SRI SIDDHARTHA ACADEMY OF HIGHER EDUCATION

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AGALKOTE, TUMAKURU – 572107

KARNATAKA

Mini Project Work-I (EC5MP1) Report

on

"SMART STREET LIGHT SYSTEM USING IOT"

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In partial fulfillment of requirements for the award of degree

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

Accredited by NBA

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CERTIFICATE

This is to certify that the mini project work-1 entitled ***"SMART STREET LIGHT SYSTEM USING IOT"*** *is a bonafide work carried out by* ***Prajwal K J, Pruthvi Raj H, Srivatsa S & Vinay S H*** *in partial fulfillment for the award of degree of* ***BACHELOR of ENGINEERING*** *in* ***Electronics and Communication Engineering*** *during the academic year* ***2023-24***.

It is certified that all the corrections/suggestions indicated for internal assessment have been incorporated in the mini project work-1 report. The mini project work-1 report has been approved as it satisfies the academic requirements in respect of mini project work-1 prescribed for the degree of Bachelor of Engineering in Electronics and Communication Engineering.

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ABSTRACT

Smart street light spotlights on different restriction and difficulties identified with traditional and old street lights that are confronted now a days and the answer for the deal with those issues by embracing the vision of a smart street light. The noteworthiness of this vision is "A completely mechanized bidirectional force conveyance of power and information between the road lights and all the directions in the middle".

Smart street lights are vitality effective as well as extremely dependable. The primary thought in the present field advances are computerizations, power utilization, and expense adequacy. Automation is implied for the decrease of labour as the human has gotten to be excessively occupied and even incapable, making it impossible to discover time to switch the lights. In present days everyone is worried about the availability of limited power sources like coal, biomass, and hydro and so on. Unnecessary wastage of power in the street lights is one of the noticeable power losses.

Two sensors that are light dependent resistor (LDR) and object sensor utilized as a part of the smart street light framework to recognize day and light and distinguish the movement of walker and vehicle separately. The LDR identifies the vicinity of daylight and the proposed circuit turn off the street lights in the day time and turn it on during dark which avoids the manual switching of street lights.

The proposed system uses the object sensors to identify the movement of any object and offer command to the microcontroller to glow the street lights with 100% intensity if there is no vehicle or object the intensity reduced to 10% of the maximum.

In this proposed system Node-MCU(microcontroller unit) is used to take the data from LDR and infrared (IR) sensor and take necessary actions. Therefore, it acts as the mind of the entire framework.

Keyword: Node MCU, LDR, IR sensor, Smart street light.

LIST OF ABBREVATIONS

Sl.No.	Abbreviations	Full form of the abbreviations
1	ADC	Analog to Digital Converter
2	AM	Amplitude Modulation
3	GPIO	General Purpose Input /Output
4	HID	High Intensity Discharge
5	IDE	Integrated Development Environment
6	IOT	Internet of Things
7	IR	Infrared
8	LDR	Light Dependent Resistor
9	LED	Light Emitting Diode
10	Node-MCU	Node-Microcontroller Unit
11	PWM	Pulse Width Modulation
12	RTO’S	Real Time Operating System
13	UART	Universal Asynchronous Receiver/Transmitter

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Chapter 1

INTRODUCTION

Smart street light systems using Internet of Things (IOT) technology are the next generation of street lighting systems that offer improved energy efficiency, reduced costs and better control and management of street lighting.

The basic concept of a smart street light system is to incorporate sensors, wireless communication and intelligent controllers into the street light infrastructure. These smart lights can be coded or programmed to automatically turn on and off based on the surrounding light levels as well as other factors like pedestrian and vehicular traffic. Additionally, they can be remotely monitored and controlled using IOT technology it allows smart street light systems to gather data and feedback on energy consumption, maintenance needs and other important factors. This data can then be used to optimize the system, improveenergy efficiency and reduce costs.

Street lighting is a particularly critical concern for public authorities in developing countries because of its strategic importance for economic and social stability. Inefficient lighting wastes significant financial resources every year and poor lighting creates unsafe conditions.

Energy efficient technologies and design mechanism can reduce cost of the street lighting drastically. Manual control is prone to errors and leads to energy wastage's and manually dimming during mid-night is impracticable. Also, dynamically tracking the light level is manually impracticable. The current trend is the introduction of automation and remote management solutions to control street-lighting.

