IoT Based Smart Energy Management Systems

CSE3009 – Internet of Things

Slot: E2

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DECLARATION

I hereby declare that the report entitled **“IOT BASED SMART ENRGY SYSTEM MANAGEMENT”** submitted by me, for the CSE3009 Internet of Things (EPJ) to VIT is a record of bonafide work carried out by me under the supervision of Dr.S.Ebenezer Juliet

I further declare that the work reported in this report has not been submitted and will not be submitted, either in part or in full, for any other courses in this institute or any other institute or university.

Place: Vellore

Date:12/04/2023

Signature of the Candidate

ACKNOWLEDGMENT

We students as the authors of this following project would like to reconcile the contributions made during the project by the students involved in this project and our course faculty for her continuous support in carrying out this project. We would also like to acknowledge the HOD, Department of SCOPE for providing this opportunity and all the other resources and ambience that we have collected through various mediums to carrying out the work.

ABSTRACT:

Internet of Things (IoT) is an emerging technology that is making our world smarter. The idea of connected world cannot be imagined without IoT. An IoT based Smart Home is one such example. In IoT enabled Smart Home environment includes various things such as lighting, home appliances, computers, security camera etc. all are connected to the Internet and allowing user to monitor and control things regardless of time and location constraint. This paper proposes a micro IoT architecture for LED lighting and diming control and automatic fan speed control in smart homes. The proposed solution integrates not only open software platforms on front-end devices and the cloud server, but also presents hardware specifications to LED lighting control and fan speed control equipment.

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INTRODUCTION:

Internet of Things (IoT) is an emerging technology that is making our world smarter. The idea of connected world cannot be imagined without IoT. An IoT based Smart Home is one such example. In IoT enabled Smart Home environment includes various things such as lighting, home appliances, computers, security camera etc. all are connected to the Internet and allowing user to monitor and control things regardless of time and location constraint. This paper proposes a micro IoT architecture for LED lighting and diming control and automatic fan speed control in smart homes. The proposed solution integrates not only open software platforms on front-end devices and the cloud server, but also presents hardware specifications to LED lighting control and fan speed control equipment.

Since most of the energy supply is from fossil fuels, the resource is depleting, thus increasing cost of energy. The global amount of urban population is larger than 50 percent, and is expected to rise to 70 percent by 2050. To deal with the explosive increment of population, smart city projects are being proposed by many countries and organizations for promoting and developing a new paradigm to optimize energy consumption in cities. Burning fossil fuels has also increased concentration of carbon di-oxide in the environment leading to extreme weather patterns. Hence it is imperative that Industries, commercial enterprises and homes take steps to reduce energy wastage, become energy efficient and reduce costs.

OBJECTIVES:

- The main objective is to save and conserve energy
- Also provides visual comfort to users as it adjusts speed of the fan according to the temperature
- Also, a form of security in homes and offices
- Extra durability

MOTIVATION:

- Rise in energy costs and concerns over resilient energy supply
- Lack of proper user behavior
- Integration of an IoT system in subsystems of the energy system

LITERATURE SURVEY

Publication details	Methodology	Advantages	Disadvantages	Assumptions	Limitations
M. Lavanya , P. Muthukannan, Y.S.S. Bhargav, V. Suresh, “IoT Based Automated Temperature and Humidity Monitoring and Control”, Journal of Chemical and Pharmaceutical Sciences ISSN: 0974- 2015.	The system uses various sensors and actuators connected to a microcontroller, which communicates with a central server through the internet.	ability to remotely monitor and control environmental conditions, reduce energy consumption, and prevent damage to stored materials.	The paper does not mention any disadvantages of the methodology used.	The paper assumes system for monitoring and controlling temperature and humidity levels in various settings such as storage rooms, laboratories, and greenhouses.	Dependence on Internet connectivity.
Abhijeet Rajurkar, Onkar Shinde, Vinayak Shinde, Bhushan Waghmode,”Smart Home Control and Monitor System Using Power of IoT’s”, International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 5, May 2016. 8ORCID andMuhammad Shafiq 9,*	The sensors are used to monitor different environmental parameters such as temperature, humidity, and motion, while the actuators control various appliances such as lights, fans, and air conditioners.	energy savings, improved convenience, and enhanced security.	The paper does not mention any disadvantages of the methodology used.	system is intended to provide an efficient and convenient way to manage various home appliances and devices remotely using a smartphone or other internet-connected devices.	Security risks
Suresh Sankaranarayanana , Au Thien Wanb , Aida Harayani Pusac ,” Smart Home Monitoring using Android and Wireless Sensors”, I.J. Engineering and Manufacturing, 2014, 2, 12-30.	used to monitor different environmental parameters such as temperature, humidity, and gas levels, while the communication network facilitates the transmission of sensor data to the mobile application	energy savings, improved convenience, and enhanced safety.	The system can pose security and privacy risks if it is not properly configured and protected.	The system is intended to provide an easy-to-use and efficient way to monitor various home parameters and appliances remotely using a smartphone or tablet.	Security and privacy is limited.

