IOT BASED WEATHER ADAPTIVE STREET LIGHTING SYSTEM

PROJECT REPORT

Submitted By

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in partial fulfilment for the award of the degree of

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BONAFIDE CERTIFICATE

Certified that this project report titled **"IOT BASED WEATHER ADAPTIVE STREET LIGHTING SYSTEM"** is the bonafide work of **"KOWSHIKA S, NANDHINI S, KAVYA P, HARIPRAVEEN S"** who carried out the project work under my supervision.

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ACKNOWLEDGEMENT

At the outset, we express our heartfelt gratitude to **GOD,** who has been our strength to bring this project to light.

At this pleasing moment of having successfully completed our project,we wish to convey our sincere thanks and gratitude to our beloved president **Mr. C. Balakrishnan,** who has provided all the facilities to us.

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ABSTRACT

An IoT-based weather adaptive street lighting system is a smart and energy-efficient solution that can adapt to changing weather conditions and traffic patterns. The system uses embedded sensors and wireless communication to monitor and control the ON/OFF status of streetlights based on the frequency of vehicles at different times of the day. The system can also measure ambient conditions such as light levels

and adjust the intensity of the lights accordingly The proposed system aims to save energy by controlling the street lights based on the detection of vehicles or other obstacles on the street. The system can be controlled wirelessly in a centralized manner, allowing for easy management and maintenance. This project is designed to be an automated method for controlling street lights, making it a cost-effective and sustainable solution for smart cities.

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CHAPTER 1

1. INTRODUCTION

1.1 PROJECT OVERVIEW

Introduction:

In recent years, the advancement of smart technologies has revolutionized various aspects of our lives, including the way we illuminate our cities and streets. Traditional street lighting systems, characterized by fixed brightness levels and timers, are gradually being replaced by more intelligent and efficient alternatives. One such innovation is the Adaptive Street Lighting System, a cutting-edge solution that leverages advanced sensors, data analysis, and automation to create a dynamic and responsive lighting environment.

The Adaptive Street Lighting System represents a significant leap forward in terms of energy efficiency, cost-effectiveness, and overall sustainability. By intelligently adjusting lighting levels based on real-time conditions and specific requirements, this system offers numerous benefits to municipalities, citizens, and the environment alike.

This paper explores the concept and features of the Adaptive Street Lighting System, highlighting its key components and the advantages it brings. We will delve into how the system utilizes sensors and data analytics to optimize lighting levels, the impact on energy consumption and cost savings, as well as the positive effects on safety, visibility, and community well-being.

Furthermore, we will examine the potential challenges and considerations associated with implementing such a system, including technological requirements, infrastructure upgrades, and public acceptance. Understanding these factors is crucial for city planners, engineers, and policymakers to make informed decisions and successfully transition to adaptive street lighting.

In conclusion, the Adaptive Street Lighting System represents a transformative approach to urban lighting management. By embracing this intelligent and dynamic lighting solution, cities can achieve substantial energy savings, reduce carbon emissions, enhance public safety, and improve overall quality of life for residents and visitors. With its potential to revolutionize urban landscapes, the Adaptive Street Lighting System is poised to shape the future of smart and sustainable cities.

1.2 PURPOSE

The purpose of an adaptive street lighting system is to provide efficient and effective illumination for public streets and roads while minimizing energy consumption and environmental impact. It aims to improve safety, visibility, and overall quality of the urban environment at night.

The adaptive aspect refers to the system's ability to dynamically adjust the brightness levels of street lights based on real-time conditions and requirements. By using sensors, such as motion sensors, ambient light sensors, and traffic sensors, the system can intelligently respond to changes in lighting needs.

The system can optimize energy usage by dimming or brightening the lights according to the presence of pedestrians, vehicles, or changing weather conditions. This reduces energy waste and lowers carbon emissions.

By adjusting lighting levels as needed, the system helps municipalities save on electricity costs. The ability to dim lights during low-traffic periods or in areas with low activity reduces unnecessary energy expenses.

CHAPTER 2

2. IDEATION & PROPOSED SOLUTION

2.1 PROBLEM STATEMENTS DEFINITION

The traditional manual system of operating street lights has led to enormous energy wastage worldwide, resulting in an urgent need for a smart street lighting system that leverages the capabilities of the Internet of Things (IoT) to automate and optimize energy usage. The lack of such a system not only contributes to the energy crisis but also hinders the development of street lighting systems globally. This survey aims to explore the various sensors and components used in IoT-based smart street lighting systems and assess their effectiveness in creating reliable and intelligent systems.

Example:

