

This figure shows working mechanism of Li-Fi.

3.3 Workflow

As our project is based on simulation and also based on the implementation of Li-Fi we want to discuss it step by step so that the logic understanding may improve.

Step 1:

Thinking and decide what to do – First we are making a total plan of implement our project. We want to make a real road location so that the project shines naturally. So we decide that our project will be on Karwanbazar cross road. Then we collect all the equipment of the model and get started to do our dream by own.

Step 2:

Model implement – We design the karwanbazar cross road and we also look after the real scenario like how the road are actually have, how many buildings are there, how many lamp post we can put so that the communication of Li-Fi could established.

Step 3:

Project Implement – To implement our project we use some equipment and sensor as sender and receiver. We also use microcontroller.

3.4 System Design and Understanding of Traffic Control

A very important part of the highway system is Traffic control devices (TCDs) - traffic signs, signals and pavement markings and system learning. They provide important information simultaneously about the roadway to the drivers of vehicles. Traffic signs, different color, shape, symbols and/or words to convey information. To control traffic, signs using colors are used in the form of four different types of LED lights in roads. The light sequence is: green: safe to cross, yellow or orange: continue to cross only if unable to stop safely, Flashing yellow or orange: cross with caution (often used when lights are out of order or shut down) and red: do not cross [13]. Figure 2 illustrates this scenario.

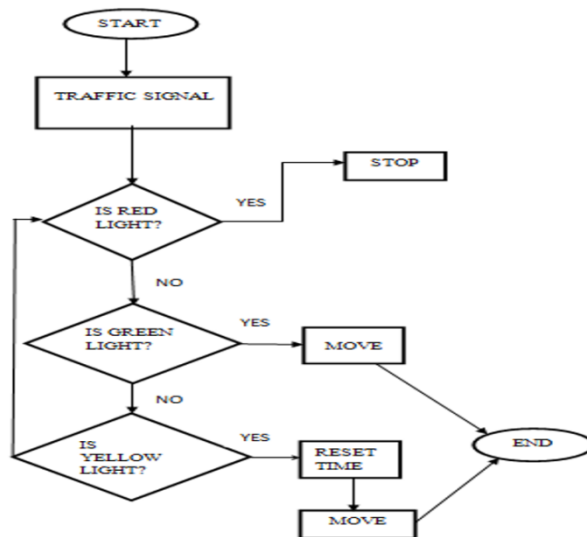


Figure 3.2. A flow chart of the meaning of Traffic control signals

This figure shows the basic traffic control signals.

For understanding the working principle of our project we can see another flow chart

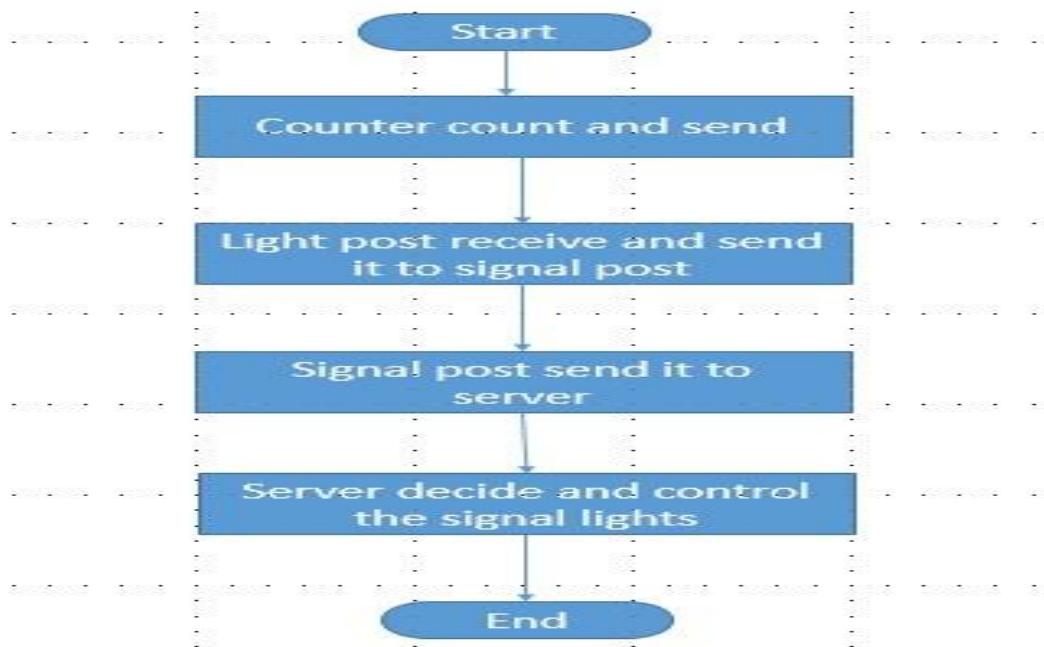


Figure 3.3. A flow chart of smart traffic control system using Li-Fi

This figure shows the step by step logic of our project.

