SMART LIGHTING SYSTEM

Project report submitted in partial fulfilment of the requirement for the degree of Bachelor of Technology

in

Electronics and Communication Engineering

By

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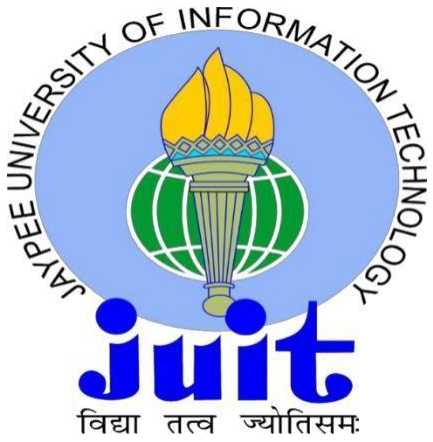
Under the supervision of

Dr. Rajiv Kumar
to



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CANDIDATE'S DECLARATION

We hereby clearly declared that the entire work presented in this project report entitled '**Smart Lighting System'** in the partial fulfillment of the requirements for awarding **Bachelor of Technology** degree in **Electronics and Communication Engineering** submitted to the Electronics and Communication Engineering Department of Jaypee University of Information Technology, Waknaghat, is a record of our own research work and conducted over a period from **January 2021 to May 2021** under the supervision and guidance of **Dr Rajiv Kumar** (Associate Professor and Head, Electronics and Communication Engineering).

The research material present in this report has never been submitted for the award of any other diploma or degree.

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This is to certify that the above statement made by the candidate(s) is true to the best of my knowledge.

30/06/2021

Dr. Rajiv Kumar

Associate Professor and Head,

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Dated:

ACKNOWLEDGEMENT

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We would like to acknowledge the guidance, supervision, support, encouragement and motivation of our supervisor **Dr. Rajiv Kumar** with our deepest sense of gratitude and thankfulness. His kind support throughout the project has been a major source of our motivation. His educated comments, eagerness to listen to our problems, proper guidance and timely advises, played a crucial role in the successful completion of this work. We would also like to thank all the professors and supporting members of **Electronics and Communications Department** for their advice and guidance in various stages of our project.

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ABSTRACT

An IoT based Smart lighting system which ensures low power consumption, high efficiency, all weather usability, low cost and easy design using microcontrollers such as Arduino UNO &Arduino NANO and various sensor modules such as DHT11, Ultrasonic, LDR, Flame sensor etc. Moreover, it requires zero emission green energy by utilizing power from Solar Energy and Piezoelectricity. Our project aims to develop a Minimum Viable Product (MVP), that can be utilized for commercial purposes with enough utilizability to satisfy early consumers. Our research also focuses on how to conciliate and harmonize between the challenging requirements of usage factors, high power consumption and the application possibilities.

CHAPTER 1

INTRODUCTION

1.1 Why we need Smart Lighting?

It was Buckminster Fullerwho said that the best way to predict the future is to create one. Keeping this ideology in our minds we as engineers invested our time in choosing a project that not only utilizes our learnings and knowledge, but also helps us in shaping and impacting the future as well.We decided to choose a project which helps us to express this idea in a profound and innovative way.Thus we choose to work upon the idea of smart lighting system.

In in the modern technological era we are moving towards more and more smart technologies to reduce the human intervention and thus move towards automation.Smart devices and smart technologies are not just an idea anymore. We as a human race are building smart cities smart vehicles etc. The ultimate aim of in smart technology is to reduce or completely remove the human intervention or the human factor, thus limiting the chances of human error and making our lives safer and secure.

Presently technology has its impact and presence in every sphere of our lives. We already live in the world where we have self-automated cars, fully automated industrial production units and so on. In developed countries this integration of smart technology with traditional work is quiet well established. In most European countries as well as United States of America smart lighting both homes and public spaces is present.

However, in developing countries such as India it's not the case. There is a very drastic gap between the current technologies and its uses by common man. In most of the cities in India streets are still lit by traditional lighting without the use of any renewable energy resources or smart technology. Although we aspire to build more and more smart cities,but some of the basic requirements of a smart environment it is missing in most of

Indian cities.Only a limited number of Indian streets use smart lighting system. When we talk about home smart lighting the percentage is very low in Indian homes.

While researching for a project we were adamant to find the reasons behind this discrepancy. During a research we realized that the biggest reason for the limited use of smart lighting in Indian homes and other public places is due to the high cost and requirement of highly skilled labor to install and if things don't work properly, to repair these installations. Also we realized that much of the technology is not invented in India, but rather imported from countries like China.

The biggest disadvantage of not manufacturing technologies in India is that most of these devicesare not regulated according to Indian standards and usage. They are very fragile highly technical and in some cases quiet unreachable to the common public.Thus our aim was to develop are economically viable product which can meet Indian standards its climate and satisfy the customer needs.

Hence we invested our time and effort in developing a prototype for a smart lighting system which is durable,dependable and can be used in multiple venues. To achieve this goal weintegrated our knowledge of microcontrollers, various sensors and current technologies such as Internet of Things (IoT).

1.2 History of Lightbulb

As for as we can date back we humans always had this innate desire to light our surroundings. But for a major portion of human existence this process was not economical and also not efficient.

Once electricity was discovered, the human race did not look back. We invented devices after devices to ease our life. Light bulb word invented more than a century ago and we were able to use this miracle of electricity to light our homes. In present era the light devices that we use are very different the old ones. With invention of LED light, market

was completely revolutionized. According to a survey LED industry is worth more than 50 billion US dollars.