Publication details	Methodology	Advantages	Disadvantages	Assumptions	Limitations
Suresh,S, Anusha, H.N.S, Rajath,T, Soundarya, P and Prathyusha, V (2016), "Automatic Lighting and Control System for Classroom", Proceedings of 2016 IEEE International conference on ICT in Business, Industry and Government, Indore, Madhyapradesh, pp.1-6	used to detect various environmental parameters such as light levels, temperature, and occupancy, while the controllers use this data to automatically adjust the lighting and other parameters to optimal levels.	energy savings, improved comfort, and reduced maintenance costs.	The system is dependent on internet connectivity to function properly.	system is intended to provide a more energy-efficient and comfortable learning environment for students and teachers.	Limited to the connectivity of wifi and its capabilities.
The paper "IoT Based Smart Energy Management System" was published in the journal "International Journal of Advanced Research in Computer Science and Software Engineering" in 2021. Authors - Rajesh Kumar Sahoo and S.K. Sahoo.	The paper presents an IoT-based smart energy management system (SEMS) that uses various sensors and technologies such as ZigBee, Wi-Fi, and cloud computing to manage and optimize energy consumption in buildings. The system collects real-time data on energy consumption from sensors installed in the building and sends it to the cloud for analysis. Based on the analysis, the system makes decisions on energy optimization and sends control signals to various devices such as lighting, heating, and cooling systems to reduce energy consumption.	The IoT-based SEMS has several advantages, including real-time monitoring of energy consumption, optimization of energy usage, reduction of energy costs, and reduction of carbon footprint. The system is also scalable and can be easily integrated with other building management systems	The main disadvantage of the IoT-based SEMS is the initial cost of installation and implementation. The system requires various sensors and technologies, which can be expensive to install. Moreover, the system requires a stable and reliable internet connection, which can be a challenge in some areas.	The paper assumes that the building has the necessary infrastructure to support the installation of the IoT-based SEMS. The system also assumes that the building occupants are willing to change their energy consumption behavior to achieve energy efficiency.	The main limitation of the IoT-based SEMS is that it relies on the accuracy of the data collected from the sensors. Any errors in the data can lead to incorrect decisions on energy optimization. The system also requires regular maintenance and updates to ensure optimal performance.

Publication details	Methodology	Advantages	Disadvantages	Assumptions	Limitations
The paper "An Advanced IoT-based System for Intelligent Energy Management in Buildings" was published in the journal "Sensors" in 2019. Authors - Gianpaolo Basile, Sergio Masciullo, and Antonio Pescapé	The paper presents an advanced IoT-based system for intelligent energy management in buildings. The system uses various sensors, actuators, and technologies such as LoRa, Wi-Fi, and cloud computing to collect real-time data on energy consumption and optimize energy usage. The system employs machine learning algorithms to learn the energy consumption patterns and make decisions on energy optimization. The system also provides users with feedback on their energy consumption behavior through a user-friendly dashboard.	The advanced IoT-based system has several advantages, including real- time monitoring of energy consumption, optimization of energy usage, reduction of energy costs, and reduction of carbon footprint. The system is also scalable and can be easily integrated with other building management systems. The system's machine learning algorithms can also adapt to changes in energy consumption patterns, making it more efficient over time.	The main disadvantage of the advanced IoT-based system is the initial cost of installation and implementation. The system requires various sensors and technologies, which can be expensive to install. Moreover, the system requires a stable and reliable internet connection, which can be a challenge in some areas. The system's machine learning algorithms also require a significant amount of data to learn the energy consumption patterns accurately.	The paper assumes that the building has the necessary infrastructure to support the installation of the advanced IoT-based system. The system also assumes that the building occupants are willing to change their energy consumption behavior to achieve energy efficiency.	The main limitation of the advanced IoT-based system is that it relies on the accuracy of the data collected from the sensors. Any errors in the data can lead to incorrect decisions on energy optimization. The system also requires regular maintenance and updates to ensure optimal performance. The system's machine learning algorithms may also be less effective in buildings with highly variable energy consumption patterns.
The paper "Design, Implementation, and Deployment of an IoT-Based Smart Energy Management System" was published in the journal "International Journal of Engineering and Advanced Technology" in 2019. Authors - S. S. Uthaya Kumar and R. Nithya.	The paper presents the design, implementation, and deployment of an IoT-based smart energy management system (SEMS) that uses various sensors, actuators, and technologies such as ZigBee, Wi-Fi, and cloud computing to manage and optimize energy consumption in buildings. The system collects real-time data on energy consumption from sensors installed in the building and sends it to the cloud for analysis. Based on the analysis, the system makes decisions on energy optimization and sends control signals to various devices such as lighting, heating, and cooling systems to reduce energy consumption. The system also provides users with feedback on their energy consumption behavior through a user-friendly dashboard.	The IoT-based SEMS has several advantages, including real-time monitoring of energy consumption, optimization of energy usage, reduction of energy costs, and reduction of carbon footprint. The system is also scalable and can be easily integrated with other building management systems. The system's user-friendly dashboard provides users with valuable information on their energy consumption behavior, which can help them make informed decisions on energy efficiency.	The main disadvantage of the IoT-based SEMS is the initial cost of installation and implementation. The system requires various sensors and technologies, which can be expensive to install. Moreover, the the system requires a stable and reliable internet connection, which can be a challenge in some areas. The system's reliance on cloud computing also raises concerns about data security and privacy.	The paper assumes that the building has the necessary infrastructure to support the installation of the IoT-based SEMS. The system also assumes that the building occupants are willing to change their energy consumption behavior to achieve energy efficiency.	The main limitation of the IoT-based SEMS is that it relies on the accuracy of the data collected from the sensors. Any errors in the data can lead to incorrect decisions on energy optimization. The system also requires regular maintenance and updates to ensure optimal performance. The system's reliance on cloud computing also raises concerns about data security and privacy.