There is some logic understanding topic. Our project “Smart Traffic Control System using Li-Fi” is working based on this logic. They are –

- All side of cross road has counter sensor. So the counter sensor counts down the vehicles. The data of the sensor send the data by using Li-Fi to the server. Then the server decides which road will be open based on higher number of vehicles.
- If the roads have same amount of vehicles then server decide to open immediate next road.

- For emergency vehicle support we used sound sensor. When sensor detects the emergency sound then server decide to open the emergency vehicle road.

3.5 Data Collection

There are two types of data we collect and process them to complete the simulation.

- Sensor data
- Counter data

As Li-Fi has a disadvantage that during the day, intense sunlight may interfere in communication. Also, other light sources, such as normal light bulbs, may also be the cause of miscommunication. So we decide to calculate the average consistency of sensor data and counter data.

3.6 Implementation requirements

Now here is the list of device we use

- IR sensor for counting the vehicles
- Laser light bulb for sending data
- LDR sensor for receiving data
- IR sensor for sending data
- IR receiver for receiving data
- Sound sensor
- Obstacle sensor
- Circuit board
- LED
- resistor
- Audrino Uno
- Audrino neon

- Copper
- battery
- Jumper

CHAPTER 4

DESIGN SPECIFICATION

4.1 Introduction

In this chapter we will try to describe front-end and back-end design specification. For an application front-end design is the most important thing, because we would like to give our project a real view. Front-end design is essential for better understanding. Back-end design is also an important part for sensor working and managing them.

4.2 Front-End

4.2.1 Model Design



Figure 4.1.Model Design

This figure shows the model design of our project.

4.2.2 Lamp Post

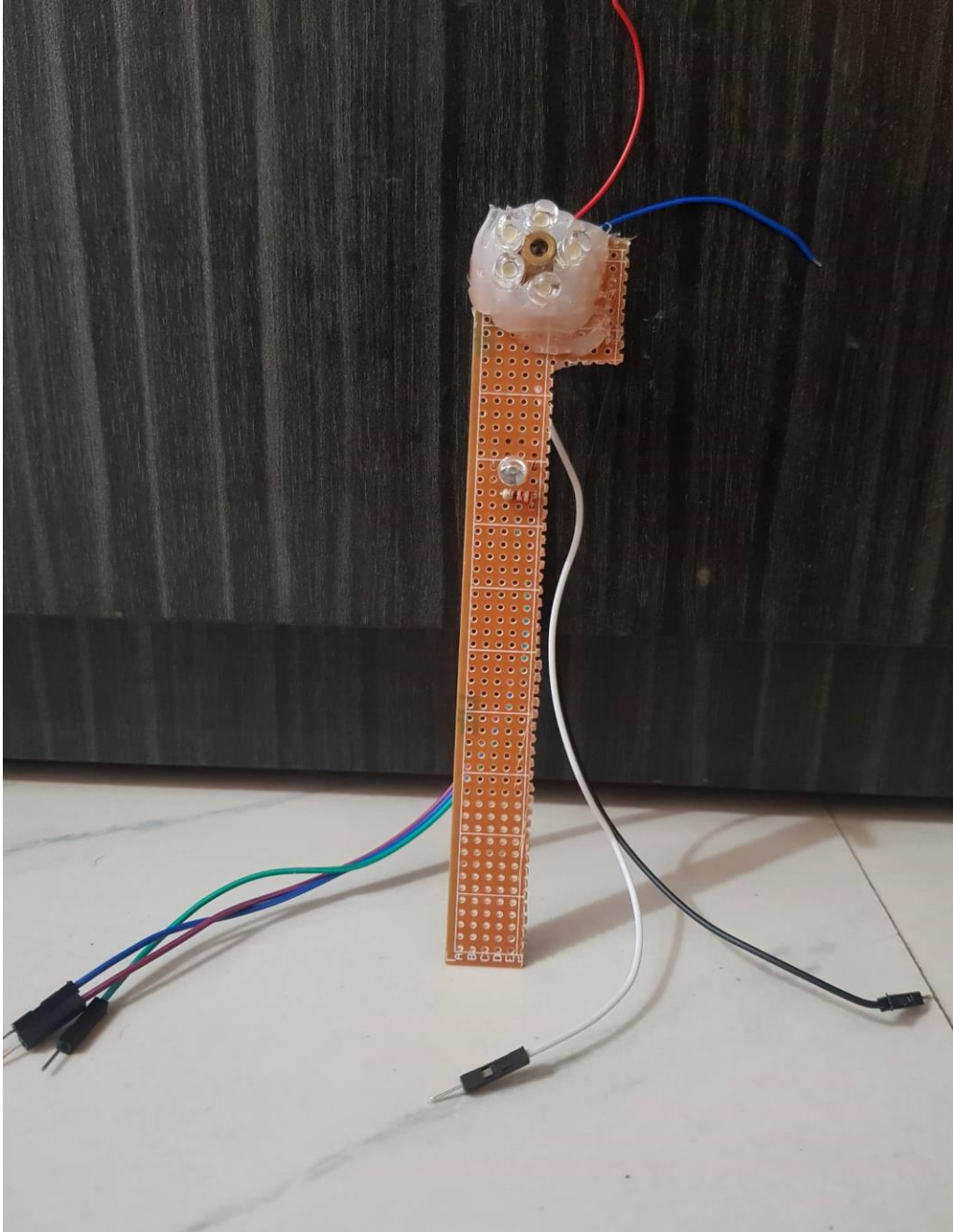


Figure 4.2.Lamp Post Design

This figure shows the lamp post design of our project.