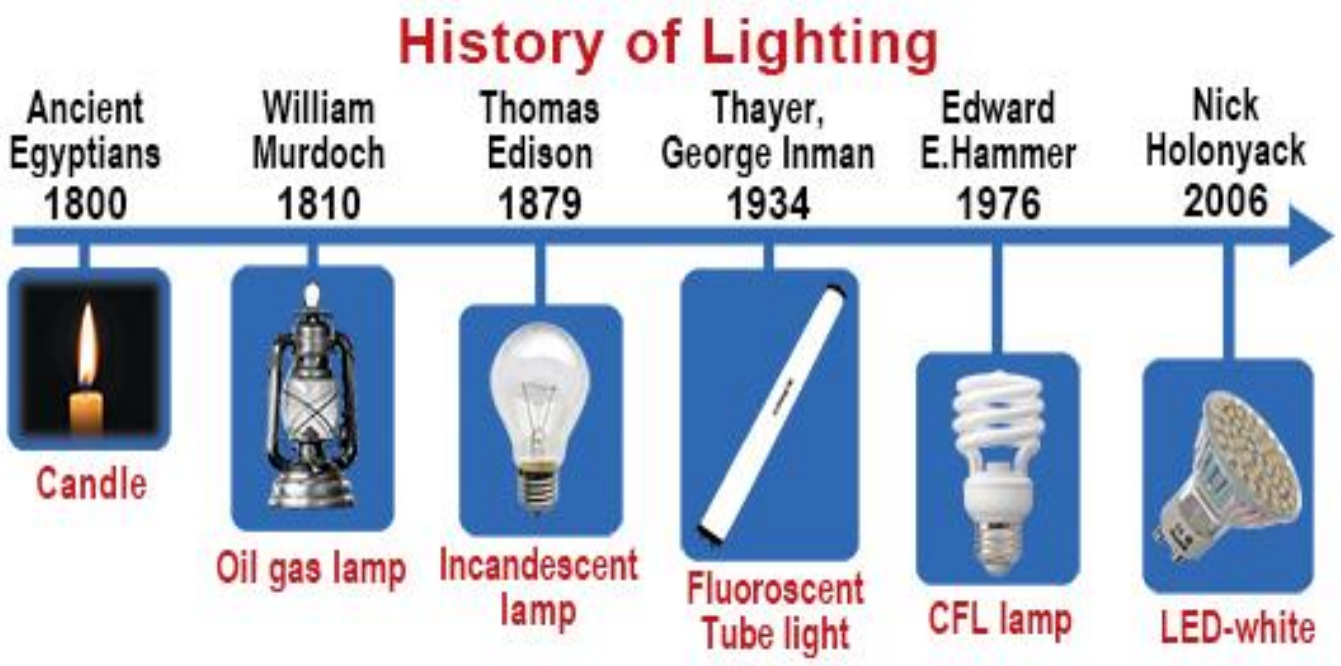


Fig-1

LED is not only a brilliant scientific invention which fetched Nobel prizes for its inventors but also became a game changer in the lighting industry. They were robust, efficient, came in manageable sizes and unlike fluorescent lights which lasted only 5 years, they can last for about 20.The efficacy continues to grow. In the last 10 to 12 years the white LED's have achieved 330% more efficiency.

Also nowadays you can easily control the color, brightness and contrast through your smartphones thus making the smart use of these light.

1.3 Working Principle of LED's:

In LED's we use solid materials and its size can be made very small. In today's time these LED lights can be easily controlled to generate any light across the visible spectrum hence paving way for efficiency, greater usability and high customer demand. This known as smart lighting.

LED stands for Light emitting diode/ device. It works on the principle of PN junction diode to utilize the concept of electroluminescence. Electroluminescence means that when electric current or electric field is applied through semiconductor material, it emits radiation invisible spectrum thus producing various colored lights.

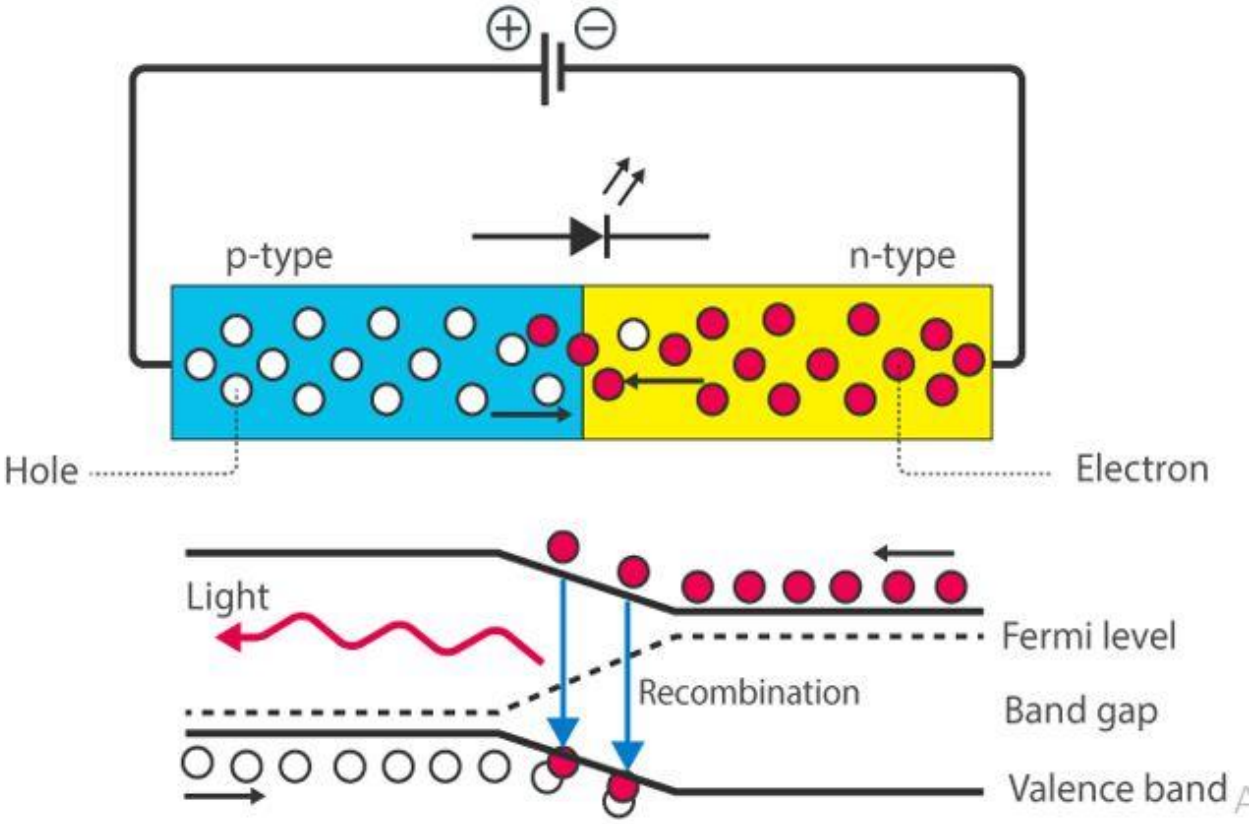


Fig-2

CHAPTER 2

SCOPE AND MOTIVATION

2.1 As an Alternative:

A typical market works on the simple principle of supply and demand. In the current economical times we need efficient solutions to conserve electricity, save environment and at the same time satisfy the growing customer needs and demands.

Today we are all witnessing the adverse effects of climate change and its global impact We need green solutions as an alternative to traditional sources of electricity and power. Our project aimed at smart lighting utilizes solar energy and piezo electricity as its power sources.
We choose these two keeping in mind sustainability and durability. We wanted our prototype to not only be smart in its functionality but also cause zero damage to the environment. Hence it is smart in both its usability and its energy usage.

2.2 Energy Harvesting:

A major part of our project deals with energy harvesting. In simple words energy harvesting refers to the extraction of energy from various sources.