1.1 Motivation

As the traffic decreases slowly during late-night hours, the intensity gets reduced progressively till morning to save energy and thus, the street lights switch on at the dusk and then switch off at the dawn, automatically. This process repeats every day. White Light Emitting Diodes (LED) replaces conventional High Intensity Discharge (HID) lamps in street lighting system to include dimming feature. The intensity is not possible to be controlled by the high intensity discharge lamp which is generally used in urban street lights. light emitting diodes are the future of lighting because of their low energy consumption and long life.

1.2 Objectives

1. Provide efficient, automatic and smart lighting system.
2. Totally based on Renewable energy sources.
3. Longer life expectancy.
4. Energy Saving.

Chapter 2

LITERATURE SURVEY

In this section, literature review of referred papers has been done for current work. It highlights the recent trends and innovation in concerned technique.

Table 2.1 Literature Survey on Smart Street Light System Using IOT

SL. No.	Hardware used	Software used	Observation	References
1	IOT, video vehicle detection, Light Dependent Resistor (LDR), Infrared (IR) sensor.	Arduino IDE (Integrated Development Environmen)	It controls lighting on the streets based on the intensity of sunlight available and lights up during the night when vehicles and pedestrians are detected.	[1]
2	Street light, panic button, sensor, microcontroller, cloud account, LDR, IR sensor.	Arduino IDE	The system is mainly used for smart and weather adaptive lighting in street lights.	[2]
3	IOT, Arduino Nano,LDR, temperature-humidity sensor, relay, Wi-Fi module, LED,	Arduino IDE	This system includes an additional temperature-humidity sensor. This is a composite sensor that contains a calibrated digital signal output of the temperature and humidity.	[3]

4	IOT, lighting system, power electronics, TRIAC (Triode for Alternate Current), LDR sensor.	Arduino IDE	This paper proposes a smart system for efficient control of intensity of street lights. The system uses a TRIAC based light intensity control circuit.	[4]
5	Smart street light systems, IOT, temperature sensor, weather sensor, Raspberry-Pi, Arduino UNO.	Arduino IDE	All the components of this survey are frequently used and very modest but effective to make the unswerving intelligence systems.	[5]
6	IOT, IR sensor,LDR, LED, servo motor, solar panel, automation, energy efficiency, monitoring, surveillance camera	Arduino IDE	The purpose of this article is to invent an intelligent system which can make decisions for luminous control (ON/OFF/DIM) considering the light intensity.	[6]
7	Solar Energy,	Arduino IDE	This paper presents a smart	[7]

	smart systems; photovoltaics, dust cleaning circuit; motion sensor.		street lighting system, in which a conventional street light is modified to obtain its power from solar energy.	
8	Solar energy, rechargeable battery, photovoltaic, PIR(Passive Infrared) sensor.	Arduino IDE	This paper presents a smart street lighting system, turns ON and OFF in presence of sunlight.	[8]

2.2 Outcome of Literature Survey

1. According to the survey made, use of many sensors like LDR , IR sensor, vehicle detectors, temperature and weather sensors, surveillance cameras are used.
2. To detect passing of vehicles IR sensors has been taken.
3. Controllers like Arduino, Node-microcontroller unit (MCU), Raspberry Pi is implemented.
4. To control the switching of LED’s Node-MCU is used.
5. Use of LDR sensors is more useful and also used in current systems.

2.3 Problem Statement

- In the presence of sunlight, the street lights are in ON condition.
- Street lights are ON in the absence of any vehicle and pedestrian.

2.4 Solution to the Problem

- To face the various problem in the conventional lighting system there is need of lighting system that is well equipped with recent inventions and technology.
- The automation in this particular case is used so that all the street lights can be switched on and off automatically when it is really necessary.
- And the use of controller circuits to implement a model so that all the street lights can only glow with its maximum intensity when there is activity in its region otherwise it should glow at a minimum given intensity.
- With the inventions of light emitting diodes which has a small amount of power consumptions and high efficiency the proposed system should use light emitting diodes instead of all classical fuse bulbs.
- With the help of all these sensors available in the market the system should have 100% control over the street for the safety and security of lives in the streets along with a flexible transportation system.

2.5 Methodology

- The proposed system consists of IR sensors, LDR sensor, Node-MCU and LED’s.
- IR sensor detects the presence of any vehicles or objects and send the signal to Node- MCU to increase the intensity of the street lights.
- LDR sensor working is based on the intensity of the sunlight. If the intensity of the sunlight is high the proposed system switches OFF the street lights and vice versa.