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The paper "An IoT based Intelligent Smart Energy Management System with accurate forecasting and load strategy for renewable generation" was published in the journal "International Journal of Electrical Power & Energy Systems" in 2020. Authors - Ehsan Fathi, Maryam Amrollahi, Ali Farrokhi, and Mohammad Vahid Alizadeh.	The paper presents an IoT-based intelligent smart energy management system (ISEMS) that uses various sensors, actuators, and technologies such as ZigBee, LoRaWAN, and cloud computing to manage and optimize energy consumption in buildings. The system collects real-time data on energy consumption and renewable energy generation from sensors installed in the building and sends it to the cloud for analysis. Based on the analysis, the system makes decisions on energy optimization and sends control signals to various devices to reduce energy consumption. The system also uses accurate forecasting and load strategies to optimize renewable energy generation.	The IoT-based ISEMS has several advantages, including real-time monitoring of energy consumption, optimization of energy usage, reduction of energy costs, reduction of carbon footprint, and optimized renewable energy generation. The system's accurate forecasting and load strategies ensure that renewable energy generation is optimized, and any excess energy is stored in batteries for future use. The system is also scalable and can be easily integrated with other building management systems.	The main disadvantage of the IoT-based ISEMS is the initial cost of installation and implementation. The system requires various sensors and technologies, which can be expensive to install. Moreover, the system requires a stable and reliable internet connection, which can be a challenge in some areas. The system's reliance on cloud computing also raises concerns about data security and privacy.	The paper assumes that the building has the necessary infrastructure to support the installation of the IoT-based ISEMS. The system also assumes that the building occupants are willing to change their energy consumption behavior to achieve energy efficiency.	The main limitation of the IoT-based ISEMS is that it relies on the accuracy of the data collected from the sensors. Any errors in the data can lead to incorrect decisions on energy optimization. The system also requires regular maintenance and updates to ensure optimal performance. The system's reliance on cloud computing also raises concerns about data security and privacy.

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HARDWARE AND SOFTWARE SPECIFICATION

1. **Humidity and Temperature Sensor:**

DHT11 Sensor is a temperature and humidity sensor which has been calibrated with digital signal output. This Sensor ensures high reliability and excellent long-term stability. This offers an excellent quality, fast response, anti-interference and cost effectiveness.

2. **Light Intensity Sensor:**

BH1750FVI is a Digital Light sensor which is most suitable for obtaining the ambient light towards adjusting LCD and Keypad backlight power of Mobile phone. Unit of light quantity is called lumen where light flows from a source in one second. In here, reading is taken as Lux which is equal to one lumen per square meter:

Lux=1Lm/m2

3. **Darlington Resisto***r:*

The transistor is used to vary the amount of current going into the appliance. This resistor called Darlington pair consists of compound structure containing two bipolar transistors. These two transistors are connected in such a way that current amplified by the first transistor is amplified by the second one. The transistor consists of three pins the base pin, the emitter pin and the collector pin. The collector pin is connected to the Arduino, the base pin is connected to the wire that carries power supply to the device and the emitter pin is connected to the ground pin.