2.2 EMPATHY MAP CANVAS

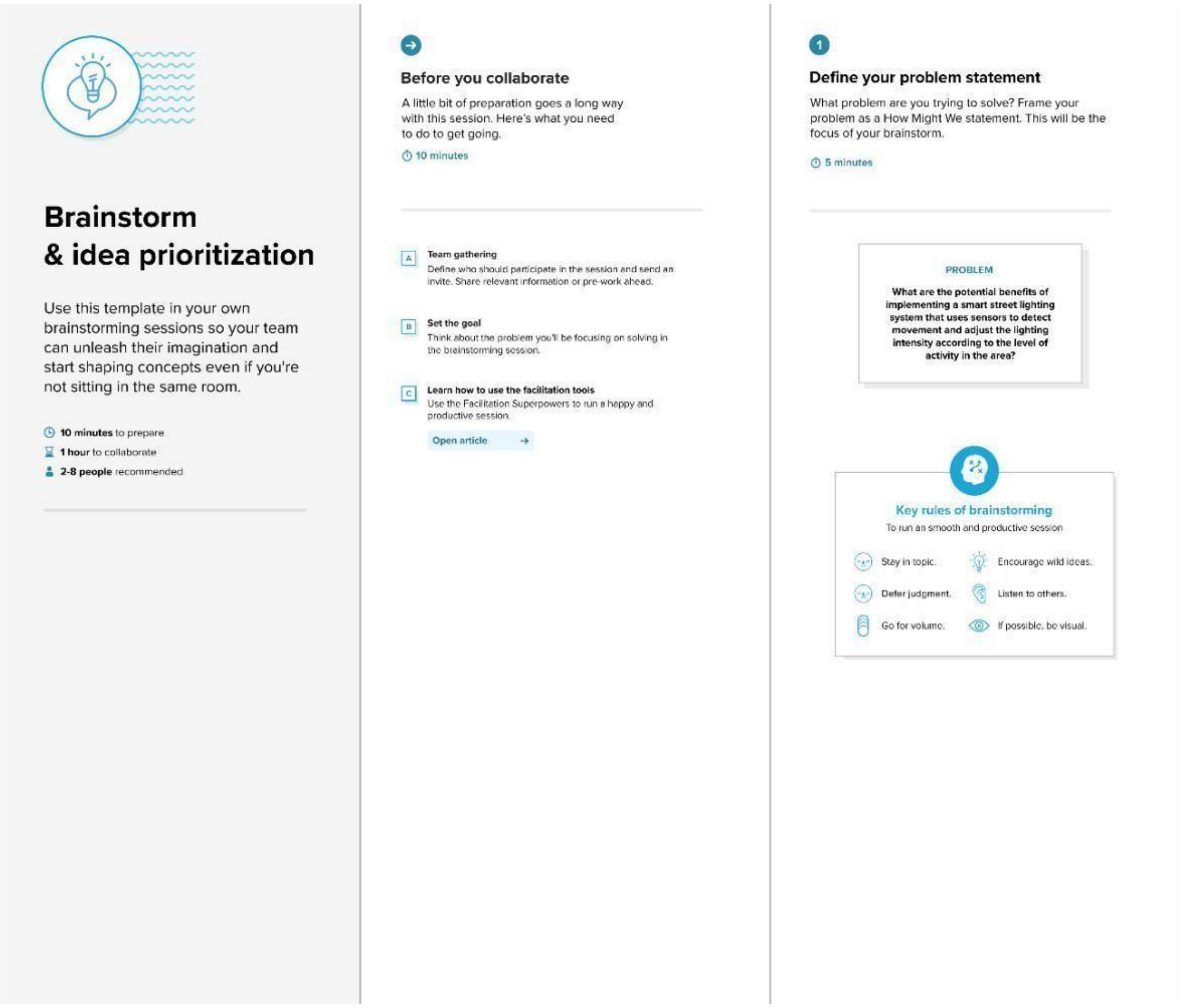
An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. The empathy map was originally created by Dave Gray and has gained much popularity within the agile community. Have the team members speak about the sticky notes as they place them on the empathy map. Ask questions to reach deeper insights so that they can be elaborated for the rest of the team. To help bring the user to life, you may even wish to sketch out the characteristics this person may have on the center of the face.