4.2.3 Traffic Light



Figure 4.3.Traffic Light Design

This figure shows the traffic receiver of our project.

4.2.3 Communication

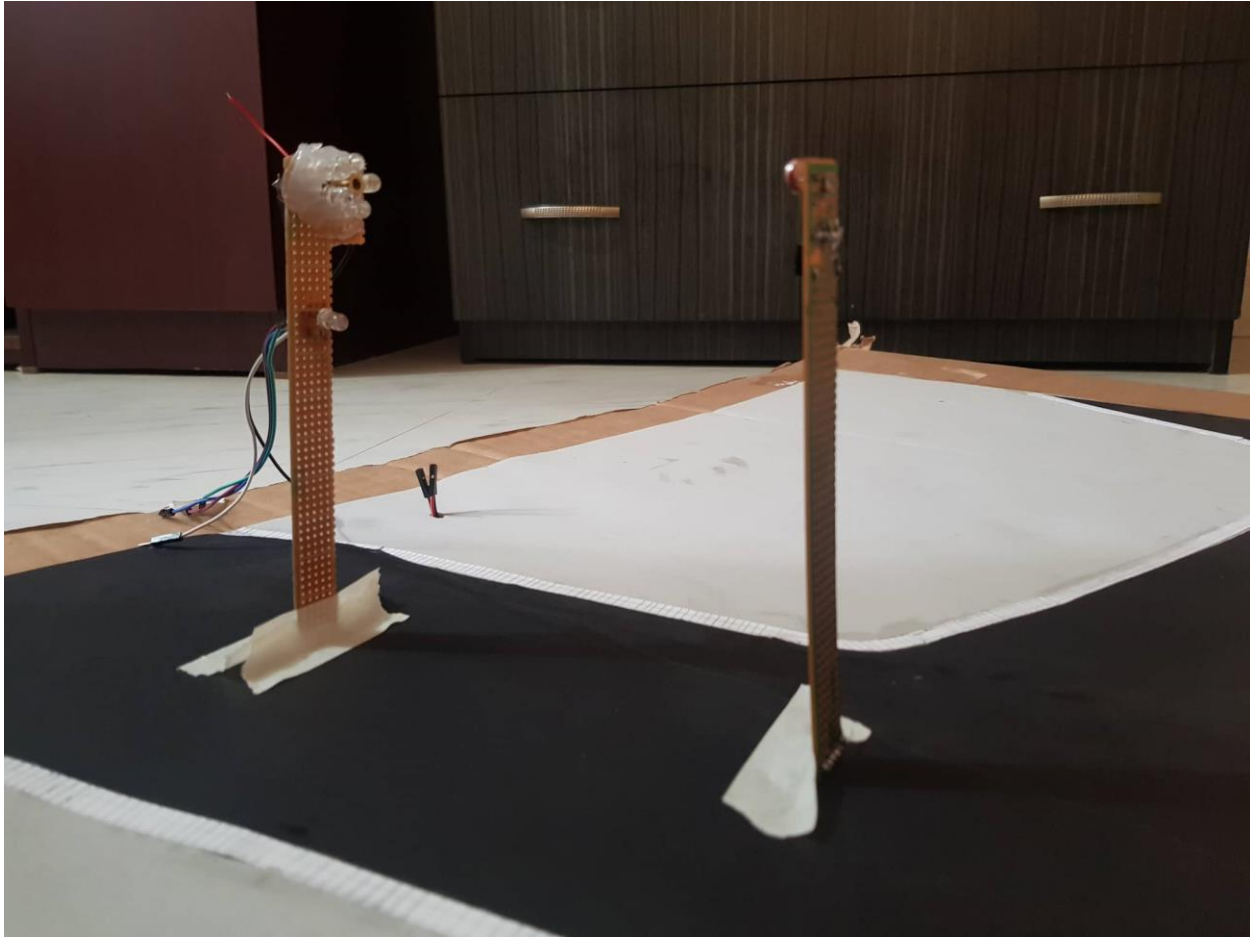


Figure 4.4.Communication

This figure shows overall view of our project.

