P.E.S COLLEGE OF ENGINEERING

MANDYA

(An Autonomous Institute under Visvesvaraya Technological University, Belagavi)

A MINI PROJECT REPORT ON

IOT BASED STREET-LIGHT SYSTEM FOR A SMART COLLEGE

Submitted in partial fulfilment of the requirement
For the award of the
BACHELOR OF ENGINEERING DEGREE

Submitted by

Ruthuparna K	**[4PS17EC076]**
Sathwik N Sharma	**[4PS17EC080]**
Amrutha Somayaji	**[4PS17EC124]**
Ajay M	**[4PS17EC049]**

Under the guidance of

Mr. M. J. Anand
Assistant Professor

Department of Electronics and Communication Engineering

P.E.S College of Engineering, Mandya.
2019-2020

P.E.S COLLEGE OF ENGINEERING

MANDYA-571401

(An Autonomous Institution Affiliated to VTU, Belagavi)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that,

Ruthuparna K	**[4PS17EC076]**
Sathwik N Sharma	**[4PS17EC080]**
Amrutha Somayaji	**[4PS17EC124]**
Ajay M	**[4PS17EC049]**

have successfully completed the Mini-project work entitled **"IOT BASED STREET-LIGHT SYSTEM FOR A SMART COLLEGE"** in partial fulfillment for the award of degree of **Bachelor of Engineering in Electronics and communication Engineering** of **P.E.S college of Engineering, Mandya, VTU Belagavi** during the year **2019-2020**. It is certified that all corrections/suggestions indicated in internal assessment have been incorporated in the report deposited in the Library. The Mini-project has been approved as it satisfies the academic requirements in respect of project work prescribed for the degree **in Bachelor of Engineering.**

Signature of the guide
Mr. M.J. Anand.
Assistant Professor

Signature of the HOD
Dr.K.A.Radhakrishna Rao
Professor & HOD

Dr. H. V. Ravindra
Principal
PES College of engineering, Mandya

Mini Project work viva-voice examination			
Sl.No	Examiners		Date
	Name	Signature	
1			
2			

P.E.S COLLEGE OF ENGINEERING

(An Autonomous Institute under VTU, Belagavi)

MANDYA – 571401

Department of Electronics and Communication Engineering

DECLARATION

We **Ruthuparna K, Sathwik N Sharma, Amrutha Somayaji and Ajay M** students of 6th semester, Bachelor of Engineering in Electronics & Communication, PESCE, Mandya, hereby declare that the Mini-project work being presented in the dissertation entitled **"IOT BASED STREET-LIGHT SYSTEM FOR A SMART COLLEGE"** is an authentic record of the work that has been independently carried out by us and submitted in partial fulfilment of the requirements for the award of degree in **Bachelor of Engineering in Electronics & Communication,** affiliated to **Visvesvaraya Technological University (VTU), Belagavi** during the year 2019-2020.

The work contained in the thesis has not been submitted in part or full to any other university or institution or professional body for the award of any other degree or any fellowship.

Place: Mandya

Date:1/06/2020

Ruthuparna K

Sathwik N Sharma

Amrutha Somayaji

Ajay M

I. ABSTRACT

India is the 3rd largest consumer of electricity in the world and is the second largest contributor to the increase in energy demand. However, the country imports 53% of its energy and 80% of its generation is through fossil fuels. As a result, the government must focus not only on renewable energy but also to make its current system smart and efficient in order to prevent unnecessary losses.

Providing street lighting is one the most important and expensive responsibilities of a city. Lighting can account for 10–38% of the total energy bill in typical cities worldwide. Over 27 million street lights light up India and consume 20 - 40% of the total energy that we produce that accounts to about 66.86 - 133.72 GW. Energy consumption due to street lights needs proper monitoring and control to reduce wastage of power.

Conventional street light systems suffer from drawbacks as they are manually controlled and are powered through the electrical board power station. In this project, an automatic street light control system is implemented based on IoT. Automated street lights consume power only when it is required by evaluating the conditions of the environment, thus minimizing the consumption. Furthermore, it cuts down on maintenance costs as fault detection is easier and provides nodes in the city from where data can be harvested. The project uses Node MCU as the core controller and a few peripherals so as to build the entire system.

II. LIST OF FIGURES

CONTENTS

Chapter 1: INTRODUCTION & LIERATURE SURVEY

Automation systems are becoming more prominent in our everyday life as faster and cheaper internet connectivity has given devices the option to connect with each other and work without any human intervention. From the rise of home assistants like Alexa to smart security systems, automation has become the de facto solution to take care of manual and cumbersome tasks.