4. **Hall Sensor:**

The AllegroTM ACS712 is a Hall sensor providing economical and precise solution in industries, commercial and communication systems. The hall sensor is used to measure current flowing in the wire. The hall sensor can measure the current by placing a fixed resistance for the wire. A part of the wire that is going to the appliance from the transistor is cut and made to go through the hall sensor. The hall sensor has 3 pins- voltage pin, the ground pin and the output pin. The voltage pin is connected to the voltage supply from Arduino and the ground pin is connected to the ground and the output pin is connected to the analog pin in the Arduino. The output pin from the hall sensor measuring current in the appliance is connected to the analog pin A2 and that measuring the current into light is connected to Arduino pin A1.

- **Appliances:**

To operate with real appliances, we will use a relay to switch on and off the power and a 220 volts electricity voltage line The Arduino UNO is responsible for getting temperature and intensity of light from the sensors and based on that it varies the current provided to the appliances and it also then measures the current consumed by each appliance.

With the help of the software TinkerCad, we are able to create a simulation of automatic light and fan control system. The components used are:

- Breadboard
- Arduino UNO Microcontroller
- LED
- Photoresistor
- Resistors
- Temperature Sensor
- Buzzer
- DC Motor
- LED
- SERIAL MONITOR

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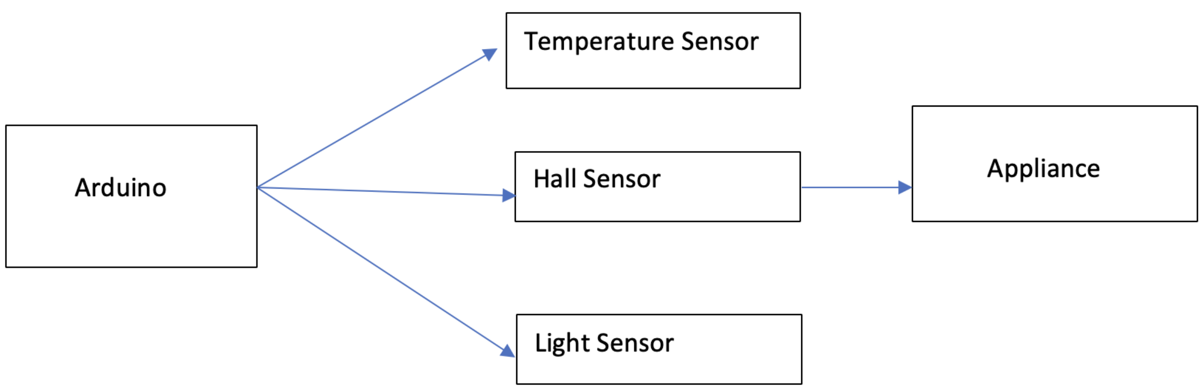
SYSTEM DESIGN

We here have developed an IoT Based Energy Management System where environmental sensors like Temperature and light intensity sensor employed and reading sensed are sent to Arduino Microcontroller. Based on sensed reading, the Arduino microcontroller is programmed to control the appliance usage accordingly. The graphical information on power consumption versus time for all appliances with varying environmental conditions is uploaded. The BH1750- light intensity sensor will be used to measure the light intensity in the form of lux and send it to the Arduino. The Arduino runs a code that obtains the temperature and humidity from the DHT11 sensor. The Arduino then controls fan and light based on the temperature, Humidity and light intensity. Based on the data captured the in-cloud server. The system design of IoT based Energy Management system shows the Data Flow Diagram and Use Case diagram of our system. Arduino will also control the voltage required to be sent to the appliance with the help of transistor. The Hall sensor will measure the amount of current sent to the appliance and send it to the Arduino.