4.2.4 Overview of the project

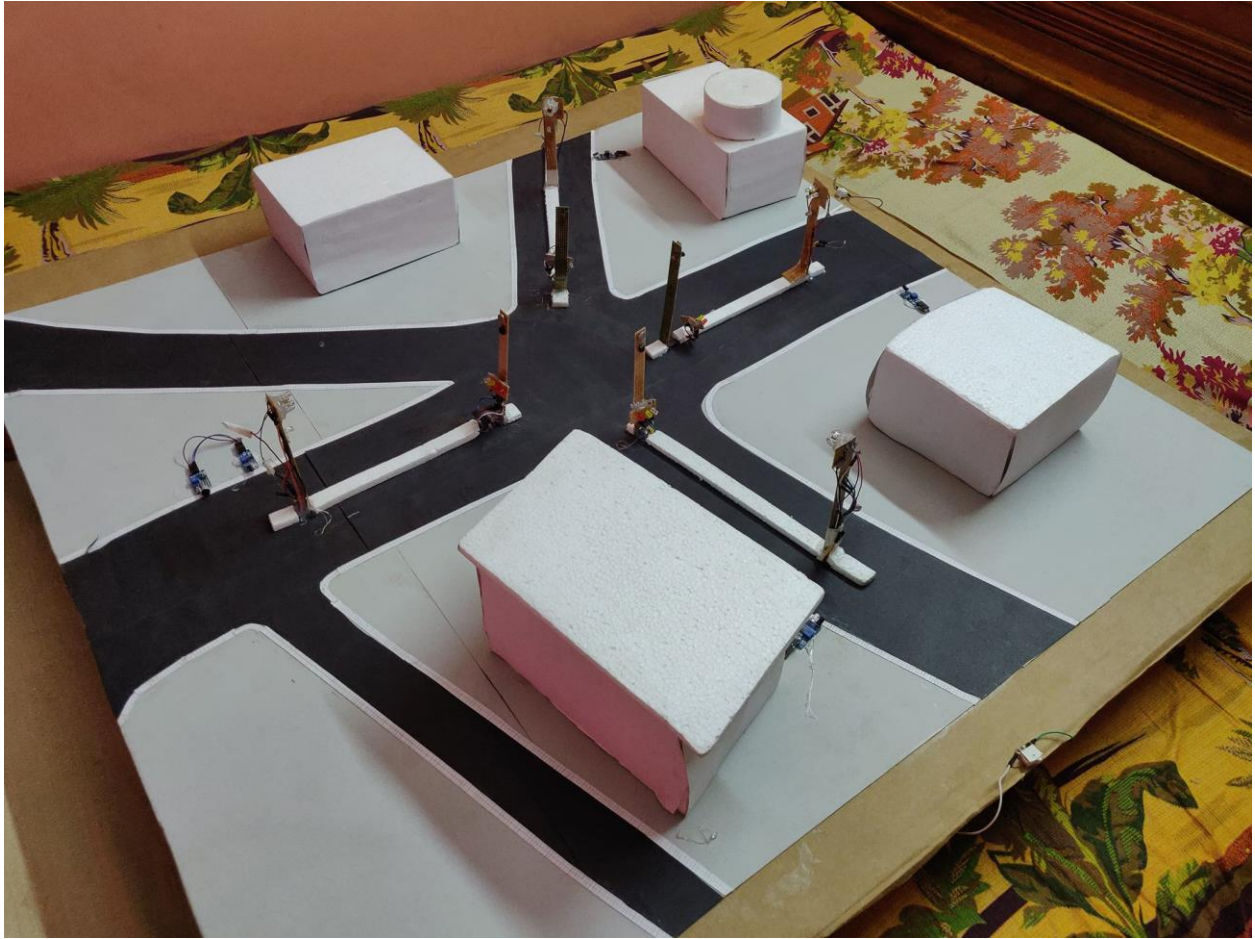


Figure 4.5. Overview

This figure shows the outlook of the project.

4.3. Back-End

4.3.1 Sender Code all four roads

First Road Sender

```
#include <IRremote.h> // Referring to the IRRemote function library, the header file
                        //has defined PIN 3 as the signal output, so it can only connect
                        //to PIN 3. If change, please change it in the header file

IRsend irsend;

void setup()
{
  //
  pinMode(8,OUTPUT);
  Serial.begin(9600);
}

void loop()
{

  int a=digitalRead(7);
```

Figure 4.6.1. Sender for 1st road

This figure shows the fixed sender for a fixed road.

```

if(a==0)
{

irsend.sendNEC(0xFFFF, 32);
digitalWrite(8,1);
  Serial.println("ok1"); //use the receiving tube read the correct encoding value.
  delay(200);

}
else
{
  digitalWrite(8,0);
}
}

```

Figure 4.6.2. Sender for 1st road

This figure shows the fixed sender for a fixed road.

Second Road Sender

```

#include <IRremote.h> // Referring to the IRRemote function library, the header file
                      //has defined PIN 3 as the signal output, so it can only connect
                      //to PIN 3. If change, please change it in the header file

IRsend irsend;

void setup()
{
  //
  pinMode(8,OUTPUT);
  Serial.begin(9600);
}

void loop()
{

int a=digitalRead(7);

```

Figure 4.7.1. Sender for 2nd road

This figure shows the fixed sender for a fixed road.

```

if (a==0)
{

irsend.sendNEC(0xFFFF, 32);
digitalWrite(8,1);
  Serial.println("ok1"); //use the receiving tube read the correct encoding value.
  delay(200);

}
else
{

  digitalWrite(8,0);
}

}

```

Figure 4.7.2. Sender for 2nd road

This figure shows the fixed sender for a fixed road.