Since the beginning of industrial era we have been using coal and petroleum as a major sources of power. But innumerable researches have proved that our over dependence and overutilization of coal and petroleum has had some adverse effects on environment. The growing pollution in the last two centuries is a typical reminder to shift up power demand from coal and petroleum to renewable resources. Both solar energy and piezoelectricity are clean and green sources of electricity. By using these two sources in our project we have solved a major problem of pollution and adverse climatic impact.

2.3 Fundamentals of Solar energy:

Our planet earth receives a lot of solar energy by sun but only a fraction of that energy is utilized by the human population. We receive around 173 thousand Terawatts of solar energy which is approximately 10,000 times then the energy requirement of our entire planet.

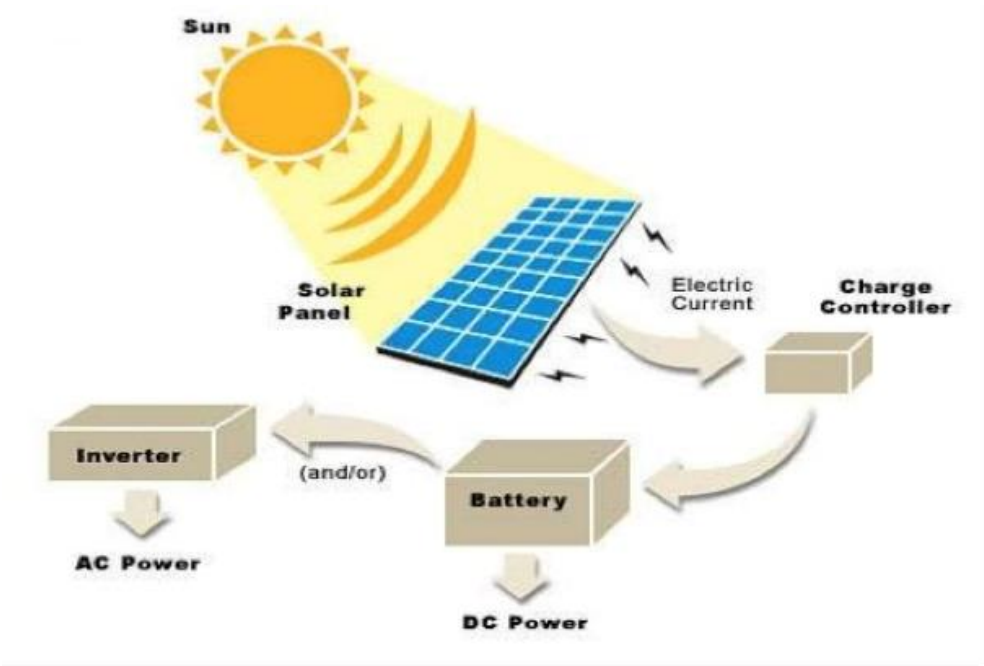


Fig-3

Hence using solar energy as a renewable source of energy to power project is a sustainable idea. We used solar panels to convert solar energy into electrical energy. The solar panels are made of solar cells which are further made up of semiconductor material silicon. In a solar cell silicon crystal is put between two conductive layers. When photons from the Sun strike the surface of this semiconductor material it displaces the electron and thus constant bombarding of these photons will result in various free electrons. These electrons travel through the thin conducting layers and power the required device. Since solar panels use only electrons as charge carriers they can last long and can be reliable.

In India we get enough sunlight to power solar devices and thus generate clean form of energy. Although the current state of technology of solar power faces huge efficiency challenge but in coming years with more and more technological advancements we can surely increase this efficiency.

2.4 Fundamentals of Piezoelectricity:

The word “piezoelectricity” originates from two words “piezo” and “electricity”. Piezo means “pressure”. Thus in simple terms we can say that energy derived by applying mechanical stress/pressure on certain materials either through bending for pressing them is called piezoelectricity or piezo energy. This phenomenon t was discovered by two brothersPierre Curie and Jacques Curie in 1880.

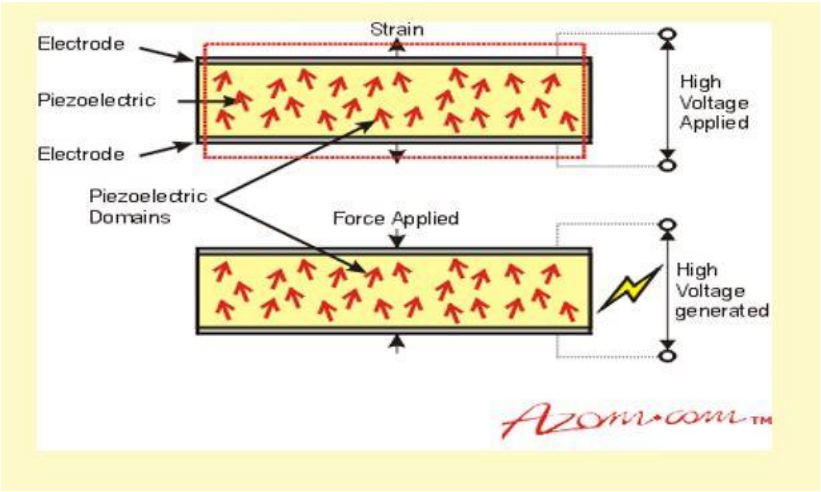


Fig-4

Our motivation for using piezo electricity in our project arise from the idea that it in case of absence of sunlight we must have an alternate source of power, hence piezoelectricity.

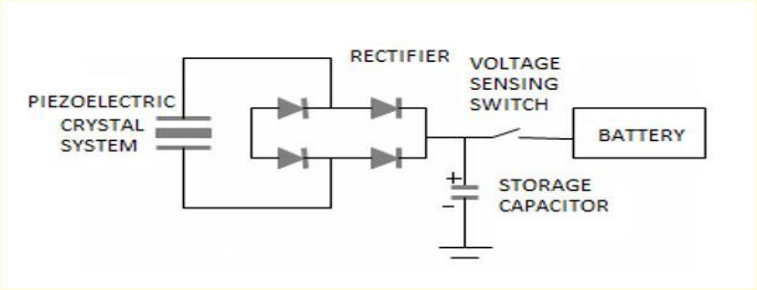


Fig-5

We use piezoelectric crystals which can be embedded inside footpaths,roads, streets, office floors and so on. These crystals will produce electricity whenever there will be a pressure applied on them. This electricity will be stored and utilized for further use.

