MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(An ISO 9001:2015 Certified Institution)

(Affiliated to Visvesvaraya Technological University, Belagavi)

Badaga Mijar, Moodabidri – 574225, Karnataka

A Mini-Project Report

On

"IoT BASED AUTOMATIC STREET LIGHTING SYSTEM"

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF ENGINEERING

In

MECHANICAL ENGINEERING

By

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(Accredited by NBA, New Delhi & NAAC)

2019-20

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Mr/~~Ms~~ ....NIRANJAN.....KAMATH...

from Mangalore Institute of Technology & Engineering has successfully completed two days hands-on workshop on **"Internet of Things for Sustainable Technologies"** on 2nd and 3rd of November 2019.

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DECLARATION

We the students of third semester of Mechanical Engineering, Mangalore Institute of Technology & Engineering, Moodabidri, declare that the work entitled " **IoT BASED AUTOMATIC STREET LIGHTING SYSTEM "** has been successfully completed under the guidance of **Dr. VIGNESH NAYAK ULLAL**, Professor, Department of Mechanical Engineering MITE, Moodabidri. This dissertation work is submitted to Visvesvaraya Technological University in partial fulfilment of the requirements for the award of Degree of Bachelor of Engineering in Mechanical Engineering. Further the matter embodied in the project report has not been submitted previously by anybody for the award of any degree or diploma to any university.

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ABSTRACT

Automation, power consumption and cost effectiveness are the three key considerations when it comes to make modern devices function smarter and more efficiently compared to their predecessors. Automation is intended to reduce human effort by incorporating intelligence in systems that perform day to day activities with human aid. Reduction in power consumption is an added advantage in such systems as energy costs are spiraling upwards and their sources getting diminished. The Internet of Things (IoT) is a field primed to take off in the next few years. Recent estimates by industry leaders, Cisco and GE, predict that by the year 2020 there will be more than 5 billion people connected to the IoT. This accounts for over two-thirds of the world's current population. These same estimates predict that these people will make use of more than 50 billion devices, contributing $7.1 trillion to the global market.

The present project aims to describe a method for controlled switching ON and OFF of street lights and regulate their illumination by using sensors with minimum electrical energy consumption. When presence is detected, all surrounding street lights glow at their brightest mode, else they stay in the dim mode. LED bulbs were implemented as they are better than conventional incandescent bulbs. These bulbs also reduce heat emissions, power consumption, maintenance, replacement costs and carbon dioxide emissions.

Keywords: Automation, Power consumption, cost effectiveness, Heat emissions.

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CHAPTER 1

INTRODUCTION

Streetlights are an integral part of a developing locality. They are present on all major roadways and in the suburbs too. Every day, streetlights are powered from sunset to sunrise at full strength, even when there is no one around. On a global scale, millions of dollars are spent each day on these street lights to provide the required electric energy. The maintenance and replacement costs of conventional incandescent bulbs are immense. They consume a lot of electric power to function and their heat emissions are also quite high. All of this contributes to greater demand of electricity production and consequently, more carbon dioxide emissions from powerhouses. So, along with unnecessary light pollution, this practice causes damage to our planet too.

The project is aimed at harvesting the energy from renewable energy sources like the sun and to effectively use the harvested energy for the benefit of mainly the remote villages facing serious power shortage problems. The main aim of the project is to provide an "IoT based Automatic Street Lighting System" powered by solar energy that lasts throughout the night. Integration of the street light system with IoT enables regulation of light to produce required illumination that provides pedestrians sight to reach their destination, especially in remote rural areas that face serious electric power supply issues. The same system can also be used in metropolitan cities as well. A simple and effective solution to this would be dimming the lights during off peak hours. Whenever presence is detected, the lights around it will glow at the normal (bright) mode. This would save a lot of energy and also reduce the cost of operation of the streetlights. We can check the status of street lights on the IoT software platform from anywhere in real time and solve any issues regarding operation of the street light system.

CHAPTER 2

CONSTRUCTION & FUNCTIONAL DESCRIPTION

2.1 Functional Description

The present system employed power delivery via a single-phase line to the streetlight. This system involved five more components to regulate power delivery. An Infra-Red proximity sensor was attached at the base of the street light to detect presence. The data from the sensor was sent to the Arduino which functioned as a brain of the circuit. The Arduino then commanded to switch between dim and bright modes depending upon the. A battery that supplied power by the single-phase line mode was used to supply 5V of input to the sensors and the Arduino.