Third Road Sender

```

#include <IRremote.h> // Referring to the IRRemote function library, the header file
                      //has defined PIN 3 as the signal output, so it can only connect
                      //to PIN 3. If change, please change it in the header file

IRsend irsend;

void setup()
{
  //
  pinMode(8,OUTPUT);
  Serial.begin(9600);
}

void loop()
{

int a=digitalRead(7);

```

Figure 4.8.1. Sender for 3rd road

This figure shows the fixed sender for a fixed road.

```
if (a==0)
{
    irsend.sendNEC(0xEEEE, 32);
    digitalWrite(8,1);
    Serial.println("ok1"); //use the receiving tube read the correct encoding value.
    delay(200);

}
else
{
    digitalWrite(8,0);
}

}
```

Figure 4.8.2. Sender for3rd road

This figure shows the fixed sender for a fixed road.

Fourth Road Sender

```
#include <IRremote.h> // Referring to the IRRemote function library, the header file
                        //has defined PIN 3 as the signal output, so it can only connect
                        | //to PIN 3. If change, please change it in the header file

IRsend irsend;

void setup()
{
    //

    pinMode(8,OUTPUT);
    pinMode(9,OUTPUT); // ROAD LIGHT
    Serial.begin(9600);
}

void loop()
{

    int roaddata=analogRead(A0);
```

Figure 4.9.1. Sender for 4th road

This figure shows the fixed sender for a fixed road.

```
int a=digitalRead(7);
Serial.println(roaddata);

if(roaddata<30)
{
    digitalWrite(9,1);
}
else
{
    digitalWrite(9,0);
}

if(a==0)
{

    irsend.sendNEC(0xDDDD, 32);
```

Figure 4.9.2. Sender for 4th road

This figure shows the fixed sender for a fixed road.

```
digitalWrite(8,1);  
  Serial.println("ok1"); //use the receiving tube read the correct encoding value.  
  delay(200);  
  
}  
else  
{  
  
  digitalWrite(8,0);  
}  
  
}
```

Figure 4.9.3. Sender for 4th road

This figure shows the fixed sender for a fixed road.

4.3.2 Decision Code

```
#include <IRremote.h> // use the IRremote.h
unsigned long previous=0;
int a=0;
int b=0;
int c=0;
int d=0;
int e,f,x,y,z;
int ir8,ir2,ir7,ir4;
const int irReceiverPin8 = 9;
IRrecv irrecv8(irReceiverPin8); //Creates a variable of type IRrecv
decode_results results8;    // define resultsas
//08 ir receiver end
//07 ir receiver start
const int irReceiverPin7 = 12;
IRrecv irrecv7(irReceiverPin7); //Creates a variable of type IRrecv
decode_results results7;    // define resultsas
//07 ir receiver end
//04 ir receiver start
const int irReceiverPin4 = 10;
```

```

IRrecv irrecv4(irReceiverPin4); //Creates a variable of type IRrecv
decode_results results4;    // define resultsas
//04 ir receiver end
//02 ir receiver start
const int irReceiverPin2 = 11;
IRrecv irrecv2(irReceiverPin2); //Creates a variable of type IRrecv
decode_results results2;    // define resultsas
//02 ir receiver end
void setup()
{
  pinMode(2, OUTPUT);
  pinMode(4, OUTPUT);
  pinMode(5, OUTPUT);
  pinMode(7, OUTPUT);
  pinMode(8, OUTPUT);
  pinMode(13, OUTPUT);
  pinMode(3, OUTPUT);
  pinMode(6, OUTPUT);
  pinMode(A4, OUTPUT);
  Serial.begin(9600);    //initialize serial,baudrate is 9600
  irrecv7.enableIRIn(); // enable ir receiver module
  irrecv8.enableIRIn(); // enable ir receiver module
  irrecv4.enableIRIn(); // enable ir receiver module
  irrecv2.enableIRIn(); // enable ir receiver module
  analogWrite(A4,255);
}
void loop()
{
  //02 ir receiver start
  if (irrecv2.decode(&results2)) //if the ir receiver module receiver data
  {
    int ldrData2 = analogRead(1);
    ir2 = results2.value;
  }
  //for positvive
  if(ir2<0)
  {
    ir2=ir2*(-1);
  }
}