One such task whose automation has heralded in making cities more energy-friendly and efficient is smart street lighting. Street lights play a vital role in our environment and also plays a critical role in providing light for the safety of our citizens and reduce crimes against women.

In the scenario where street lights function the entire night, a lot of unnecessary energy gets consumed and the lifetime of the electrical equipment involved (such as an electric bulb) reduces. Especially in cities, streetlights are a severe power consuming factor and also the most significant energy expense for a city. Furthermore, as a result of the large network of lights, maintenance proves to be a challenging task - finding and fixing faulty lights proves to be a slow and costly affair.

Taking all of these factors into consideration, our project aims to offer a more efficient solution. We provide a centralized and real time web application that is connected over the internet to every streetlight in the system's network. The administrator will be able to control any light by selecting it on the map. Furthermore, the lights automatically turn on during the night and turn off in daylight. Apart from that, the street lights operate at 20% brightness in the absence of pedestrians and vehicles, allowing for energy savings.

1.1: LITERATURE SURVEY

Reference paper [1] says that the aim of automated streetlight management system using IOT is the conservation of energy by reducing electricity wastage as well as to reduce the manpower. Streetlights are the elemental part of any city since it facilitates better night vision, secure roads, and exposure to public areas but it consumes quite a large proportion of electricity. The manual streetlight system is powered from sunset to sunrise with maximum intensity, even when there is sufficient light available. This energy wastage can be avoided by switching off lights automatically. This can be achieved using an IOT enabled streetlight management system.
Reference paper [2] gave us an outlook of power consumption of various types of bulbs. Most commonly used street light are high pressure sodium vapor (HPSV), Low pressure sodium vapor (LPSV) and Metal Halide (MH) lamps. The consumption range is about 50W-400W depending on the lumen's requirement. It can be reduced largely by replacing existing HPSV, MH lamp with the LED lamps - thus reducing power consumption by around 50-75%. Furthermore, if the power consumption is reduced, the amount of carbon-dioxide produced during the electricity production can also be reduced. According to the CNCF the amount of carbon-dioxide produced for the production of 1KWH of power is about 0.94kg. Hence LED lights contribute less to global warming.
Reference paper [3] provided necessary documentations for understanding the working of Wi-Fi Modul and LDR (Light Dependent Resistor) which we have used in this project.
Reference Paper [4] gave us an idea on how to control the light intensity. Ambient Light Intensity Sensor: The ambient Light Intensity Sensor is designed using an LDR (Light Dependent Resistor). A small experiment was conducted to determine the value of the resistance of LDR at the threshold value of ambient light intensity the threshold value of the light intensity is the value at which artificial lighting is required.
Reference Paper [5] hints that the use of CFLs and LED lamps reduces network losses, reduces the voltage drop in the network and at the same time reduces the need for reactive (50 Hz) power from the HV network. However, it also increases harmonic currents and reduces the power factor (PF) in the network.