ARCHITECTURE AND BLOCK DIAGRAM



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DATA FLOW DIAGRAM`

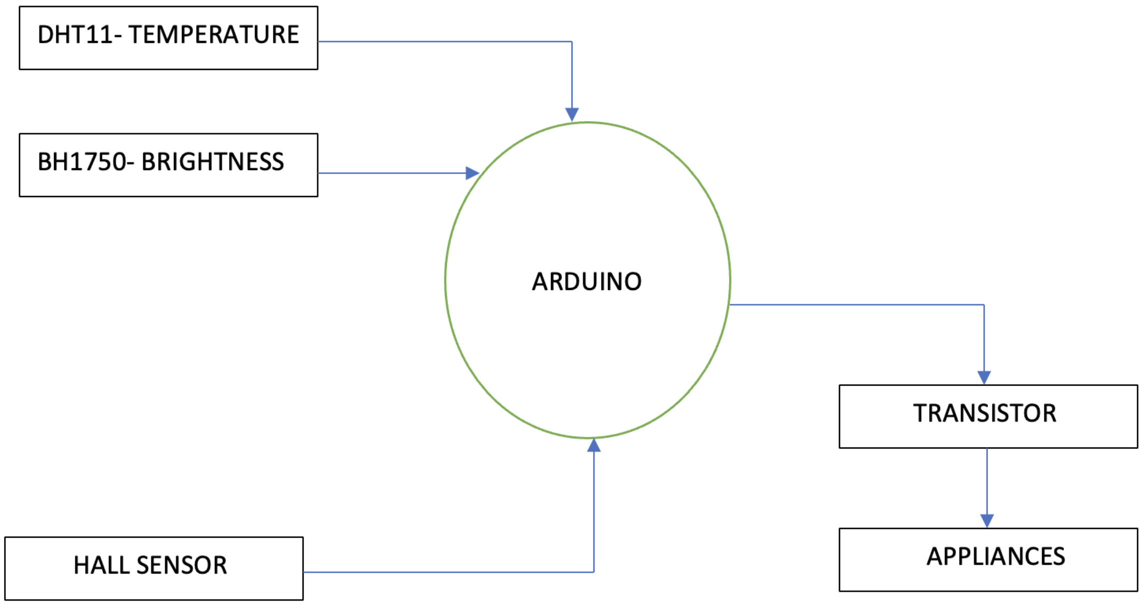

Figure 2: Data Flow Diagram

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SYSTEM DEVELOPMENT

The introduction of LED in lighting systems has reduced energy consumption remarkably. In addition to these features, different control mechanisms (wired or wireless) provide seamless integration with LU and other components of a Smart Lighting System (SLS). Typically, an LU of an SLS consists of a controller and several sensors connected to it, which gathers data and provides the ability to communicate with each other as well as with a control unit called Control Center (CC). The data can be gathered from motion sensors or light sensors. While motion sensors are used to detect the pedestrians and cars, ambient light sensors like LDR can be used to both check the operational condition (intensity, on/off) of the lamp and the intensity of the daylight. Some other types of sensors like the temperature sensor can also be deployed to detect the fault in the power lines.

GENERIC FRAMEWORK

Lamps used in SLS must be energy efficient and should have easy maintenance steps.
• LUs must be comprised of necessary and sufficient sensors to provide automatic control to the overall system. Also, sensors must be deployed to provide the intelligent on-off scheme to reduce power consumption.
•As an SLS must utilize both centralized and localized control schemes, an efficient and reliable control system is needed with LUs to handle various conditions. Generic Framework
•Local Control Unit (LCU): Local control unit collects the data from an array of LUs through a short-range communication protocol (e.g., IEEE 802.15.4 protocols such as ZigBee, 6LoWPAN or Bluetooth Low Energy etc.) transmit the data to the Control Center.
•Control Center (CC): The Control Center collects all types of data from LCUs and stores it on a server.

With recent advancements in cloud computing, it is also possible to store data in the cloud instead of a server. With this, a more cost-effective SLS model is possible as storing data from all the LCUs for large urban areas requires large storage unit on the server. To store data in the cloud instead of a server. With this, a more cost-effective SLS model is possible as storing data from all the LCUs for large urban areas requires large storage unit on the server.

The power consumption of the appliances is measured every 30 seconds. The Maximum power consumed by the appliance at highest usage is 60 watts but with the help of this system the maximum goes only up to 45 watts. The power consumed is stored in a list and from the list we can calculate the average total power consumed in the day.

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The development is based on the following protocols

COMMUNICATION PROTOCOLS:

A. Long-range Communication:
   Long-range communication in the context of SLS usually refers to information sharing between LCUs and CC and also between LCUs. For a large urban area, SLS usually consists of several LCUs and one central CC. After collecting data from LUs, LCUs all over the area transmit the data to a CC. Protocols such as Wi-Fi, Ethernet, GPRS, WiMax, 3G/4G/5G are utilized to establish communication channels between LCUs and CC.

B. Short-range Communication:
   Short-range communication usually refers to communication between devices that are in the line of sight. For an SLS, distances between LUs and corresponding LCU are in small range (less than 100 meters). Short-range protocols are utilized to provide a communication mainly between the LCUs and LUs in an SLS. Short-range protocols can be both wired (e.g., DALI) and wireless (e.g., ZigBee, JenNET-IP, 6LoWPAN).