Chapter 3

BLOCK DIAGRAM

In this chapter the discussion is about block diagram of smart street light which consists of IR sensors, LDR sensor, Node-MCU and LED's where the data is collected from all the sensors and fed into Node-MCU. Through Node-MCU the data is uploaded to ThingSpeak application where the real time data can be achieved. The block diagram of proposed system is shown in Fig.3.1

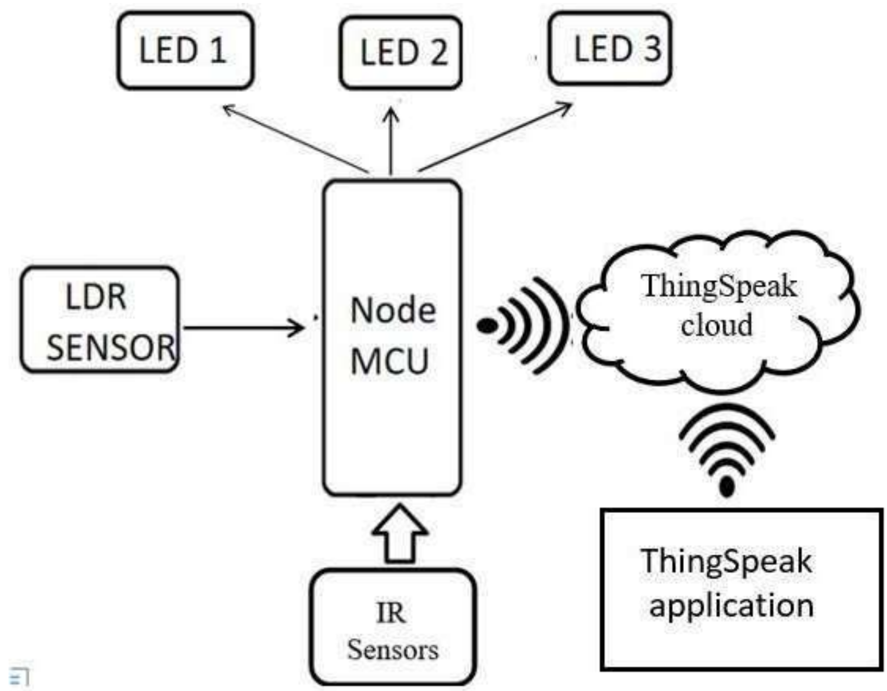


Fig. 3.1 Block Diagram Representation of Proposed System

The LDR senses the visible spectrum of light and IR sensor senses the detection of vehicles and sends the information to the Node-MCU as shown in the Fig.3.1. From Node-MCU, LDR and IR values are uploaded to the cloud at regular intervals of time. From the cloud LDR and IR values can be seen graphically on ThingSpeak platform from anywhere in the world. Once sketch uploading is done, it will upload LDR and IR values on ThingSpeak platform and able to see it graphically in private view window.

Chapter 4

HARDWARE AND SOFTWARE REQUIREMENTS

The hardware and software used in the proposed system are as follows:

1. Light Dependent Resistor.
2. Light Emitting Diode.
3. Infrared Sensor.
4. Node-MCU.
5. ThingSpeak Application.

4.1 LDR (Light Dependent Resistor)

LDR is as shown in Fig.4.1 is made up of light sensing material called Cadmium Sulphide i.e. CdS. LDR is a cadmium sulphide photo resistor that changes its resistance according to the spectrum of light falling on it. lts resistance is 1Mega ohm in the absence of sunlight and 5kilo ohm in the presence of sunlight. So, when there is complete darkness, it conducts electricity very poorly due to high resistance and when there is a visible spectrum of light it conducts electricity very well.

Fig. 4.1 Light Dependent Resistor [9].

So according to problem statement [1] the classical street lights

1. Are remain switched on in the presence of sunlight.
2. Need manual switching.
3. Need man power.
4. Face variable on-period due to change in seasons.
5. Less reliable.
6. Waste of huge amount of energy unnecessarily.

To overcome this problem, the system must be connected to a relay in series with all the street lights which will receives the signals from LDR where to switch the street lights on or off. By using this concept, the automation of the street light is done.