Chapter 2: BLOCK DIAGRAM

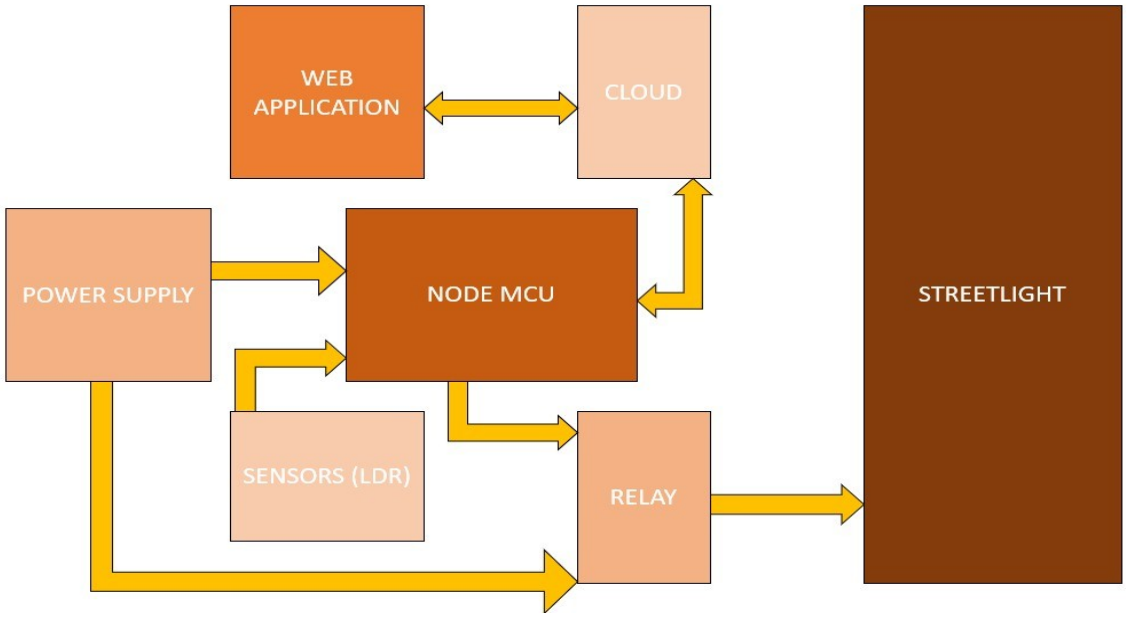

Fig.2.1 Block Diagram

- The NodeMCU controls the streetlight through the relay. It connects the device to the cloud server and is powered by the mains through Hi-link - 5V 3W - AC to DC Power Supply Module.

- The Cloud Server maintains a PostgreSQL database of all the streetlights in the network. It hosts the web application so its online 24/7, and collects and analyzes data from all the nodes to get insights

- The Web Application boasts an interactive map that plots all the streetlights in the network for easy visualization and Real time control of streetlights.

Chapter 3: HARDWARE & SOFTWARE REQUIREMENT

3.1 HARDWARE REQUIREMENTS

3.1.1. NODE MCU

Fig 3.1.1 Node MCU

NodeMCU is an open source firmware for which open source Lua based prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. NodeMCU is the best fit for the project undertaken because of its low cost as well as the in-built Wi-Fi module that makes the MCU small and multifunctioning.

FEATURES:

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs, SPIs,I2Cs: 1 each
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 Mhz
- Wi-Fi: IEEE 802.11 b/g/n

In our mechanism NodeMCU is the brain of the entire system, It manages the switching of the street lights, measures the light in the environment and takes decisions based on threshold limit that has been set and also sends commands to the web application to upload the data from the sensors to the cloud and to collect the data from the web application as well.

3.1.2. 4 CHANNEL 5V RELAY

The 4 Channel Relay Module is a convenient board which can be used to control high voltage, high current load such as motor, solenoid valves, lamps and AC load. It is designed to interface with microcontroller such as Arduino, PIC and etc. The relays terminal (COM, NO and NC) is being brought out with screw terminal. It also comes with a LED to indicate the status of relay.

Fig 3.1.2 5V RELAY

FEATURES:

- Size: 75mm (Length) * 55mm (Width) * 19.3mm (Height)
- Weight: 61g
- PCB Color: Blue
- There are four fixed screw holes at each corner of the board, easy for install and fix. The diameter of the hole is 3.1mm
- High quality Single relay is used with single pole double throw, a common terminal, a normally open terminal, and a normally closed terminal
- Optical coupling isolation, good anti-interference.
- Closed at low level with indicator on, released at high level with indicator off
- VCC is system power source, and JD_VCC is relay power source. Ship 5V relay by default. Plug jumper cap to use
- The maximum output of the relay: DC 30V/10A, AC 250V/10A

In this project the relay is used to handle the AC input given to the street lamps. It acts as a switching circuit based on the input received from the controller. Relays are one of the essential components of any IoT projects.

3.1.3. LIGHT DEPENDENT RESISTOR

Fig. 3.1.3 LDR

A photoresistor or light dependent resistor is a component that is sensitive to light. When light falls upon it then the resistance changes. Values of the resistance of the LDR may change over many orders of magnitude the value of the resistance falling as the level of light increases. It is not uncommon for the values of resistance of an LDR or photo-resistor to be several mega-ohms in darkness and then to fall to a few hundred ohms in bright light. With such a wide variation in resistance, LDRs are easy to use and there are many LDR circuits available. The sensitivity of light dependent resistors or photo-resistors also varies with the wavelength of the incident light. LDRs are made from semiconductor materials to enable them to have their light sensitive properties. Many materials can be used, but one popular material for these photoresistors is cadmium sulphide, CdS, although the use of these cells is now restricted in Europe because of environmental issues with the use of cadmium. Similarly, cadmium CdSe is also restricted. Other materials that can be used include lead sulphide, PbS and indium antimonide, InSb.

This project uses LDR sensor to know the amount of light in the environment on the basis f which we decide whether or not to turn on the street light in a college campus.