2.3 IDEATION & BRAINSTORMING

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome

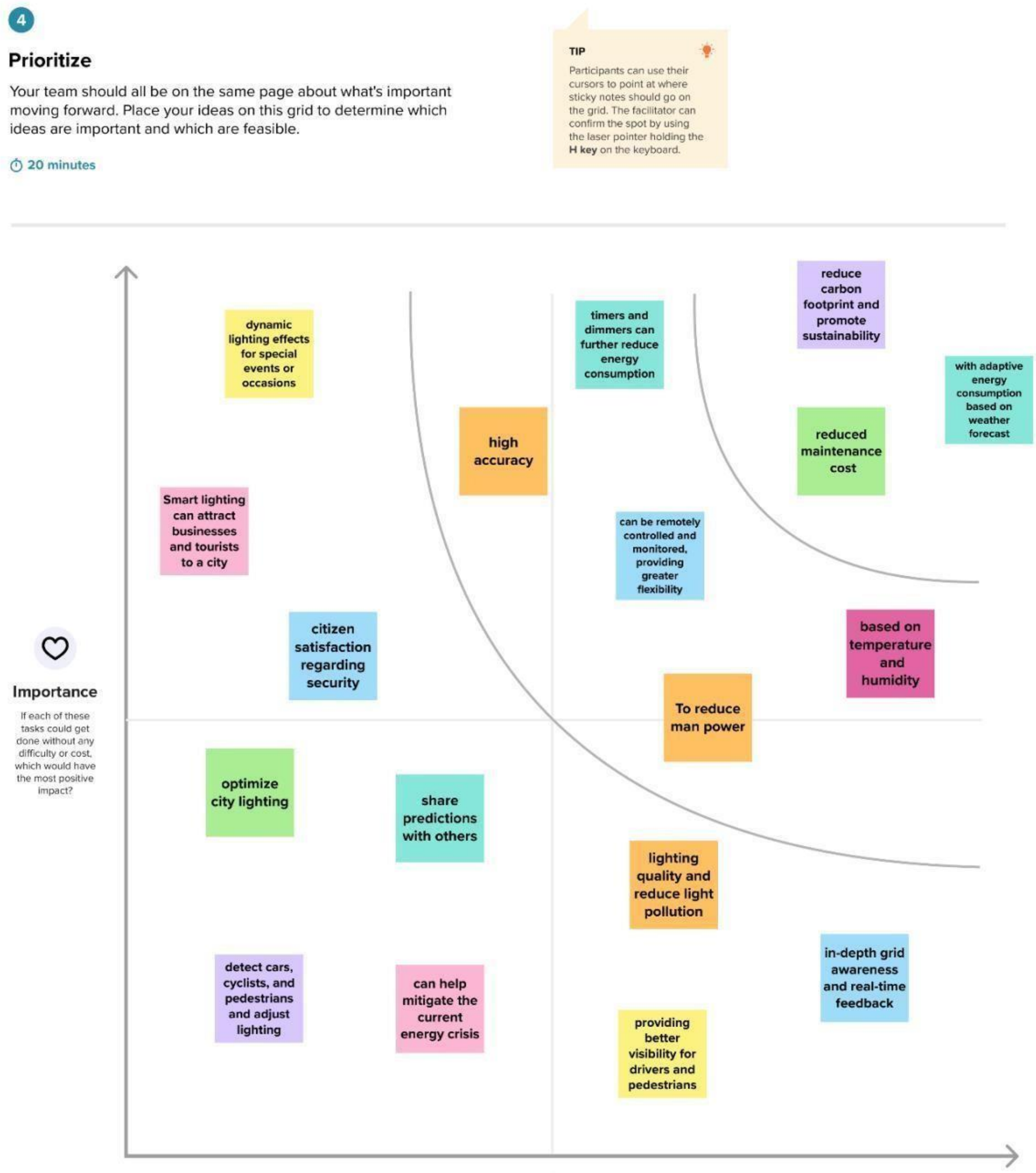
Brainstorm & Idea Prioritization:

Step-1: Team Gathering, Collaboration and Select the Problem Statement:



Step-2: Brainstorm, Idea Listing and Grouping

Step-3: Idea Prioritization



2.4 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	IoT-based smart lighting systems are weather adaptive. Some of these systems are designed specifically for street light. These systems use embedded sensors to detect sunlight and adjust the lighting accordingly. These systems aim to save energy and reduce costs by optimizing the use of street lighting.
2.	Idea / Solution description	Our idea is to build an IoT-based weather adaptive street light system using a cloud interface, one can use the existing IoT-based smart lighting systems that are weather adaptive. These systems use embedded sensors to detect sunlight and adjust the lighting accordingly By integrating the cloud interface with the IoT-based smart lighting system, one can remotely monitor and control the street lights, making it more efficient and cost effective. This system can be a price-effective, ecofriendly, and safe technique to save energy.
3.	Novelty / Uniqueness	The uniqueness of an IoT based weather adaptive street light system with a cloud interface lies in its ability to remotely monitor and control the street lights, making It more efficient and cost-effective.
4.	Social Impact / Customer Satisfaction	These systems can improve safety by using monitoring cameras to control the street lights based on sunlight detection. The ability to remotely monitor and control the street lights through a cloud interface can also improve maintenance and reduce downtime, leading to higher customer satisfaction.

5.	Business Model (Revenue Model)	The business model or revenue model of an IoT-based weather adaptive street light system with a cloud interface can be based on energy savings and maintenance costs. The revenue can be generated through the sale of the system, installation, and maintenance services. The system can also be offered as a subscription-based service, where the customer pays a monthly or yearly fee for the use of the system.
6.	Scalability of the Solution	The IoT-based street lighting can be defined as internetworked digital lighting systems that utilize individual lights as network node assemblies to receive, collect, and transmit data. The scalability of these systems is further enhanced by the fact that a large number of applications can be put into practice within a broader context of the extensive development of smart city initiatives across the world.

CHAPTER 3

3. REQUIREMENT ANALYSIS

3.1 FUNCTIONAL REQUIREMEMTS

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through Linked IN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User authentication	The solution should allow users to log in securely and authenticate their identity before accessing protected resources or functionality.
FR-4	Data input and output:	The solution should allow users to input and retrieve data from the system in a clear and intuitive manner, using appropriate user interfaces and data formats.
FR-5	Workflow management:	The solution should support the workflows and business processes of the organization, ensuring that tasks are routed to the appropriate users and completed in a timely and efficient manner.
FR-6	Reporting and analytics	The solution should provide users with the ability to generate reports and analyze data to support decision making and performance monitoring.

3.2 NON -FUNCTIONAL REQUIREMENT

Following are the Non- functional requirements of the proposed solution.