4.2 LED (Light Emitting Diode)

LED as shown in Fig.4.2 semiconductor light sources. The light emitted from LEDs varies from visible to infrared and ultraviolet regions. They operate on low voltage andpower. LEDs are one of the most common electronic components and are mostly used as indicatorsin circuits. They are also used for luminance and optoelectronic applications.

Fig. 4.2 Light Emitting Diode [10].

Based on semiconductor diode, LEDs emit photons when electrons recombine with holes on forward biasing. The two terminals of LEDs are anode (+) and cathode (-) and can be identified by their size. The longer leg is the positive terminal or anode and shorter one is negative terminal.

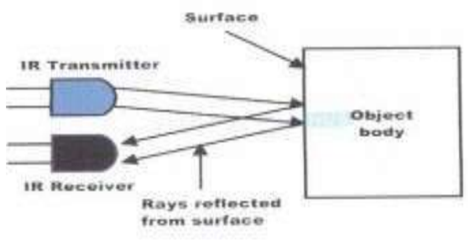
The capability of reducing the intensity of output light is called dimming. LEDs can be dimmed by controlling the forward current flowing through them. This can be achieved in two ways: Amplitude Modulation (AM) and Pulse Width Modulation (PWM). Amplitude Modulation: In AM, the direct current flowing through the LEDs is controlled to achieve dimming.

4.3 Motion Detector

According to problem statement [2] all the classical street lights are remained switched on from 6am to 6pm whether there is a pedestrian or vehicle is present or notpresent of any activity. The most probable peak time of movement is from 6pm to 10pm in a smart city, so after 10pm all the street lights are glowing at its full intensity which leads to loss of enormous amount of energy. So, to overcome this problem the government needs to install a small motion detection device which will control the street light to glow at its 100%only in the presence of any activity in the street. To overcome this problem, the system is implemented with IR sensor or proximity sensor or photoelectric beam detector.

Infrared sensor

An infrared sensor represented in Fig. 4.3b is an electronic device that emits in order to sense some aspects of the surrounding. An IR sensor can measure the heat of an object as well as detect the motion. Usually in the IR spectrum, all the object radiates some form of thermal radiations. These types of radiations are invisible to our naked eyes but that can be detected by an IR sensor. The emitter is simply an IR,LED and the detector is simply an IR photo diode which is sensitive to IR light of the same wavelength as that emitted by the IR, LED. When IR light falls on the photodiode, the resistances and this output voltage, change in proportion to the magnitude of the IR light received as shown in Fig.4.3a.



. Fig. 4.3a Working of IR sensor Fig. 4.3b IR Sensor [11].

4.4 Node-MCU

The Node-MCU is as shown in Fig.4.4 is an open-source based firmware and development board specially targeted for IOT based applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC(System on chip) from Espressif Systems, and hardware which is based on the ESP-12 module.

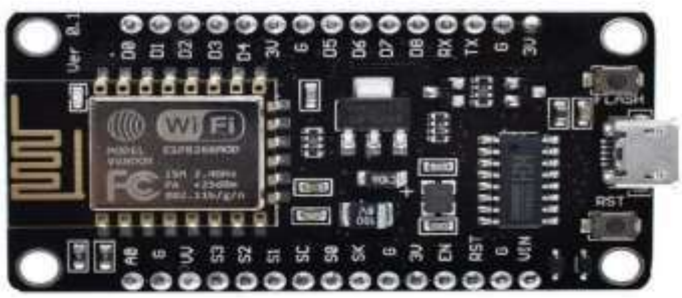


Fig .4.4 Node MCU Wi-Fi module [12].

Features of Node MCU are as follows:

1. WIFI Frequency Range 2.4GHz -2.5GHz.
2. Clock frequency adjustment range from 80 MHz to 240 MHz, support for Real Time Operating System (RTOS).
3. Built-in 2-channel 12-bit high-precision Analog to Digital converter (ADC) with up to 18 channels.
4. Support Universal Asynchronous Receiver and Transmitter (UART)/General Purpose Input and Output pins (GPIO)/ Digital to Analog converter (DAC)/ Pulse Width Modulation (PWM) interface.
5. Support multiple sleep modes, ESP32 chip sleep current is less than 5mA.

4.5 ThingSpeak Application

ThingSpeak is a platform providing various services exclusively targeted for building IOT applications. It offers the capabilities of real-time data collection, visualizing the collected data in the form of charts, ability to create plugins and apps for collaborating with web services, social network and other apps. The core element of ThingSpeak is a 'ThingSpeak Channel' represented in Fig.4.5.