WIRELESS PROTOCOLS:

1. ZigBee:
   ZigBee is the most popular 802.15.4-based protocol considered for IoT devices and applications. It uses 802.15.4 as MAC layer and defines Layer 3 and above by adding some additional services including encryption, authentication, association (only valid nodes can be added to topology), and routing protocol (AODV, a reactive ad hoc protocol). There are three kinds of nodes defined in ZigBee which are coordinator, routers, and end devices. These correspond to CC, LCU, and LU, respectively.

2. 6LoWPAN:
   6LoWPAN is the short form of IPV6 over Low-Power Wireless Personal Area Networks. The basic idea behind developing 6LoWPAN is to apply Internet Protocol suite in the context of smaller IoT devices. Data communication and control system can be both centralized and distributed using 6LoWPAN, which provides more flexibility in SLSs. LUs can transmit sensor data and control messages in the same data packet to other LUs in 6LoWPAN. After each successful packet transfer, an acknowledgment handshake is initiated in this protocol stack. Information can be sent to LCU and CC by using both wired and wireless network for 6LoWPAN which considerably reduces the implementation cost

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3. Bluetooth Low Energy (BLE):
   Another protocol worth mentioning in this section is Bluetooth Low Energy1 (BLE). BLE is primarily designed for one-to-one communication and mostly applied in daily applications such as health and fitness monitoring devices, and PC peripherals and accessories. It supports multiple network topologies and is a good candidate for low power, low-cost sensor networks.

WIRED PROTOCOLS:

1. PLC:
   Power line communication uses power line infrastructure both in indoor and outdoor settings for networking and communication purposes. The main purpose of using PLC in SLSs is to reduce the cost by utilizing already established wired networks. The architecture of PLC-based lighting system consists of two main hardware components: one microcontroller and one PLC modem. The microcontroller in PLC allows receiving, processing data, and forwarding the control messages towards a PLC modem. The PLC modem is used to modulate and demodulate data before communication between LUs and thus ensures to minimize the effect of noise and interference in the communication channel.

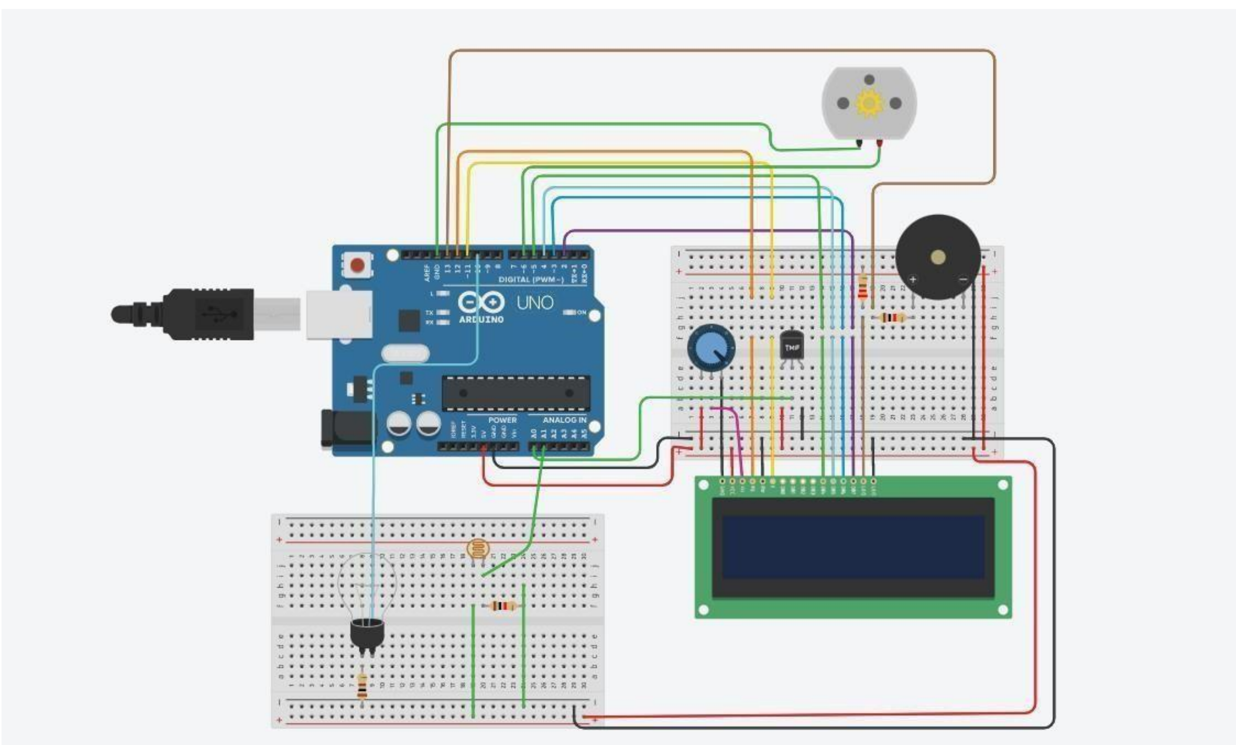
2. DALI:
   DALI is a lighting standard adopted by International Electrotechnical Commission (IEC). DALI integrates lighting system by using bus or star network topology and custom communication protocol. DALI uses digital circuitry to establish an SLS. Each LU in an SLS based on DALI uses a Manchester-coded frame to communicate with each other. Different sensors such as motion sensors, light sensors, etc. send and receive information regarding control command and their response using this bit stream. DALI needs two wires to connect the devices and initiate data communication between the devices.