CHAPTER 3

SMART LIGHTING SYSTEM

3.1 Objective:

Our objective was to developed aMinimum viable product (MVP) for Indian market which consists of Internet of Things(IoT) based smart lighting system which insurances low power consumption, clean power usage, high efficiency, all weather usability, low cost, easy design, scalability, economically viability and sustainability for future. We used multiple microcontrollers such as Arduino UNO and/orArduino Nano to provide easy user accessibility and smart controlling and regulating off the device. We also used various sensor modules such as DHT11 for temperature and humidity, Ultrasonic sensor for measuring distance, LDR for detecting whether it's day or night, Flame sensor etc. Moreover, we aimed to use Wi-Fi module for future development to connect devices with internet and thus provide easy remote monitoring and regulating. Also, we use green energy by utilising solar power by using solar panels and piezoelectricity.

3.2 Project Design:

We used LDR as photo resistors and located them at strategic places to signal the Arduino(s) whether there is sufficient light available or not. This process made it completely automatic for the code inbuilt in the Arduino to detect light. After the readings from LDR Arduino decides whether to turn off or on lights. This saves energy as light gets turned off automatically once there is sufficient natural light.

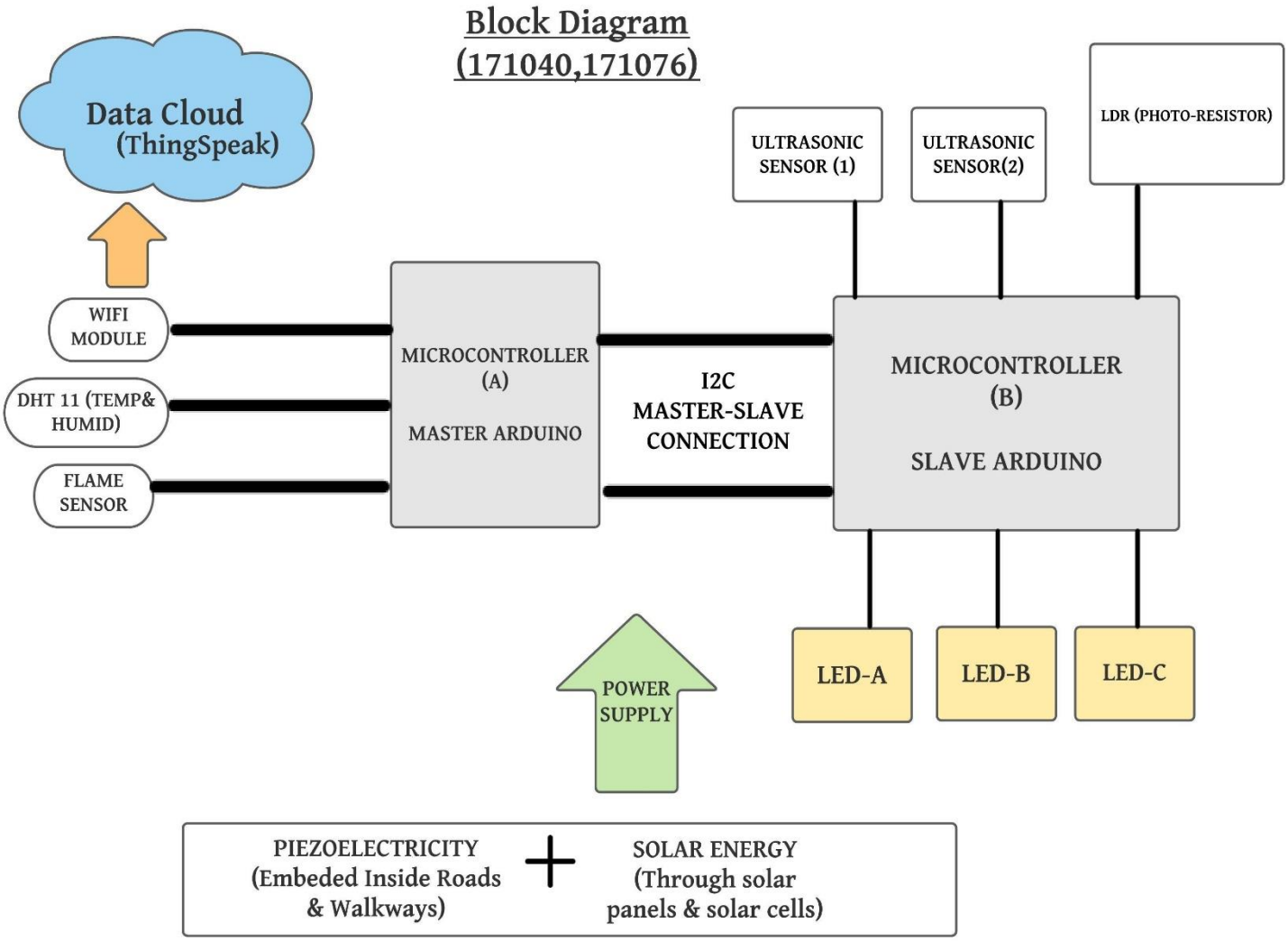


Fig-6

We also use ultrasonic sensors to detect range of an approaching object/person and smartly decide whether light is required or not. This helps in conserving energy as light is turned on only when it is not required. Thus our project works in a fully automated manner without any intervention by human presence. Besides this we also aimed to integrate Wi-Fi module in later stages to achieve IoT applicability and remote controlling and monitoring.

3.3 Conditions for operation:

- LDR will detect the presence of natural light and then Arduino decides from the data to switch on light on or not.
- In case of street lights apart from above mentioned, a DHT sensor is required to check temperature and humidity. For foggy conditions generally Humidity is more than 80% and temperature less than 15 degrees Celsius.
- If the conditions are foggy then the lights remain on at full intensity even when there is no vehicle approaching to avoid accidents.

3.4 Scalability:

While working on a project like this the biggest challenge faced by any team is scalability. To implement such technologies in real world we require high level of scalability and economic viability. A project should be easy to implement and must be scalable according to the requirements of customers. We solved this problem by using master slave I2C connection.

This simple method helps in overcoming the challenge to deploy a project in both small usage and highly massive industrial applications.

3.5 Master Slave I2C Connection:

While using a single microprocessor there is a drawback of high dependability on its working. Often one Arduino is not sufficient to bear the working load and succumb to failure. Also we might need projects where we require to assess data from multiple sensors not operating at the same time thus we use master slave connection which facilitates easy inter-integrated circuit connection or I2C. Thus distributing the work load and making more complex scalable and robust systems.