Broadly, the design basically included three working modes: -
OFF mode: When there was enough natural light in the surroundings i.e. during the daytime, the entire system was switched off and the battery was charging.
Active mode: When the natural light drops below a certain level the system automatically turned ON and the motion sensors were powered.
ON mode: During the presence of pedestrians, the sensors turned ON which in turn switches ON the LED lights. These lights turned off after a period of time.

2.2 Block Diagram

Block diagram describing the working of the project is shown in Figure 1. A solar panel of 10W was used which converted the incoming sunlight into electrical energy and used to charge the battery. The charged battery was used as a supply source to the rest of the system. It was also used to power the Arduino, LDR and IR sensors. A PC was used to collect, store and analyze the data of usage during operation.

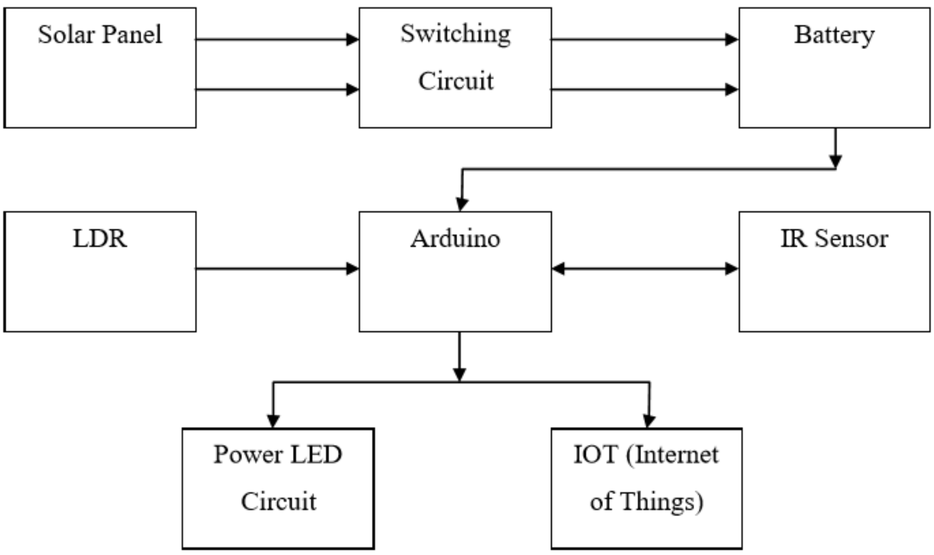


Fig.2.2.1: Block Diagram of the circuit.

2.3 Description of Hardware:-

2.3.1 Solar panel

Fig 2.3.1: Solar panel

Solar panels are active solar devices that convert sunlight into electricity. A solar panel or module is a series of interconnected silicon cells joined together to form a circuit. Presently, about 80% of all solar panels are made from crystalline silicon. Typically the solar cells are laid out in a grid pattern - with as many as 72 different solar cells. The solar panels after being hermetically sealed to protect them are covered in a non-reflective glass to protect the solar cells from environmental damage and placed into a rigid frame.

2.3.2 IR sensors

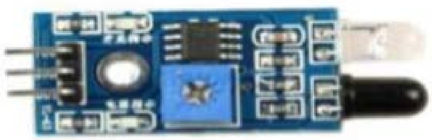


Fig.2.3.2: IR sensor

IR (infrared) sensors detect infrared light. The IR light is transformed into an electric current and this is detected by a voltage or amperage detector. A property of light-emitting diodes (LEDs) is that they produce a certain wavelength of light when an electric current is applied but they also produce a current when they are subjected to the same wavelength's light.

2.3.3 Light dependent resistor (LDR)

Fig.2.3.3: LDR

A light dependent resistor works on the principle of photoconductivity. Photo conductivity is an optical phenomenon in which the materials conductivity (hence resistivity) reduces when light is absorbed by the material. When a light dependent resistor is kept in the dark, its resistance is very high. And if the device is allowed to absorb light its resistance will decrease drastically. If a constant voltage is applied to it and intensity of light is increased the current starts increasing.

2.3.4 Arduino

IoT Board Specifications: • ATmega328p microcontroller • USB Programming, ISP Header • Input voltage 5-7 V • 0-5V outputs with 3.3 V compatible inputs • 14 Digital I/O Pins (6 PWM outputs), 6 Analog Inputs • 32k Flash Memory, 16MHz Clock Speed • Add-ons: RTC, SD card, Bluetooth, Xbee & Sensors Compatible • Compact and affordable PCB	

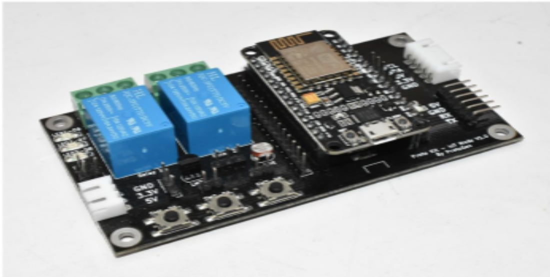
NodeMCU Board Specifications: • Input voltage 5V / 7-12 V • 1 Analog I/ O Pins • 14 Digital I/ O Pins • 3 PWM outputs • System On Chip (SOC) ESP8266-12E • Network Protocol IPv4, TCP/UDP/HTTP • Interface UART, I2C, SPI • Technology Wifi 802.1Ib/g/n • Useful for IoT product prototype • Compact and affordable IoT device	

Fig.2.3.4: Arduino board specifications.