The power consumption of a smart infrastructure can be reduced significantly by an SiLS. Different infrastructures (e.g., corporate offices, hospitals, educational institutions, etc.) use lights and fans all day long. An SiLS with a light sensor and fan with a temperature sensor can reduce power consumption in these infrastructures by utilizing daylight and temperature. As an example, assume a moderate office floor with six arrays of LUs each consisting 10 LUs and daylight access to the floor. By implementing light sensors in LUs, SiLS can effectively adjust the intensity of light on the office floor based on daylight access on the floor. Hence, immense amounts of energy is conserved.

RESULTS AND DISCUSSION

With the help of the software TinkerCad, we are able to create a simulation of automatic light and fan control system. The components used are:

- Breadboard
- Arduino UNO Microcontroller
- LED
- Photoresistor
- Resistors
- Temperature Sensor
- Buzzer
- DC Motor
- LED
- SERIAL MONITOR



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CODE

```
int value; //variable to store
int lightValue;
float degreeC;
#include <Servo.h>
Servo myservo;
#include <dht11.h>
#define DHT11PIN 3
dht11 DHT11;
int speed = 0;
int motor = 6;
int piezo = 13;


void setup ()
{
pinMode (10, OUTPUT);
Serial.begin(115200);
delay(500);
pinMode (piezo, OUTPUT) ; //Configuring digital pin 13 as an output
myservo.attach(motor);

}
void loop ()
{
  int chk = DHT11.read(DHT11PIN);
float temp=DHT11.temperature;
lightValue = analogRead (1);
float degreeC = temp; //Storing celcius value into new variable
if (lightValue<512) {
digitalWrite (10, HIGH);
}
else{
digitalWrite (10, LOW);
}
Serial.println("Temperature: ");
Serial.print(degreeC);
Serial.println();

if (degreeC<20)
{ speed=0;
myservo.write(0);
Serial.println("Fan status OFF");
```

`

```
delay (1000); // Wait for 1000 millisecond (s)
}
if (degreeC>20)
{
  Serial.println("FAN OFF ");
}

if (degreeC>20 && degreeC<40)
{ speed=80;
myservo.write(36);
delay(100);
myservo.write(0);
delay(100);
Serial.println("Fan at 20%");
}
if (degreeC>40 && degreeC<60)
{
myservo.write(72);
delay(100);
myservo.write(0);
delay(100);
Serial.println("Fan at 40%");
}
if (degreeC>60 && degreeC<80)
{
myservo.write(108);
delay(100);
myservo.write(0);
delay(100);
Serial.println("Fan at 60%");
}

if (degreeC>80 && degreeC<100)
{
myservo.write(144);
delay(200);
myservo.write(0);
delay(200);
Serial.println("Fan at 80%");
Serial.println("High temperature");

alarm (); //Calling function alarm() to send tone from Piezo

}
```