```

```

Serial.println("2no:");
Serial.println(ldrData2);
Serial.println(ir2);
//for counting
//5 send to 8 no pin 4610
if(ir8==4610||ir2==4610||ir7==4610||ir4==4610)
{
Serial.println("5 send to 8 no pin 4610");
a++;
delay(1000);
}
//1 send to 2 no pin 1
else if(ir8==1||ir2==1||ir7==1||ir4==1)
{
b++;
Serial.println("1 send to 2 no pin 1");
delay(1000);
}
//6 send to 7 no pin 4370
else if(ir8==4370||ir2==4370||ir7==4370||ir4==4370)
{
c++;
Serial.println("6 send to 7 no pin 4370");
delay(1000);
}
//3 send to 4 no pin 8739
else if(ir8==8739||ir2==8739||ir7==8739||ir4==8739)
{
d++;
Serial.println("3 send to 4 no pin 8739");
delay(1000);
}
//counter end
// Serial.println(ir2);
Serial.print("ambulance: "); //print "irCode: "
Serial.print(results2.value, HEX); //print the value in hexadecimal
Serial.print(", bits: "); //print " , bits: "
Serial.println(results2.bits); //print the bits

```

```

    irrecv2.resume();    // Receive the next value
    delay(500);
}
//02 ir receiver end
//ambulance data end
//02 ir receiver start
if (irrecv2.decode(&results2)) //if the ir receiver module receiver data
{

    int ldrData2 = analogRead(1);

    ir2 = results2.value;
//for positvive
if(ir2<0)
{
    ir2=ir2*(-1);
}
Serial.println("2no:");
Serial.println(ldrData2);
Serial.println(ir2);
//for counting
//5 send to 8 no pin 4610
if(ir8==4610||ir2==4610||ir7==4610||ir4==4610)
{
    Serial.println("5 send to 8 no pin 4610");
    a++;
    delay(1000);
}
//1 send to 2 no pin 1
else if(ir8==1||ir2==1||ir7==1||ir4==1)
{

    b++;
    Serial.println("1 send to 2 no pin 1");
    delay(1000);
}
//6 send to 7 no pin 4370
else if(ir8==4370||ir2==4370||ir7==4370||ir4==4370)

```

```

{

    c++;
    Serial.println("6 send to 7 no pin 4370");
    delay(1000);
}
//3 send to 4 no pin 8739
else if(ir8==8739||ir2==8739||ir7==8739||ir4==8739)
{
    d++;
    Serial.println("3 send to 4 no pin 8739");
    delay(1000);
}
//counter end

//    Serial.println(ir2);

    Serial.print("irCode2: ");    //print "irCode: "
    Serial.print(results2.value, HEX); //print the value in hexadecimal


---


    Serial.print(", bits: "); //print" , bits: "
    Serial.println(results2.bits); //print the bits
    irrecv2.resume();    // Receive the next value
    delay(500);
}
//02 ir receiver end
//04 ir receiver start

else if (irrecv4.decode(&results4)) //if the ir receiver module receiver data
{
    int ldrData4 = analogRead(4);
    Serial.println(ldrData4);
    ir4 = results4.value;

if(ir4<0)
{
    ir4=ir4*(-1);
}
}

```

```

if(ir4<0)
{
    ir4=ir4*(-1);
}

//for counting
//8 no pin 4610
if(ir8==4610||ir2==4610||ir7==4610||ir4==4610)
{
    Serial.println("5 send to 8 no pin 4610");
    a++;
    delay(1000);
}
//1 send to 2 no pin 1
else if(ir8==1||ir2==1||ir7==1||ir4==1)
{

    b++;
    Serial.println("1 send to 2 no pin 1");
    delay(1000);
}
//6 send to 7 no pin 4370
else if(ir8==4370||ir2==4370||ir7==4370||ir4==4370)
{

    c++;
    Serial.println("6 send to 7 no pin 4370");
    delay(1000);
}
//3 send to 4 no pin 8739
else if(ir8==8739||ir2==8739||ir7==8739||ir4==8739)
{
    d++;
    Serial.println("3 send to 4 no pin 8739");
    delay(1000);
}

//counter end

```

```

    Serial.println(ir4);
    Serial.print("irCode4: ");    //print "irCode: "
    Serial.print(results4.value, HEX); //print the value in hexadecimal
    Serial.print(", bits: "); //print " , bits: "
    Serial.println(results4.bits); //print the bits
    irrecv4.resume();    // Receive the next value
}
//04 ir receiver end
//08 ir receiver start

else if (irrecv8.decode(&results8)) //if the ir receiver module receiver data
{
    int ldrData8 = analogRead(2);
    Serial.println(ldrData8);
    ir8 = results8.value;

if(ir8<0)
{
    ir8=ir8*(-1);
}
if(ir8==4610||ir2==4610||ir7==4610||ir4==4610)
{
    Serial.println("5 send to 8 no pin 4610");
    a++;
    delay(1000);
}
//1 send to 2 no pin 1
else if(ir8==1||ir2==1||ir7==1||ir4==1)
{

    b++;
    Serial.println("1 send to 2 no pin 1");
    delay(1000);
}
//6 send to 7 no pin 4370
else if(ir8==4370||ir2==4370||ir7==4370||ir4==4370)
{