A channel stores the data which are send to ThingSpeak,

1. 8 fields for storing data of any type - These can be used to store the data from a sensor or from an embedded device.

2. 3 location fields - can be used to store the latitude, longitude and the elevation. These arevery useful for tracking a moving device.

3. 1 status field - A short message to describe the data stored in the channel.

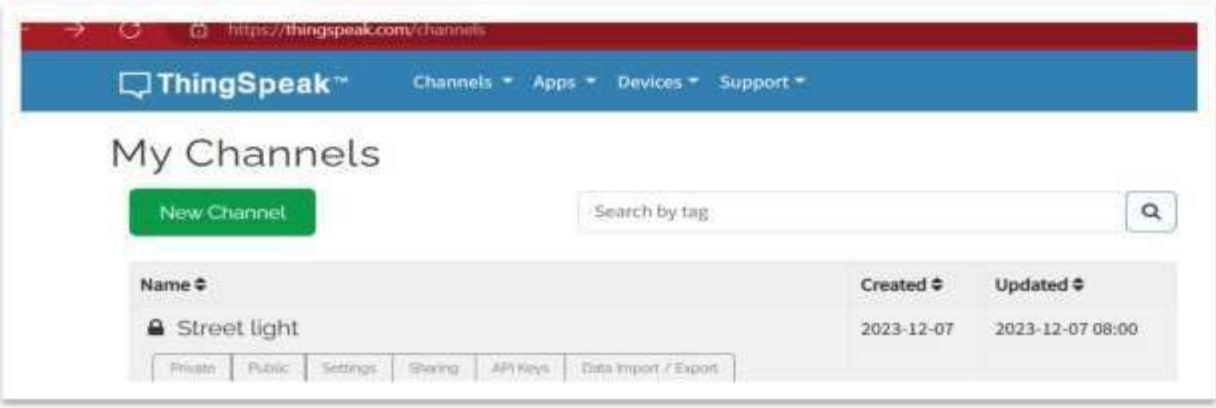


Fig.4.5 ThingSpeak login page [13].

Chapter 5

SYSTEM IMPLEMENTATION

The flow chart and working of circuit are discussed in this chapter.

5.1 Flow chart

The flow chart represented in Fig.5.1 discusses about the implemented program and it's working. The program is written in C language and it is implemented by using the application Arduino IDE.