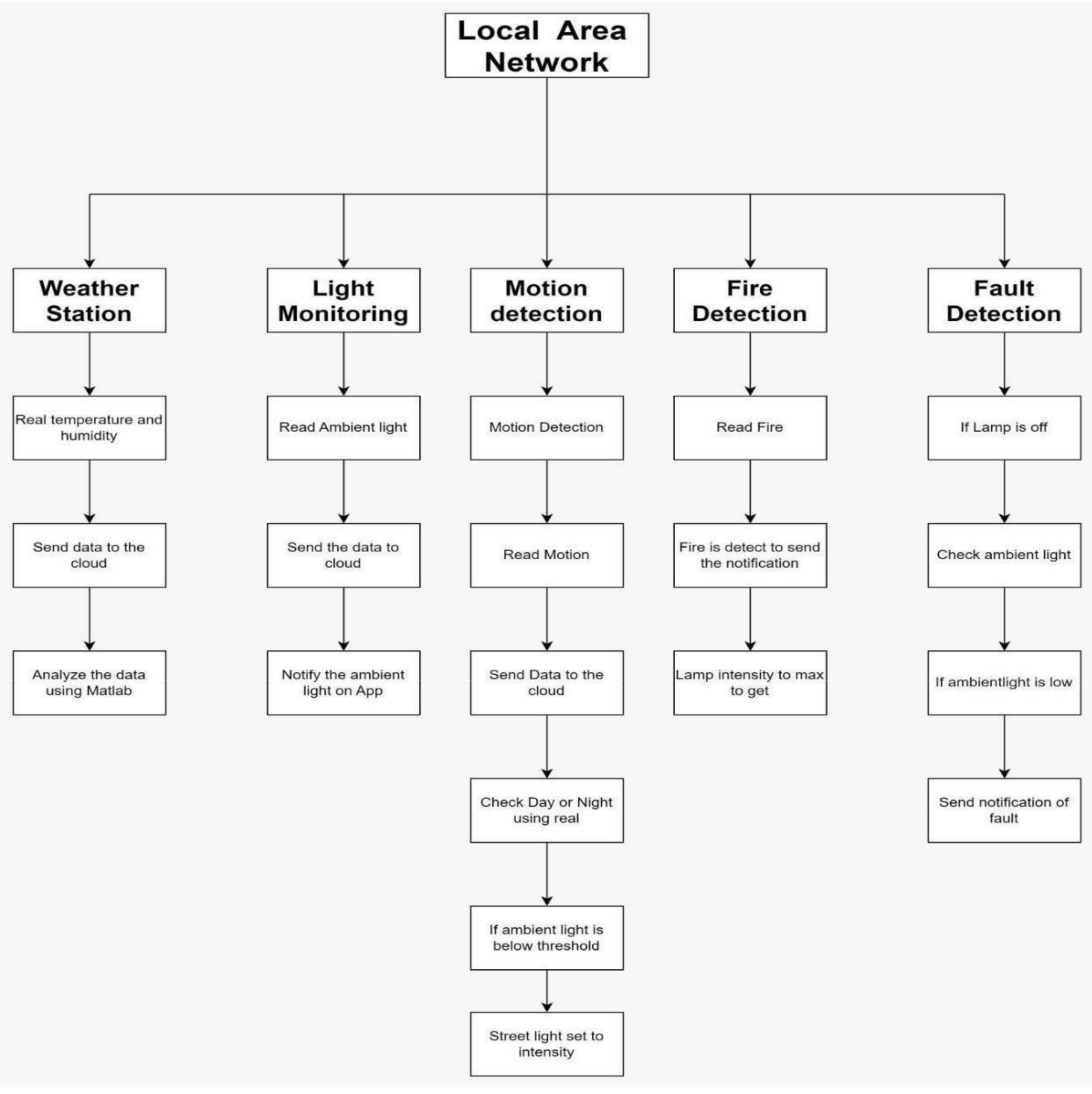
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The system should be easy to use and intuitive for all types of users.
NFR-2	**Security**	The system should be secure and protect user data from unauthorized access or breaches.
NFR-3	**Reliability**	The solution should be available and operational at all times, with minimal downtime or disruption to users.
NFR-4	**Performance**	The system should be able to handle a large number of users and requests simultaneously without experiencing any delays or crashes.
NFR-5	**Availability**	The system should be available 24/7 without any scheduled or unscheduled downtime.
NFR-6	**Scalability**	The solution should be able to scale its capacity up or down to handle changing volumes of users or transactions, without sacrificing performance or reliability.

CHAPTER 4

4. PROJECT DESIGN

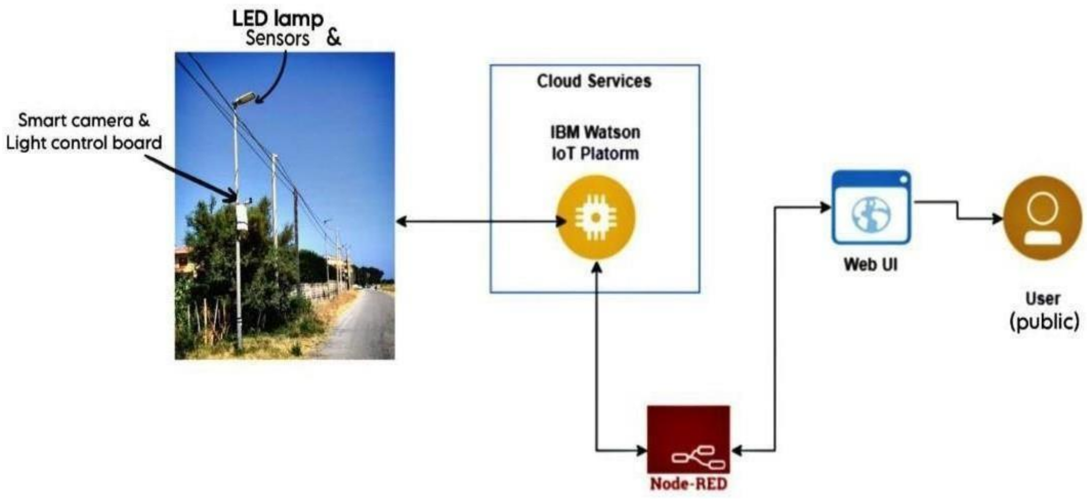
4.1 DATA FLOW DIAGRAMS

A Data flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data stored.