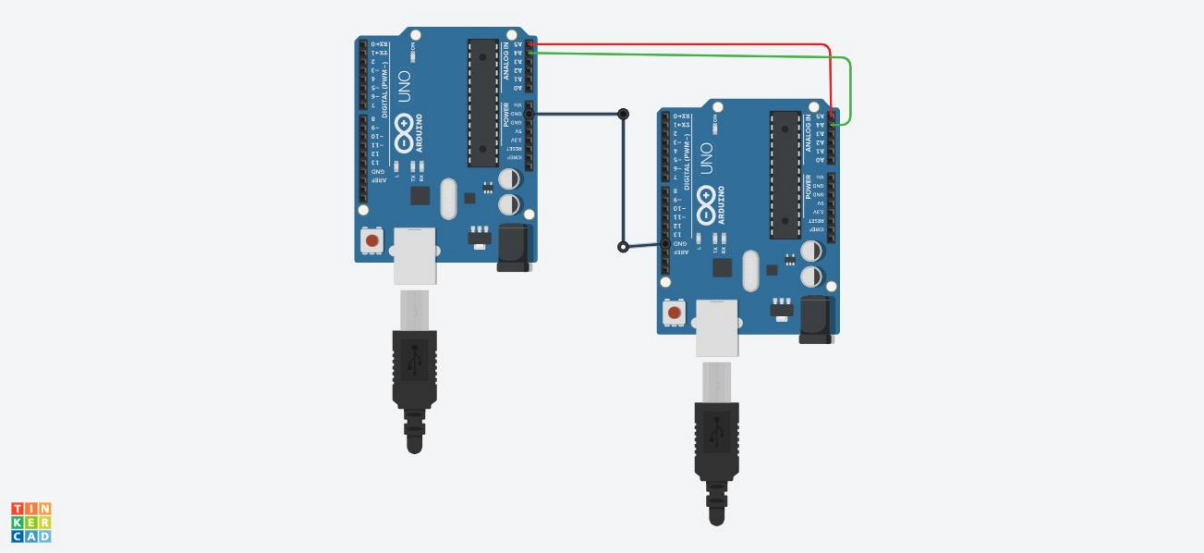


Fig-7

Hence in our project also we used one Master Arduino which carries out more advanced function and one Arduino which works as a slave to carry out essential day to day functions.