```

```

    c++;
    Serial.println("6 send to 7 no pin 4370");
    delay(1000);
}
//3 send to 4 no pin 8739
else if(ir8==8739||ir2==8739||ir7==8739||ir4==8739)
{
    d++;
    Serial.println("3 send to 4 no pin 8739");
    delay(1000);
}

//counter end

    Serial.println(ir8);
    Serial.print("irCode8: ");    //print "irCode: "
    Serial.print(results8.value, HEX); //print the value in hexadecimal
    Serial.print(", bits: "); //print" , bits: "
    irrecv8.resume();    // Receive the next value
}
//08 ir receiver end
//07 ir receiver start

else if (irrecv7.decode(&results7)) //if the ir receiver module receiver data
{
    int ldrData7 = analogRead(3);
    Serial.println(ldrData7);
    ir7 = results7.value;
if(ir7<0)
{
    ir7=ir7*(-1);
}
if(ir8==4610||ir2==4610||ir7==4610||ir4==4610)
{
    Serial.println("5 send to 8 no pin 4610");
    a++;
    delay(1000);

```

```

}
//1 send to 2 no pin 1
else if(ir8==1||ir2==1||ir7==1||ir4==1)
{

    b++;
    Serial.println("1 send to 2 no pin 1");
    delay(1000);
}
//6 send to 7 no pin 4370
else if(ir8==4370||ir2==4370||ir7==4370||ir4==4370)
{

    c++;
    Serial.println("6 send to 7 no pin 4370");
    delay(1000);
}
//3 send to 4 no pin 8739
else if(ir8==8739||ir2==8739||ir7==8739||ir4==8739)
{
    d++;
    Serial.println("3 send to 4 no pin 8739");
    delay(1000);
}

//counter end

    Serial.println("ok7");
    Serial.println(ir7);

    Serial.println("ok7");
    Serial.print("irCode7: ");    //print "irCode: "
    Serial.print(results7.value, HEX); //print the value in hexadecimal
    Serial.print(", bits: "); //print" , bits: "
    Serial.println(results7.bits); //print the bits
    irrecv7.resume();    // Receive the next value
}
//07 ir received

```

```
Serial.print("A");

Serial.print(a);

Serial.print(", ");


Serial.print("B");

Serial.print(b);

Serial.print(", ");


Serial.print("C");

Serial.print(c);

Serial.print(", ");
Serial.print("C");

Serial.print(c);

Serial.print(", ");
Serial.print("D");

Serial.print(d);

Serial.print(", ");


Serial.println();

unsigned long currentMillis = millis();
Serial.println(currentMillis);

if(currentMillis-previous>10000)
```

```
if(currentMillis-previous>10000)
{
    Serial.println("here");

    decision();

    previous=currentMillis;
}
}
```

Figure 4.10. Decision Code

This figure shows the receiving code of all road with the decision make.

CHAPTER 5

EXPERIMENTAL RESULTS AND DISCUSSION

5.1 Introduction

In this section we described the outcomes of our project implementation model. The overall process of the model divided into few steps like sending outcomes, receiving Outcomes, counting outcomes, overall outcomes.