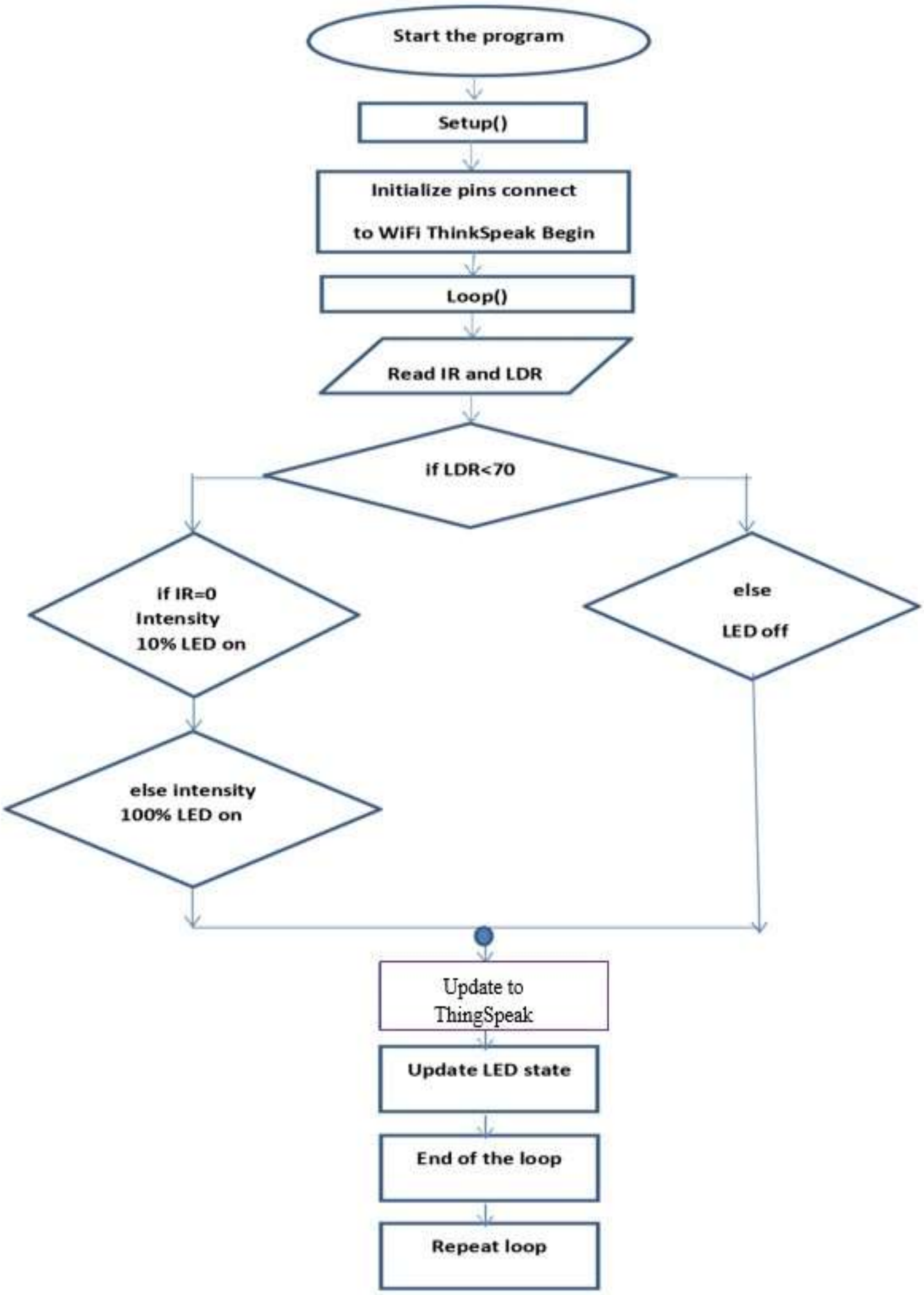


Fig.5.1 Flowchart of the proposed system.

Explanation of the Flow Chart

The flowchart outlines the logic of an Arduino program designed to control LEDs based on readings from an IR sensor and LDR sensor,

1.In the initialization phase, hardware pins are configured, establishing a connection to Wi-Fi for potential remote monitoring. This program establishes communication with ThingSpeak.

2.Within the main loop, the system dynamically responds to ambient light conditions. When the LDR reading falls below 70 indicating in-sufficient light, the program selectively activates LEDs based on the status of two IR sensors.

3.This decision-making process allows for nuanced lighting responses, such as illuminating specific sets of LEDs depending on which IR sensor is triggered.

4.Conversely, in low light conditions (LDR >= 70), all LEDs are turned off to conserve energy.

5.The integration with ThingSpeak not only enables real-time data reporting but also facilitates future analytics and visualization.

6.Thie same loop is repeated for several times.

.

5.2 Working of the circuit

In this chapter the discussion is about the implementation of the system using 3 IR sensors, 3 LEDs, one LDR sensor, Node-MCU and a resistor of 10kΩ the connections are made according to the circuit connection as shown Fig.5.1.

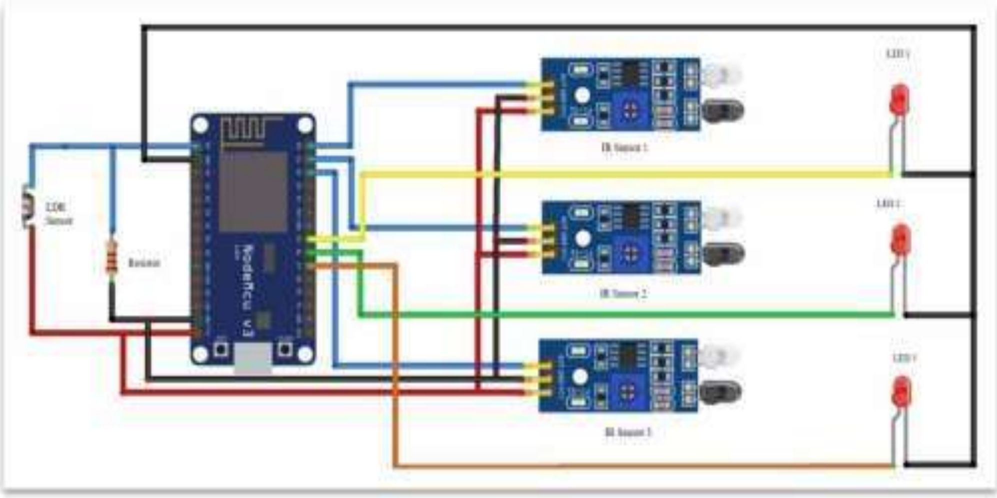


Fig.5.2 Circuit diagram of the proposed system.