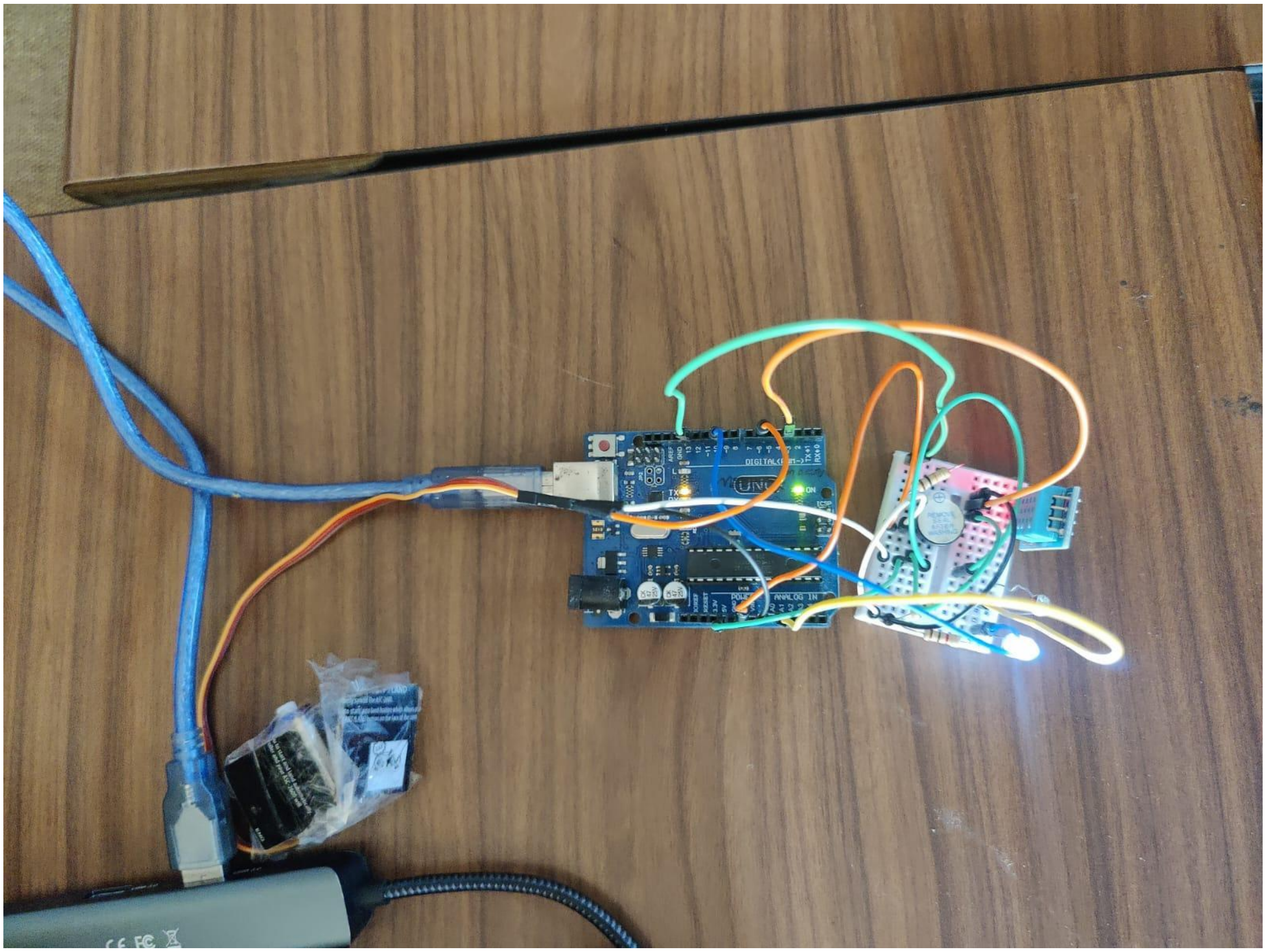
`

```
if (degreeC>100)
{
myservo.write(180);
delay(200);
myservo.write(0);
delay(200);
alarm2();
Serial.println("Alert!!  Hight temperature");
}
}

void alarm ()
{
for (int i = 0; 1 < 10; i++) {
tone (piezo, 100,100); //play tone of 100 HZ
delay (1000);// Wait for 1000 millisecond (s)
}
}
void alarm2 ()
{
for (int j =0; j <20; j++) {
tone (piezo, 200, 100); //play tone of 200 Hz
delay (500);// Wait for 500 millisecond (s)
}
}
```

`

PHYSICAL HARDWARE CONNECTION



OBSERVATION AND INFERENCES

When simulation is started, brightness reduced and the photoresistor sensor is moved, the LED starts glowing which shows that the LED (Lighting system) is able to detect the change in intensity of surrounding light and glow and not glow the rest of the time which saves and conserves a lot of energy. Also, when the temperature is increased the fan starts rotating faster and when the temperature is reduced it starts rotating slower which also helps in conserving a lot of energy in long run. Also, it can be used as a fire alarm as the buzzer starts buzzing as the temperature rises

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CONCLUSION AND FUTURE SCOPE:

In an IoT-enabled smart city environment, one of the major concerns is the efficient management of energy consumption. This issue is critical as more people start living in urban areas in the coming decades. Hence, in this paper, we focused on IoT-enabled Smart Indoor and Outdoor Lighting Systems (SiLS, SoLS) in a smart city, which can effectively reduce the power consumption and provide more intelligent operations.

In future, we propose to extend the system for controlling appliances like Refrigerator, Air cooler, Television etc. The presence of human only will switch on the appliances. More amount of power can be saved based on the lesser usage of the appliances. There can be also a manual control over the appliances. We can implement algorithm that learns the change in the weather based on season and detect changes in season based on the temperature, humidity and brightness

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