5.2 Experimental Result

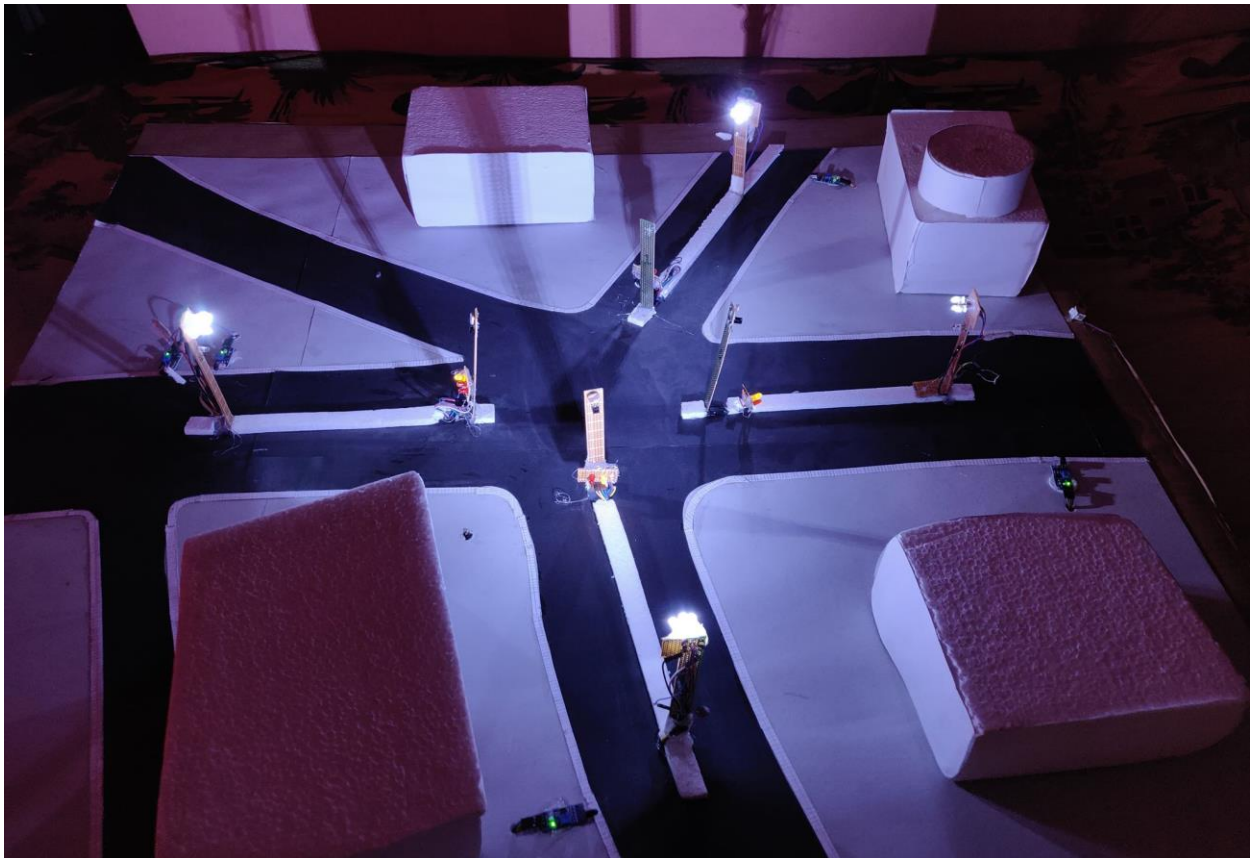
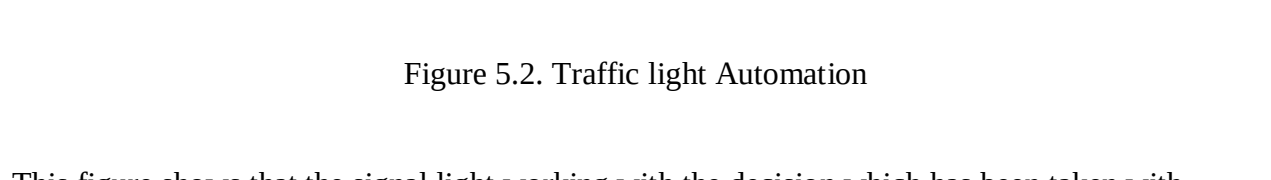


Figure 5.1. Street light automation



5.2.1 Sending Outcomes

In our project we used two types of equipment for establishing the Li-Fi sending data. First one is laser LED. We could also use normal LED but there had been a problem may occurred. Li-Fi has that problem to receive garbage value from any light source and laser LED has high intensity. And the second sending devices is IR blaster. The purpose of use the second device is to avoid deviation problem. Mainly the sending devices send the counter value as its outcome.

5.2.2 Receiving Outcomes

In our project we used two types of equipment for establishing the Li-Fi receiving data. For laser Led we use LDR sensor as photodiode. Laser LED gave an integer value as its outcome. For IR sensor we used IR receiver. IR receiver Text value as well as integer value. The main part of with receiving outcome is to convert the data to our desire format.

5.2.3 Server Outcomes

The outcome of server is to compare the data to establishment of the logic of traffic control system. The complex part is to convert two sender data into one format so that the logic of comparison become simpler.

5.3 Performance Evaluation and Summary

Li-Fi technology is very much new. Very few researchers would work with this magical creation. So it is very normal fact that it would have a lot of cons. We achieved 70% of accuracy to get consistent value. We were trying our level best to overcome the destroyer facts. We would satisfy with our performance and also satisfy with our project performance

CHAPTER 6

CONCLUSION AND IMPLICATION FOR FUTURE RESEARCH

6.1 Introduction

In this chapter we will try to discuss about the summary of our study, conclusion of our work and also discuss about our future research work. In summary part we are trying to discussing about the whole part of our project.

6.2 Conclusion

Li-Fi technology has a lot of use in traffic management and in establishing safe movements of vehicles on the road. But to implement it commercially all vehicle has to include a LED-based traffic head-light, tail-light and Arduino microcontroller. But right now, the fact is, Li-Fi technology is more costly than any other existing one. If we can somehow minimize the cost to some extent, then there is no need to play role by any traffic police on the road. Again we will not face any unnatural death on the road due to recklessness of the drivers. So it is high time we implement this fabulous technology to step forward to a digital Bangladesh.

6.3 Future Work

The future scope in the system is to reduce costing and more accuracy. We all know that 5G is knocking at the door.

And Li-Fi is the sub part of 5g communication deviation problem may remove from the system without using the second sensor. Li-Fi modulation and infrared technology will be the greatest successor because if it could be made then we could use Li-Fi technology without any barrier. At that time we could use 10gbps bandwidth easily.

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APPENDIX

To complete our dream project we faced so many problem, first one was to determine the logical or methodological approach for our project. It was not traditional work it was a research based project, more over there were a few work done before on this area. So we could not get that much help from any other researchers. Another problem was that, collecting of data, it was big challenge for us. There was no dataset available which is suitable to convert, that's why we collect our own data by our own hard work and developed a best fit model. Working with LI-Fi means to be in Future.

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