4.2 SOLUTION ARCHITECTURE

A solution architecture (SA) is an architectural description of a specific solution. SAs combine guidance from different enterprise architecture viewpoints (business, information and technical), as well as from the enterprise solution architecture (ESA).



4.3 USER STORIES

Weather station	**Light monitoring**	**Motion Detection**	**Fire detection**	**Fault detection**
Detecting the humidity and temperature of the weather	Read the ambient light	Motion detection	Read fire	If the lamp is off check the ambient light
After the detection the data is sent to the cloud	Send the data to the cloud	Read motion of the weather	Fire is detected to send the notification	If ambient light is low
Analyse the data using MATLAB	Notify the ambient light on map	Send the data to the cloud	Increase the intensity of the lamp	Send the notification to fault.
		Check day or night using real		
		Suppose the ambient light is below threshold ,the light is set to intensity		

CHAPTER 5

5. CODING & SOLUTION

5.1 Feature 1

```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQtt

#define LED 5
#define LED2 4
#define LED3 2
int LDR = 32;
int LDRReading = 0;
int threshold_val = 800;
int lEDBrightness = 0;
int flag=0;

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength);

//-------credentials of IBM Accounts------

#define ORG "8hydt8"//IBM ORGANITION ID
#define DEVICE_TYPE "hari1"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "1234" //Device ID mentioned in ibm watson IOT Platform
#define TOKEN "12345678"     //Token
String data3;
float h, t;


//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server Name
char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type of event
perform and format in which data to be send
char subscribetopic[] = "iot-2/cmd/test/fmt/String";// cmd REPRESENT command
type AND COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth";// authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id
```

```
//________________________________
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the predefined client
id by passing parameter like server id,portand wificredential
void setup()// configureing the ESP32
{
 Serial.begin(115200);

 pinMode(LED,OUTPUT);
 pinMode(LED2,OUTPUT);
 pinMode(LED3,OUTPUT);
 delay(10);
 Serial.println();
 wificonnect();
 mqttconnect();
}

void loop()// Recursive Function
{



 //PublishData(t, h);
 //delay(1000);

 /* LDRReading = analogRead(LDR);
 Serial.print("LDR READING:");
 Serial.println(LDRReading);

 if (LDRReading >threshold_val){
 lEDBrightness = map(LDRReading, 0, 1023, 0, 255);
 Serial.print("LED BRIGHTNESS:");
 Serial.println(lEDBrightness);

 analogWrite(LED, lEDBrightness);
 analogWrite(LED2, lEDBrightness);
 analogWrite(LED3, lEDBrightness);
 }
```

```
else{


  analogWrite(LED, 0);
  analogWrite(LED2, 0);
  analogWrite(LED3, 0);
  }

  delay(300);*/

  if (!client.loop()) {
    mqttconnect();
  }
}
```

5.2 Feature 2

```
/*.....................................retrieving to Cloud.............................. */

/*void PublishData(float temp, float humid) {
  mqttconnect();//function call for connecting to ibm*/
  /*
     creating the String in in form JSon to update the data to ibm cloud
  */
  /*String payload = "{\"temperature\":";
  payload += temp;
  payload += "," "\"humidity\":";
  payload += humid;
  payload += "}";


  Serial.print("Sending payload: ");
  Serial.println(payload);


  if (client.publish(publishTopic, (char*) payload.c_str())) {
    Serial.println("Publish ok");// if it sucessfully upload data on the cloud then it will
print publish ok in Serial monitor or else it will print publish failed
```

```
 } else {
    Serial.println("Publish failed");
  }



}  */
void mqttconnect() {
  if (!client.connected()) {
    Serial.print("Reconnecting client to ");
    Serial.println(server);
    while (!!!client.connect(clientId, authMethod, token)) {
      Serial.print(".");
      delay(500);
    }

     initManagedDevice();
     Serial.println();
  }
}
void wificonnect() //function defination for wificonnect
{
  Serial.println();
  Serial.print("Connecting to ");

  WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifi credentials to establish the
connection
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}

void initManagedDevice() {
  if (client.subscribe(subscribetopic)) {
    Serial.println((subscribetopic));
    Serial.println("subscribe to cmd OK");
```

```
 } else {
    Serial.println("subscribe to cmd FAILED");
  }
}

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength)
{


  Serial.print("callback invoked for topic: ");
  Serial.println(subscribetopic);

  for (int i = 0; i < payloadLength; i++) {
    //Serial.print((char)payload[i]);
    data3 += (char)payload[i];
  }

  Serial.println("data: "+ data3);
  if(data3=="lighton1")
  {
Serial.println(data3);
digitalWrite(LED,HIGH);

  }

  else if(data3=="Light off1")
  {
Serial.println(data3);
digitalWrite(LED,LOW);


  }
  else if(data3=="light on2")
  {
Serial.println(data3);
digitalWrite(LED2,HIGH);

  }
```

```
else if(data3=="light off2")
  {
Serial.println(data3);
digitalWrite(LED2,LOW);

}
  else if(data3=="light on3")
  {
Serial.println(data3);
digitalWrite(LED3,HIGH);

  }

  else if(data3=="light off3")
  {
Serial.println(data3);
digitalWrite(LED3,LOW);

  }
data3="";


 }
```