3.6 Master Arduino:

- **Circuit Diagram:**

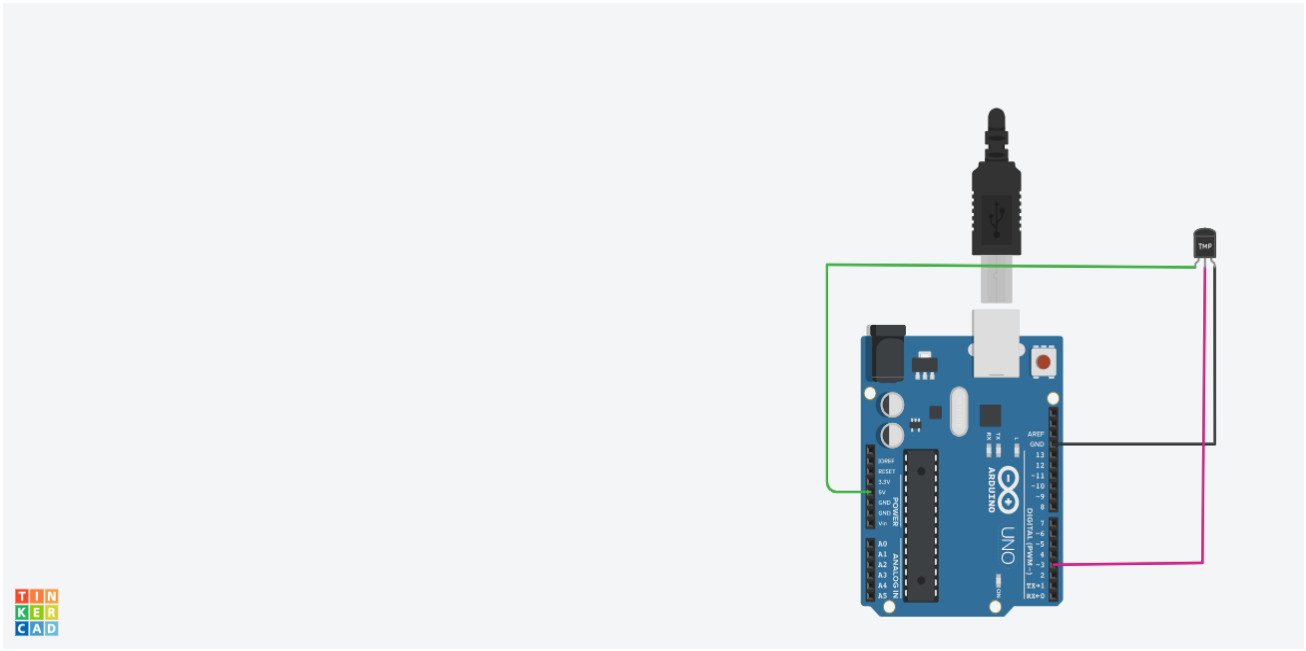


Fig-8

3.7 Slave Arduino:

- **Circuit Diagram:**

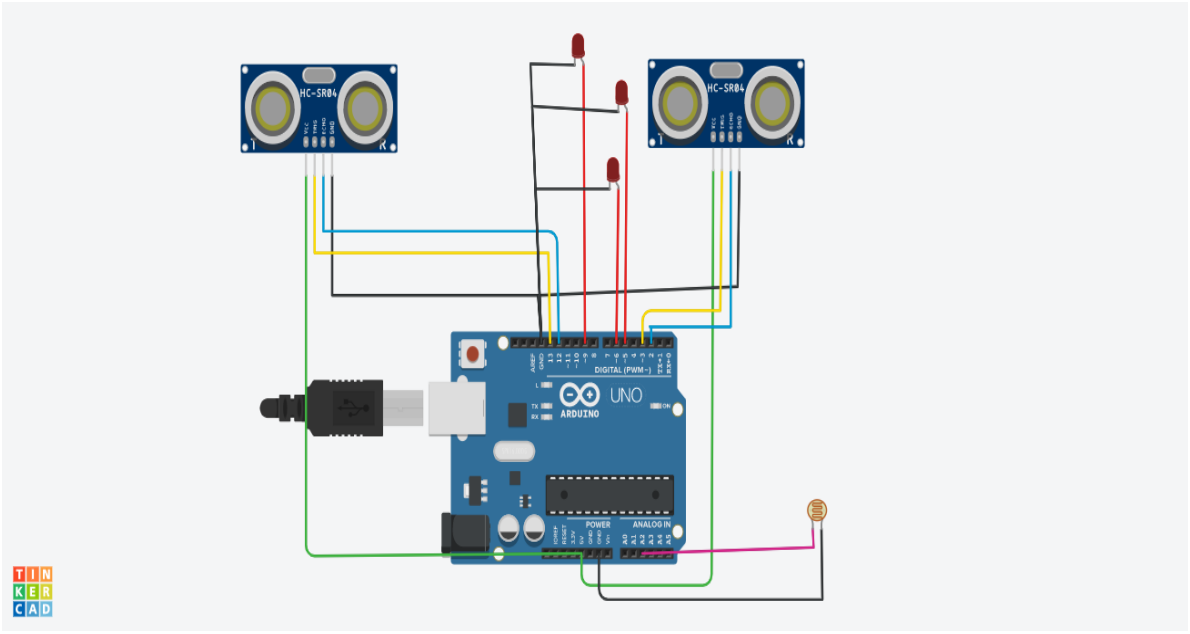


Fig-9

3.8 Circuit diagram of complete Project:

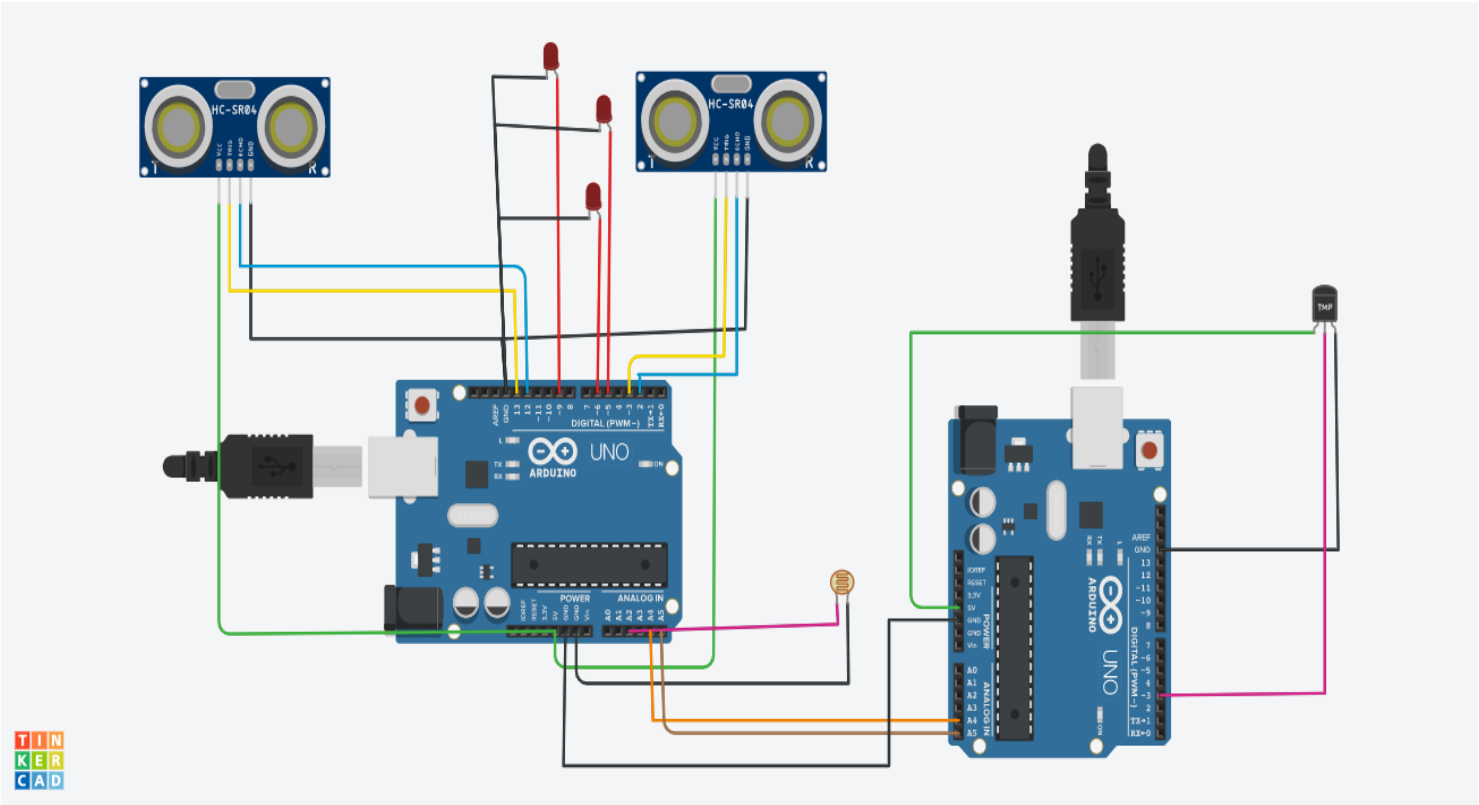


Fig-10

3.9Components Required:

- Arduino UNO x 2
- Adafruit Sensor shield v 5.0 x 1
- Ultrasonic Sensor(HC-SR04) x 2
- Photo resistor x 1
- LEDs
- Breadboard x 1
- 100k resistor x 1
- DHT11 sensor module x 1
- 9 V DC battery x 2
- Battery Connectors x 2
- Jumper Wires

3.10Soft wares used:

- **Arduino IDE**
- Fritzing
- Circuito
- **TinkerCAD**
- Github

3.11 Results:

We worked on Tinkercad as online Arduino circuit designing and simulating platform. We designed circuits for both master as well as slave Arduino. After we uploaded the code and run it, we were able to get the desired virtual output and were able to confirm various test cases and various conditions of a project.

The master-slave i2c connection worked perfectly and established a strong connection between two Arduinos. Our master Arduino was able to detect special conditions for making led ON and Slave Arduino worked continuously checking distance of approaching objects and presence of natural light, to decide to switch on the LED or not.

Hence in the end we got the desired results through virtual simulation.

3.12Applications and Usability:

- HOME: Easy to use on a daily basis for automatically switching lights on and off as and when required, thus paving the way for home automation.

- STREETS: As demonstrated above this system is quite usable with street lights saving a lot of energy. This is because street lights could be turned off when there is no vehicle activity on the street.

- OFFICES:Lights could be easily switched on and off based on presence of employees and room lighting conditions.

- HALLWAYS:Lights can be made brighter and dimmer on the basis of presence in the hallways.

- SECURITY:Data can be transferred to remote places through internet to monitor if light is on or not. This could be useful if there is a security breach inside a premises as the lights would go on automatically and can notify the concerned person.

CHAPTER 4

MINIMUM VIABLE PRODUCT (MVP)

4.1What is MVP?

Minimum viable product or MVP is nothing but a product with ample features to tie the early adopter customers and just suffices the idea of the product early in the market and in the product development cycle. In industries such as software and software as a service-based industry a minimum viable product can add the development team to receive a good amount of feedback as quickly as possible to mitigate the problems and make the product better.

·The major benefit of an MVP is that you can gain understanding about the users and their interest in the product without the loss of resources to develop the product.It helps you in a way that you will find the problems and understand the customers the sooner you launch and you will be able to make the changes and deliver in the market.