The proposed circuit uses one LDR sensor to distinguish between the day and night. LDR with a small resistor in series is connected across the 3V and GND of the Node-MCU and from the midpoint of the LDR potential divider circuit the output of the circuit is fed to A0 of the Node MCU which turn on all the street lights which are represented by LED connected to the output pin (i.e.: D5, D6, D7).

LDR is a special type of resistor whose value depends on the intensity of the sunlight which is falling on it. It has resistance of about 1M-ohm when in total darkness but a resistance of only 5kΩ when brightness is illuminated. The voltage is directly proportional to the conductance so more voltage will get when there is sunlight and vice-versa and then the system is set to a reference value for the switching actions of the LED. The reference value is set 80.

Three infrared sensors are used in this circuits. This sensor detects the movement of any vehicles or objects and the output are fed to the input terminal (i.e. D0, D1, D2) which corresponds to the led connected to D5, D6, D7 respectively. All the object sensors are connected between 3V and GND of the Node-MCU.

The output from the LDR is connected to the A0 and initially LDR flag and LDR value is set to zero. The value of LDR reference value is initialized and set to 80. If the Node- MCU reads any value from LDR whose value is less than the LDR reference value than it will turn on the street lights.

The output from IR1 and IR2 and object IR3 are connected to the pin D0, D1, D2 and reference value of all sensor is set to 500(baud rate).

Another three-proxy value for each object sensor are set to zero and if any object sensor detects any presence of objects, then Node-MCU compares the value with the object reference value. If the sensed value is less than the reference value it will glow with 100% of its intensity otherwise LEDs will be glowing in low intensity.

Chapter 6

RESULTS AND DISCUSSION

The project aims were to reduce the side effects of the current lighting system and find a solution to save power. In this project the first thing to do is to prepare the inputs and outputs of the system to control the lights. Implemented model of the project is shown in the Fig.6.1 movement of pedestrians and vehicles on the street are detected by the IR sensors and the intensity of the LED light is increased by allied circuits.

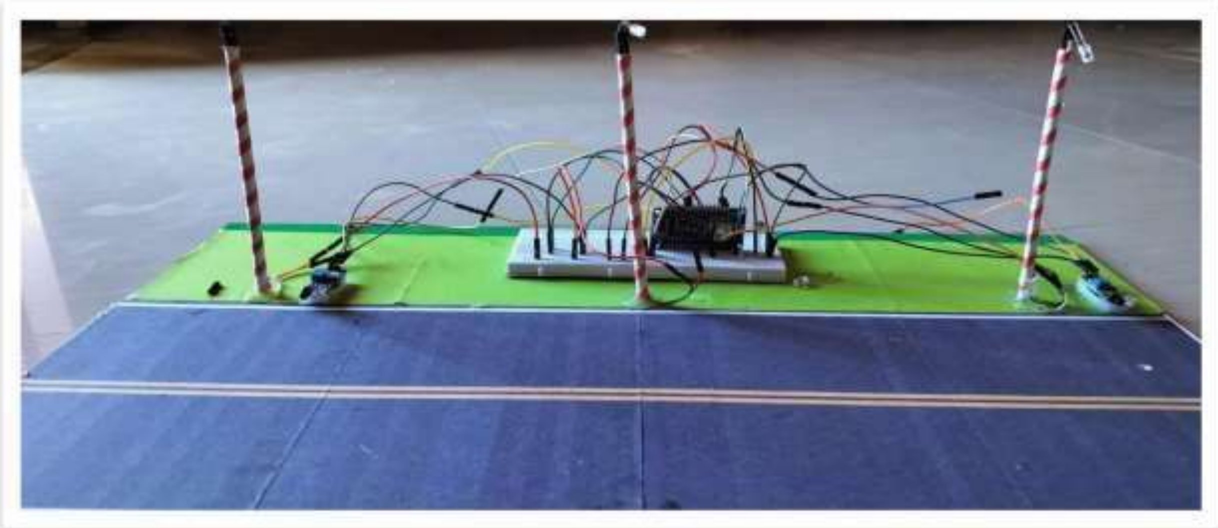


Fig.6.1 Implemented model

The LDR is used to switch ON or OFF based on the light intensity fallen on it. During day time the system is made OFF and in night the system is made ON. In the proposed system LDR is given the highest priority compared to IR sensors. In the Fig.6.2 the values of LDR are uploaded to ThingSpeak.com