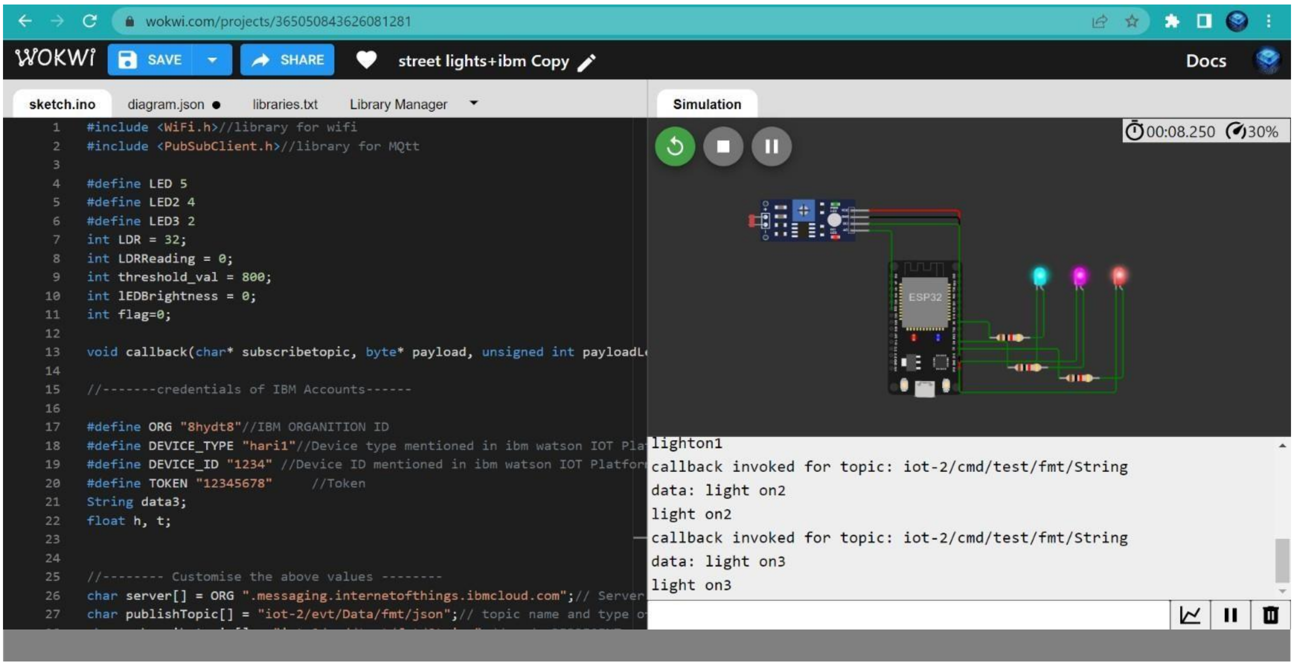
CHAPTER

6. RESULTS

6.1 Performance Metrics

Parameter	Values
Metrics	Wokwi Execution time 00:08:250

Output Screenshot:



CHAPTER 7

7. ADVANTAGES & DISADVANTAGES

ADVANTAGES

The Adaptive Street Lighting system has several advantages:

1. Energy Efficiency: By dynamically turning on and off street lights based on the presence of activity and the time of day, the system significantly reduces energy waste. It ensures that street lights are only illuminated when needed, resulting in lower electricity consumption and reduced energy costs.

2. Cost Savings: With reduced energy consumption, the Adaptive Street Lighting system helps municipalities and governments save money on their electricity bills. The funds saved can be allocated to other important areas, such as infrastructure development or public services.

3. Environmental Impact: By minimizing energy usage, the system contributes to environmental sustainability. It helps reduce greenhouse gas emissions associated with electricity generation, leading to a smaller carbon footprint and a positive impact on the environment.

4. Increased Safety: The system enhances safety by providing well-lit areas where they are most needed. By automatically turning on street lights in areas with high activity or during nighttime, it improves visibility for pedestrians, drivers, and surveillance systems, reducing the risk of accidents and crime.

5. Flexibility and Customization: The adaptive nature of the system allows for flexibility and customization. It can be programmed to adapt to specific patterns of activity in different areas. For instance, certain streets or neighborhoods may have different usage patterns based on factors like population density or commercial activity. The system can be fine-tuned to meet the specific requirements of each location, optimizing energy usage accordingly.

6. Maintenance Efficiency: The system can also provide benefits in terms of maintenance. By detecting and reporting faulty or malfunctioning street lights, it enables proactive maintenance. This reduces response times for repairs and ensures that the street lighting infrastructure remains in good working condition, improving overall reliability.

7. Public Perception: Adaptive street lighting systems demonstrate a commitment to sustainability and innovation. Implementing such systems can enhance the public image of municipalities and governments, showcasing their efforts to reduce energy consumption and promote efficient infrastructure management.