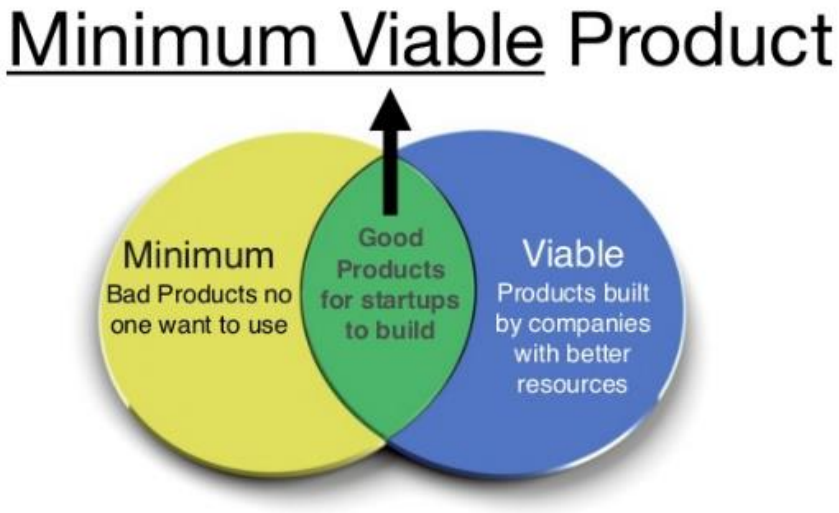
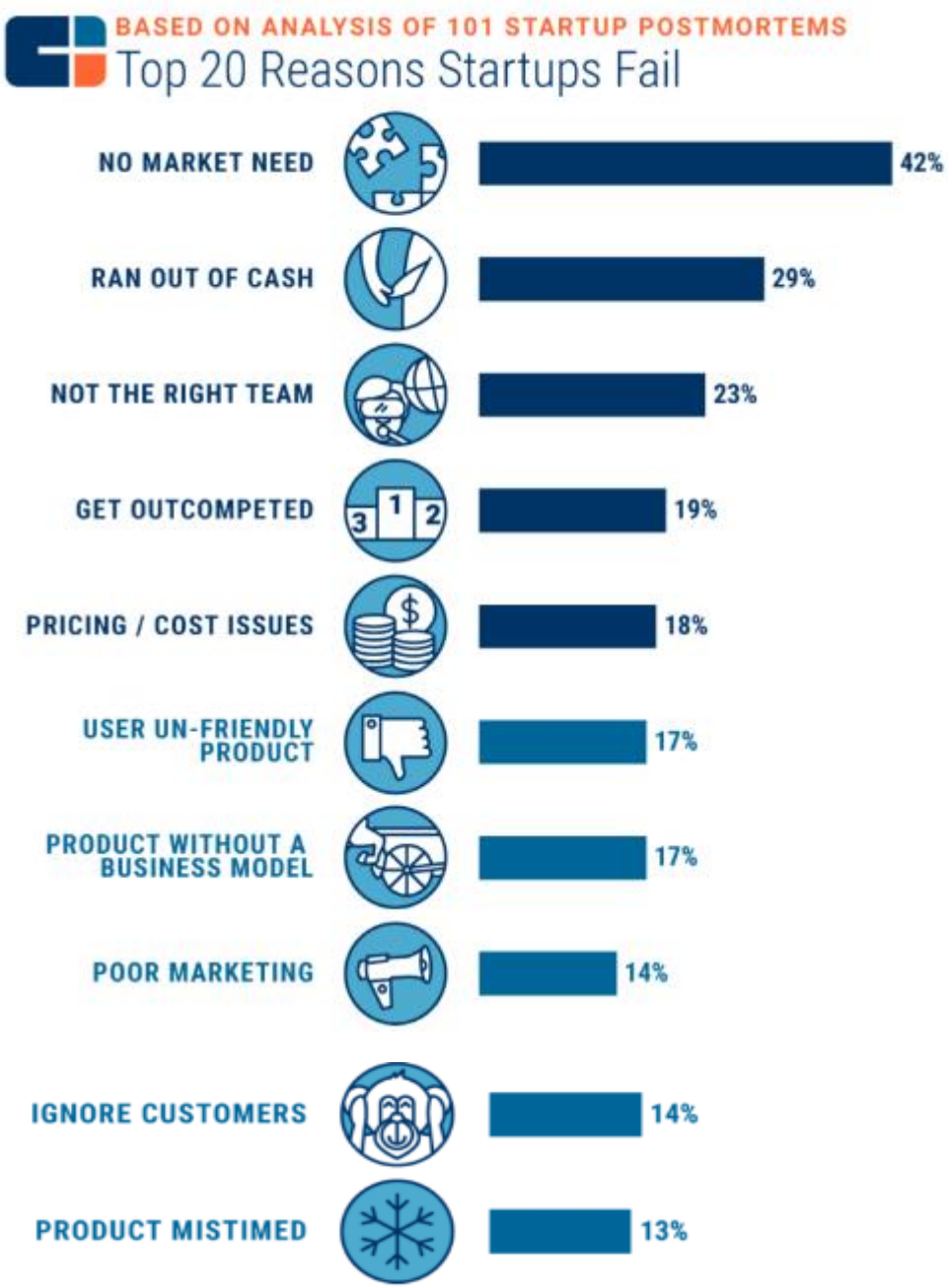