The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the wiring projects. It includes a code editor with features such as syntax highlighting, brace matching and automatic indentation, and is capable of compiling and uploading programs to the board with a single click.

2.3.5 Power light emitting diode (LED)

Fig.2.3.5: Power LED

A high-power LED light source is a single LED power higher than 0.5W. High power LED is a light emitting diode with high rated current ranging from tens of mA to several hundred mA. High power LEDs are energy efficient building block generating sufficient lumen outputs ideal for popular lighting applications. High power LEDs currently are widely applied on automobile lights, flashlights, lighting fixtures etc.

2.3.6 Voltage regulator (LM317)

Fig.2.3.6: Voltage regulator

The LM317 device is an adjustable three-terminal positive-voltage regulator capable of supplying more than 1.5 Ampere over an output-voltage range of 1.25 V to 37 V. It requires only two external resistors to set the output voltage. The device features a typical line regulation of 0.01% and typical load regulation of 0.1%. It includes current limiting, thermal overload protection, and safe operating area protection. Overload protection remains functional even if the ADJUST terminal is disconnected.

2.3.7 Resistor

Fig.2.3.7: Resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements, or as sensing devices for heat, light, humidity, force, or chemical activity.

CHAPTER 3

METHODOLOGY

3.1 Input Module Working

In the input module, we used IR sensor which is interfaced with Arduino. In this we are connecting the output pins of IR sensor to pin 4 of Arduino to give status of IR sensor. IR sensor senses the presence of a vehicle or a pedestrian on the road and increases the intensity of LED street lamps on the road through output module. IR sensor works on 5V and Arduino is working on less than 5V supply (Battery or Laptop USB driver).

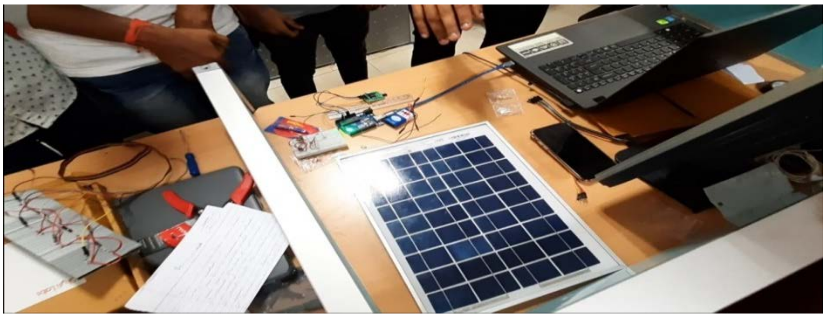


Fig.3.1: Components of Automatic Street Light system IoT kit.

3.2 Output Module Working

In the output module, the digital output pin 6 of Arduino is connected to LED street lamps and increases the light intensity when required. LDR is connected to analog pin A1 of Arduino and helps in switching between day, evening and night time modes. In this, LED lamp is working on 9V supply from the LM317 Voltage Regulator.

Fig.3.2: Engaged in coding Arduino during the project.

CHAPTER 4

RESULT & DISCUSSION

4.1 Results & Discussions

The projecct aims to find solution to save power. The inputs and outputs of the system to control the lights are prepared. The project shown in the figure has been implemented and works as expected and will prove to be vey useful.