DISADVANTAGES

While the Adaptive Street Lighting system offers many advantages, there are also a few potential disadvantages to consider:

1. Initial Cost: Implementing an adaptive street lighting system requires an upfront investment in the necessary hardware, such as motion sensors and control systems. The initial cost may be higher compared to traditional street lighting systems, which can be a deterrent for some municipalities or organizations with limited budgets.

2. Complexity: The adaptive system involves more complex infrastructure compared to traditional street lighting. It requires sensors, control units, and communication networks to detect motion, collect data, and control the lighting. This complexity can lead to increased maintenance and troubleshooting efforts.

3. Technical Challenges: Depending on the scale and complexity of the adaptive system, there may be technical challenges during the implementation and operation phases. Issues such as sensor calibration, data accuracy, communication reliability, and software integration may arise and require specialized expertise to address effectively.

4. Dependency on Sensors: The effectiveness of the adaptive system heavily relies on the accuracy and reliability of the motion sensors. If the sensors malfunction or fail to detect motion accurately, it may result in inappropriate lighting conditions, either leaving certain areas in darkness or keeping unnecessary lights illuminated.

5. Sensitivity to Environmental Factors: External factors like weather conditions, vegetation, or obstructions can affect the performance of motion sensors. False positives or false negatives in motion detection can occur due to wind, rain, or other environmental elements. This may impact the system's ability to accurately control street lighting, potentially leading to inefficient lighting conditions.

6. Privacy Concerns: Depending on the implementation and placement of motion sensors, there may be privacy concerns raised by individuals who feel their movements are being monitored. Careful consideration and transparent communication about data collection and privacy protection measures are essential to address these concerns.

7. Integration and Compatibility: Integrating the adaptive street lighting system with existing infrastructure, such as legacy lighting systems or control networks, may pose compatibility challenges. It may require additional effort and investment to ensure seamless integration and interoperability.

CHAPTER

8. CONCLUSION

In conclusion, the Adaptive Street Lighting system offers numerous advantages in terms of energy efficiency, cost savings, environmental impact, safety, flexibility, maintenance efficiency, and public perception. By dynamically adjusting the lighting based on activity and time of day, the system minimizes energy waste and reduces costs for municipalities and governments.

However, there are also potential disadvantages to consider, including the initial cost of implementation, complexity of infrastructure, technical challenges, dependency on sensors, sensitivity to environmental factors, privacy concerns, and integration issues.

Despite these potential drawbacks, the overall benefits of the Adaptive Street Lighting system make it a compelling solution for improving energy efficiency, reducing costs, enhancing safety, and demonstrating a commitment to sustainability. With careful planning, effective maintenance, and consideration of privacy and compatibility issues, the adaptive system can be successfully implemented to create well-lit and efficient street environments while minimizing energy consumption and environmental impact.

CHAPTER 9

9. FUTURE SCOPE

The future scope for the Adaptive Street Lighting system using the Internet of Things (IoT) is promising. Here are some key areas of development:

1. Advanced Sensor Technology: The use of IoT can enable the integration of advanced sensor technologies, such as infrared sensors, ultrasonic sensors, and cameras, to enhance the accuracy and efficiency of motion detection. These sensors can provide more detailed information about the presence and movement of individuals or vehicles, allowing for more precise control of street lighting.

2. Data Analytics and Machine Learning: IoT-enabled Adaptive Street Lighting systems can leverage data analytics and machine learning techniques to analyze patterns of activity, optimize energy usage, and predict lighting requirements. By analyzing historical data and real-time inputs, the system can learn and adapt to specific usage patterns, leading to further energy savings and improved performance.

3. Intelligent Network Infrastructure: IoT can facilitate the development of intelligent network infrastructures for street lighting systems. This includes the use of wireless communication protocols, such as LoRaWAN or NB-IoT, to connect and control individual street lights. This enables remote monitoring, control, and maintenance of the lighting infrastructure, reducing manual intervention and enhancing operational efficiency.

4. Smart City Integration: Adaptive Street Lighting systems can be integrated into broader smart city initiatives. By connecting with other IoT-enabled devices and systems, such as traffic management systems, surveillance cameras, and environmental sensors, the street lighting system can contribute to overall city optimization. For example, street lights can be dimmed or brightened based on real-time traffic conditions or adjusted to improve air quality in specific areas.

5. Energy Harvesting and Sustainable Power Sources: IoT technologies can facilitate the integration of energy harvesting techniques, such as solar panels or kinetic energy harvesting, into street lighting systems. This enables the generation of sustainable and renewable energy to power the street lights, reducing reliance on the electrical grid and further enhancing energy efficiency.

6. Adaptive Lighting Design: The future scope for adaptive street lighting includes the exploration of new lighting designs and techniques. For instance, the system can dynamically adjust the intensity, color temperature, or direction of the lighting based on specific requirements, such as enhancing visibility for pedestrians or reducing light pollution.

7. Integration with Smart Grids: The integration of Adaptive Street Lighting systems with smart grids allows for better energy management and load balancing. The system

can communicate with the grid to adjust lighting levels based on overall energy demand, helping to stabilize the grid and optimize energy distribution.

Overall, the future scope for Adaptive Street Lighting systems using IoT is focused on leveraging advanced sensor technologies, data analytics, intelligent networks, smart city integration, sustainable power sources, adaptive lighting design, and integration with smart grids. These advancements have the potential to further enhance energy efficiency, optimize performance, and contribute to the development of smarter and more sustainable cities.