Fig-11

4.1 Why do we need MVP?

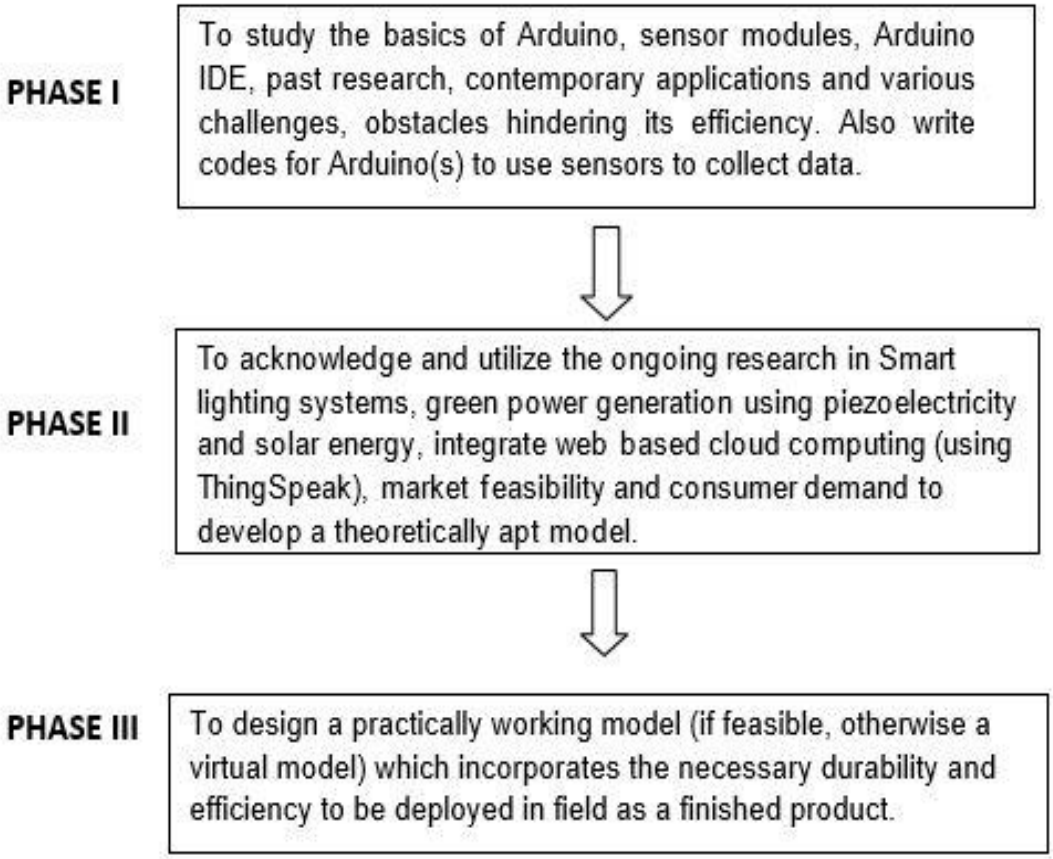


As we can see in the image that after conceptualization also, the few big reasons due to which product fails in the market is that we people don't understand the market needs, pricing and cost issue which cannot match the contemporary's prices, also un friendly product, without a business model, product mistimes and ignoring customers.

All the above problems can be eradicated by following the path of minimum viable product which kind of gives us a feel of what our product will in the market once it goes in the hands of the customers and how the product performs and in turn creates brand value and goodwill.

CHAPTER 5

PROJECT PHASES



CHAPTER 6

CONCLUSIONS AND FURTHER WORK

6.1 Conclusion:

We simulated our circuit, and also did run our code in the virtual Arduino online simulator. Our code runs smoothly and it will get the desired the output from various sensors and modules.

We did research about solar energy and piezoelectricity in order to use to power our project but since there is no way to simulate power requirements online and get the correct data, hence there is no need to implement it virtually.

6.2 Further work:

We further plan to incorporate Wi-Fi modules and regulate them with various online platforms to get real time data. Also it would help in making our project globally accessible and remotely controlled. Hence are next aim is to work on IoT applications and uses which will work for the advancement of our project.

Also After designing the circuits virtually and running the codes in simulator, we are further inspired to invest time making this project more accessible, user-friendly easy to deploy and most importantly sustain harsh environmental conditions. Thus we now plan to research in the area of of durability and material science, as well as latest electronic technological developments by which we can realise our aim of developing this project into a marketable product.

APPENDIX

Master Arduino code:

```
#include<dht.h>
#include<Wire.h>
int a ;
dht DHT;

#define DHT1_PIN 3
void setup() {

Wire.begin();
Serial.begin(9600);
}
void loop() {

Wire.beginTransmission(9);

  int temp = DHT.read11(DHT1_PIN);

Serial.println(" Temparature ");
Serial.println(DHT.temperature, 1);

Serial.println(" Humidity " );
Serial.println(DHT.humidity, 1);



delay(1000);
```

```
if(((DHT.humidity, 1) >60) && ((DHT.temperature, 1)<35))
{ x=1;   //FOG
}

Wire.write(a);

Wire.endTransmission();
}
```

Slave Arduino code:

```
 #include <Wire.h>
#define triPin1 13
#define echPin1 12

#define triPin2 3
#define echPin2 2
#define led 9
#define ledb 6
#define ledc 5
int c,ldr=A2,light;
int x;

void setup() {
Serial.begin (9600);
pinMode(triPin1, OUTPUT);
pinMode(echPin1, INPUT);
```

```
pinMode(triPin2, OUTPUT);
pinMode(echPin2, INPUT);
pinMode(led, OUTPUT);
pinMode(ledb, OUTPUT);
pinMode(ledc, OUTPUT);
pinMode(ldr, INPUT);

Wire.begin(9);

Wire.onReceive(receiveEvent);
}

void receiveEvent(int bytes) {
  x = Wire.read();    // read
}

void loop() {

if( x==1) //fog

{ analogWrite(led, 255);
analogWrite(led3,255);
digitalWrite(led2, HIGH);
}
else
  {
  light=analogRead(ldr);
  if (light<960)
  {long duration1, distance1;
  long duration2, distance2;
digitalWrite(trigPin1, LOW);
delayMicroseconds(2);

digitalWrite(trigPin1, HIGH);
```

```
delayMicroseconds(10);

digitalWrite(triPin1, LOW);
  duration1 = pulseIn(echPin1, HIGH);
  distance1 = (duration1/2) / 29.1;




digitalWrite(trigPin2, LOW);

delayMicroseconds(2);

digitalWrite(trigPin2, HIGH);

delayMicroseconds(10);

digitalWrite(triPin2, LOW);
  duration2 = pulseIn(echPin2, HIGH);
  distance2 = (duration2/2) / 29.1;




if (distance1 >= 100 && distance2 >= 100  )



{ Serial.println("out1");
analogWrite(led, 5);
analogWrite(led3,5);
digitalWrite(led2, LOW}
```

```
else{

while(distance1 <= 100 || distance2 <= 100 ){
analogWrite(led, distance1);
analogWrite(led3, distance2);
Serial.print(distance1);
Serial.println(" cm1");
Serial.print(distance2);
Serial.println(" cm2");

digitalWrite(triPin1, LOW);
delayMicroseconds(2);
digitalWrite(triPin1, HIGH);

delayMicroseconds(10);
digitalWrite(triPin1, LOW);
  duration1 = pulseIn(echPin1, HIGH);
  distance1 = (duration1/2) / 29.1;

digitalWrite(triPin2, LOW);
delayMicroseconds(2);

digitalWrite(triPin2, HIGH);
delayMicroseconds(10);
digitalWrite(triPin2, LOW);
  duration2 = pulseIn(echPin2, HIGH);
  distance2 = (duration2/2) / 29.1;


if(distance1 <= 10|| distance2<= 10)
digitalWrite(led2, HIGH);
```

```
  }


delay(1000);
  if(c==1){

digitalWrite(led2, LOW);

  }



}
  }
  else
  {analogWrite(led, 0);
analogWrite(led3,0);
digitalWrite(led2, LOW);
  }
  }



digitalWrite(led2, LOW);

}
```

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