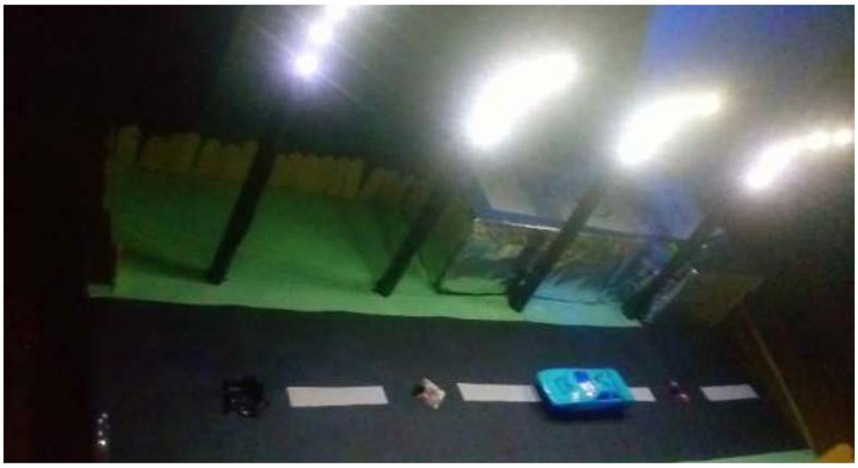


Fig.4.1.1: Automatic Street light system demonstration.

In this project, we used IoT to display the status of roads and sensors on web browser using a cloud service provider named Adafruit IO that display the output of serial monitor data of Arduino on its own app in real time. We have used C code to interface Arduino to this cloud service provider by providing the COM port and destination to address of application.

Fig.4.1.2: IoT display on cloud using Adafruit IO.

Fig.4.1.3: Display of the obtained result to the guide.

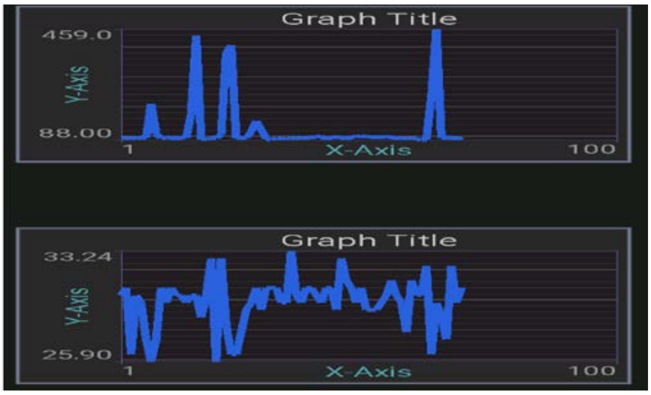


Fig.4.1.4: Light intensity and sensor response graph.

4.2 Areas of application

1. It can be used in some clocks, alarms, and other electronic devices dependent on sunlight.
2. It can be used as a binary counter.
3. We can use it outside of house, corridors or in industrial area, which helps to save power.
4. In sea off-shore side we can use it as a dangerous sign.
5. Photo resistors are also used in digital cameras to detect how much light camera sees and adjust the picture quality accordingly.

4.3 Advantages

1. Solar Street light is independent of grid as a result of this operating cost is much lower and longer life.
2. Risk of accidents is very low; hence maintenance cost is much lower compared to conventional street lights.
3. Power consumption is much lower and Intensity of LED can be controlled effectively without changes in its light color.
4. It is environmental friendly, no harmful emissions.
5. They are small enough to fit into virtually any electronic device and used all around the world as a basis component in many electrical systems.

4.3 Disadvantages

1. Initial investment is high.
2. Rechargeable batteries have to be replaced from time to time.
3. Non-availability of sunlight during rainy and winter seasons is a problem.
4. Dust accumulation on the surface of panel creates a problem.
5. It is sensitive to ambient light and requires careful shielding.

CHAPTER 5

FUTURE SCOPE

The above project i.e. Solar Street Light System with IoT can be powered from a battery, which can be charged during day time by harvesting the solar energy through a solar cell. The solar energy harvested from sunlight can be stored, inverted from DC voltage to AC voltage using Sun Solar Grid-Tied Inverter.

Using this project, we can also estimate the speed of the vehicles; record the number plates, recognizing the accidents took place on roads etc. This project not only helps in rural areas but also beneficial in urban areas too. As we are moving towards more advancement we require more power so use of renewable resources is useful and advantageous. With this project, we can even add smart parking of vehicle and it is even useful for driverless cars. This project has a bright future not only to save power but also reduced the calamities and even reduced the crime rate.

CHAPTER 6

CONCLUSION

The use of power electronics is increasing exponentially across various sectors of human life. The components used in the project, like Arduino and sensors are slowly becoming an indispensable part of our daily routines. So, it is only fitting that we use them to improve efficiency in every walk of life. Keeping in mind the urgent need for energy conservation, Solar Street Light System with IoT is an excellent and effective solution. It combines safe lighting protocols with consumption of minimal amount of power.

The future scope of this project expands into speed detection and customizable area of illumination. An additional component which would lead to better functioning of the concept would be the use of LED bulbs. Despite their high initial costs, they are a viable option as they drastically reduce the power consumption. They will aid in further saving of energy and reduction in operational costs.

CHAPTER 7

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