CHAPTER 10

10. APPENDIX

Source Code:

```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQtt

#define LED 5
#define LED2 4
#define LED3 2
int LDR = 32;
int LDRReading = 0;
int threshold_val = 800;
int lEDBrightness = 0;
int flag=0;

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength);

//-------credentials of IBM Accounts------

#define ORG "8hydt8"//IBM ORGANITION ID
#define DEVICE_TYPE "hari1"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "1234" //Device ID mentioned in ibm watson IOT Platform
#define TOKEN "12345678"     //Token
String data3;
float h, t;


//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server Name
char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type of event
perform and format in which data to be send
char subscribetopic[] = "iot-2/cmd/test/fmt/String";// cmd REPRESENT command
type AND COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth";// authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id
```

```
//___________________________
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the predefined client
id by passing parameter like server id,portand wificredential
void setup()// configureing the ESP32
{
  Serial.begin(115200);

  pinMode(LED,OUTPUT);
  pinMode(LED2,OUTPUT);
  pinMode(LED3,OUTPUT);
  delay(10);
  Serial.println();
  wificonnect();
  mqttconnect();
}

void loop()// Recursive Function
{



  //PublishData(t, h);
  //delay(1000);

  /* LDRReading = analogRead(LDR);
  Serial.print("LDR READING:");
  Serial.println(LDRReading);

  if (LDRReading >threshold_val){
  lEDBrightness = map(LDRReading, 0, 1023, 0, 255);
  Serial.print("LED BRIGHTNESS:");
  Serial.println(lEDBrightness);

  analogWrite(LED, lEDBrightness);
  analogWrite(LED2, lEDBrightness);
  analogWrite(LED3, lEDBrightness);
  }
  else{
```

```
  analogWrite(LED, 0);
  analogWrite(LED2, 0);
  analogWrite(LED3, 0);
  }

  delay(300);*/

  if (!client.loop()) {
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}




/*....................................retrieving to Cloud.............................. */

/*void PublishData(float temp, float humid) {
  mqttconnect();//function call for connecting to ibm*/
  /*
     creating the String in in form JSon to update the data to ibm cloud
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  /*String payload = "{\"temperature\":";
  payload += temp;
  payload += "," "\"humidity\":";
  payload += humid;
  payload += "}";



  Serial.print("Sending payload: ");
  Serial.println(payload);



  if (client.publish(publishTopic, (char*) payload.c_str())) {
    Serial.println("Publish ok");// if it sucessfully upload data on the cloud then it will
print publish ok in Serial monitor or else it will print publish failed
  } else {
    Serial.println("Publish failed");

}
```

```
}  */
void mqttconnect() {
  if (!client.connected()) {
    Serial.print("Reconnecting client to ");
    Serial.println(server);
    while (!!!client.connect(clientId, authMethod, token)) {
      Serial.print(".");
      delay(500);
    }

     initManagedDevice();
     Serial.println();
  }
}
void wificonnect() //function defination for wificonnect
{
  Serial.println();
  Serial.print("Connecting to ");

  WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifi credentials to establish the
connection
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}

void initManagedDevice() {
  if (client.subscribe(subscribetopic)) {
    Serial.println((subscribetopic));
    Serial.println("subscribe to cmd OK");
  } else {
    Serial.println("subscribe to cmd FAILED");
  }
}
void callback(char* subscribetopic, byte* payload, unsigned int payloadLength)
```

```
{


  Serial.print("callback invoked for topic: ");
  Serial.println(subscribetopic);

  for (int i = 0; i < payloadLength; i++) {
    //Serial.print((char)payload[i]);
    data3 += (char)payload[i];
  }

  Serial.println("data: "+ data3);
  if(data3=="lighton1")
  {
Serial.println(data3);
digitalWrite(LED,HIGH);

  }

  else if(data3=="Light off1")
  {
Serial.println(data3);
digitalWrite(LED,LOW);


  }
  else if(data3=="light on2")
  {
Serial.println(data3);
digitalWrite(LED2,HIGH);

  }

  else if(data3=="light off2")
  {
Serial.println(data3);
digitalWrite(LED2,LOW);

  }
```

```
  else if(data3=="light on3")
  {
Serial.println(data3);
digitalWrite(LED3,HIGH);

  }

  else if(data3=="light off3")
  {
Serial.println(data3);
digitalWrite(LED3,LOW);

  }
data3="";


 }
```

10.2 GitHub & Demo Link

GitHub - **https://github.com/KowshiSankar/Mcrosoft-internship-project**

Demo Link -
https://drive.google.com/drive/folders/13g8lo__69BY4BesTZr0o_BJ52rPDNGTT?usp=share_link

CHAPTER 11

11. REFERENCE

Smart lighting: Intelligent and weather adaptive lighting in street lights using IOT
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Smart Street Lighting and Weather monitoring system for SMART CITIES, Issue:05/May-2021 by International Research Journal of Modernization in Engineering Technology and Science

Intelligent autonomous street lighting system based on weather forecast using LSTM, Didar Tukymbekov, Ahmet Saymbetov, Madiyar Nurgaliyev, Nurzhigit Kuttybay, Gulbakhar Dosymbetova, Yeldos Svanbayev