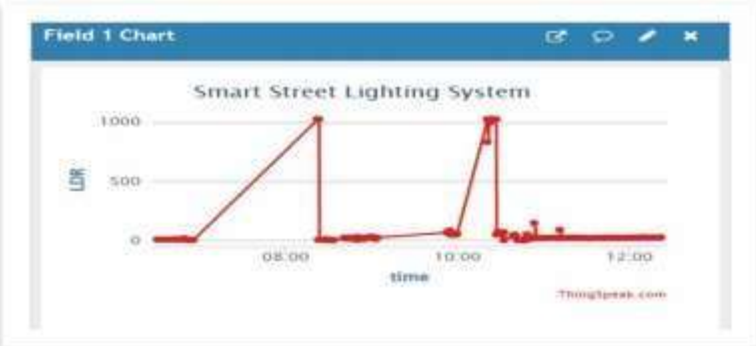


Fig. 6.2 graphical representation of LDR values uploaded to ThingSpeak.com

IR sensors implemented in this model, so that all the street lights can only glow with its maximum intensity when there is any obstacle detected in its region otherwise it should glow at a minimum given intensity. In the Fig.6.3 the values of IR sensors are represented in graphical manner in which if any obstacle is detected the high value is taken and uploaded to ThingSpeak.com

Fig.6.3 IR sensor values uploaded to ThingSpeak.com

LEDs are used in the proposed system as it operates in low voltage and can use dimming feature by using AM technique or by varying direct current voltages. It is estimated that there is a potential of reducing energy consumption up to 50% by using energy-efficient LED lighting in place of existing conventional street lights used by the gram panchayats of India.

Chapter 7

ADVANTAGES, LIMITATIONS AND APPLICATIONS

The advantages, limitations and applications are discussed in this chapter.

7.1 Advantages

- Automatically switch street lights on once the sun sets and switch them off after dawn.
- Send alerts for each light that needs attention, to reduce failure and the need for sudden repair.
- Collect different types of electronic data from different physical devices using sensors and supply information to the devices.
- Reduce maintenance of street lights, leading to cost reduction.
- They promote energy efficiency by adjusting lighting levels based on real-time needs, resulting in significant energy savings.
- Each street light can become an IOT ready installation platform for wider city applications.

7.2 Limitations

- The initial cost of an automatic street light system is higher compared to a conventional street light system.
- Automatic street lights may not work properly if the weather is bad. Things like heavy rain or fog can affect their sensors and cause them to malfunction.
- These lights turn on and off based on how bright or dark it is outside.
  If the light intensity isn't right, they might not work as expected.
- The parts of automatic street lights don't last forever. Over time, they can wear out and need to be replaced, which can be costly.
- The IOT system is dependent on the Internet.
- Dust accumulation on the surface of sensors can create major problems.

7.3 Applications

- IOT enables adaptive lighting control based on real-time factors like traffic flow, weather, and daylight levels, leading to significant energy savings.

- Smart street lights can reduce operational costs through remote monitoring, predictive maintenance, and automated fault detection.

- Smart street lights can be integrated into broader smart city initiatives, enhancing urban living by connecting various services and infrastructure.

- Incorporating sensors for surveillance, pedestrian detection, and emergency response can improve overall safety in urban areas.

- IOT-enabled street lights can facilitate citizen engagement through features like Wi-Fi hotspots, public announcements, or interactive displays.

- Implementing the smart street light system does not require manually switched ON or OFF.

Chapter 8

CONCLUSION

The proposed system is designed, implemented and tested.
The energy consumption is reduced due to intensity control of smartstreet light and automatic switching on and off of the street light. Also, errors occurring due to manual operation is eliminated completely.

8.1 Future scope

Wireless power transmission can be provided to reduce the maintenance cost and power thefts of the system.

The system can be made self-sufficient by using non-conventional energy resources like solar power, windmills, piezo-electric crystals etc.

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