3.2 SOFTWARE REQUIREMENTS

3.2.1. ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application for Windows, macOS, Linux that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards. The Arduino IDE supplies a software library

from the Wiring project, which provides many common input and output procedures. This IDE makes code

compilation easy that even a common person with no prior technical knowledge can get into this learning process. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module

3.2.2. HEROKUAPP

Heroku is a cloud platform as a service (PaaS) supporting several programming languages. One of the first cloud platforms, Heroku has been in development since June 2007, when it supported only the Ruby programming language, but now supports Java, Node.js, Scala, Clojure, Python, PHP, and Go. For this reason, Heroku is said to be a polyglot platform as it has features for a developer to build, run and scale applications in a similar manner across most languages.
In this project we use this cloud platform to host our web application through which manual and automatic controlling of street lights happen.

3.2.3. FLASK

Flask is a micro web framework written in Python. It is classified as a microframework because it does not require particular tools or libraries. It has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions. However, Flask supports extensions that can add application features as if they were implemented in Flask itself. Extensions exist for object-relational mappers, form validation,

upload handling, various open authentication technologies and several common framework related tools. Extensions

are updated far more frequently than the core Flask program. The flask framework includes Pinterest and LinkedIn as well.

In this project the framework done for the web application is based on this very package of python. Though the web application uses front end developing technologies like HTML, CSS the framework is entirely built with Flask.

FEATURES:

- Development server and debugger
- Integrated support for unit testing
- RESTful request dispatching
- Uses Jinja templating
- Support for secure cookies (client-side sessions)
- 100% WSGI 1.0 compliant
- Unicode-based
- Extensive documentation
- Google App Engine compatibility
- Extensions available to enhance features desired

Chapter 4: CONNECTION DIAGRAM & PROCEDURE

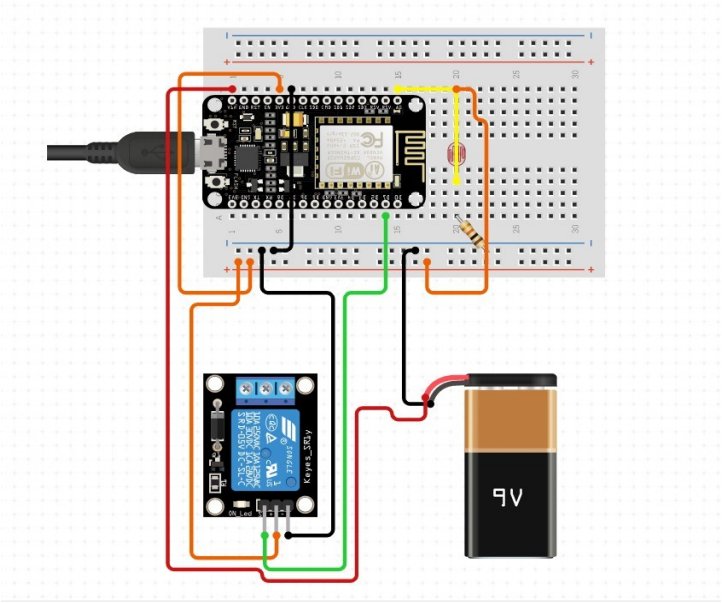

Fig. 4. Connection Diagram

4.1. PROCEDURE

- Keeping Arduino Uno as the central portion, connect all the peripheral devices as shown in fig 4.0.1.

- Connect output of logic level controller/Voltage regulator circuit to VCC of ESP8266 module, so that the module is supplied with 3.3v with necessary driving current.

- With Arduino in place, connect 5V pin of Arduino to Positive Bus in Breadboard and GND pin to Ground Bus on the Breadboard. From there on provide biasing voltage to the LCD.

- Now, Power up Arduino by connecting it to one of the COM ports on a computer installed with Arduino-IDE via the USB cable provided.

- Upload the program to Arduino by selecting appropriate COM port and baud-rate.

- Check if the load cell is calibrated properly by using a known weight as reference and check if the system is connected to the Thing Speak cloud and values are being updated.

- Add weights on to the load cell and notice the changes.

- Continue adding weights on to the load cell until the load exceeds the threshold value and notice that as soon as load exceeds the threshold an indication is made and power to the wheels is halted. In case of a real truck the connection between the battery and fuel injector is disconnected.

- On reducing the load within the limit notice that the system restores back to its normal operation and the power to the wheels is restored. In case of a real truck the connection between the battery and fuel injector is reestablished.

- Notice that the data is being updated on the cloud at regular intervals. The data from the cloud can be used to track real time load on the truck and malpractices can be identified easily.

Chapter 5: FLOW CHART

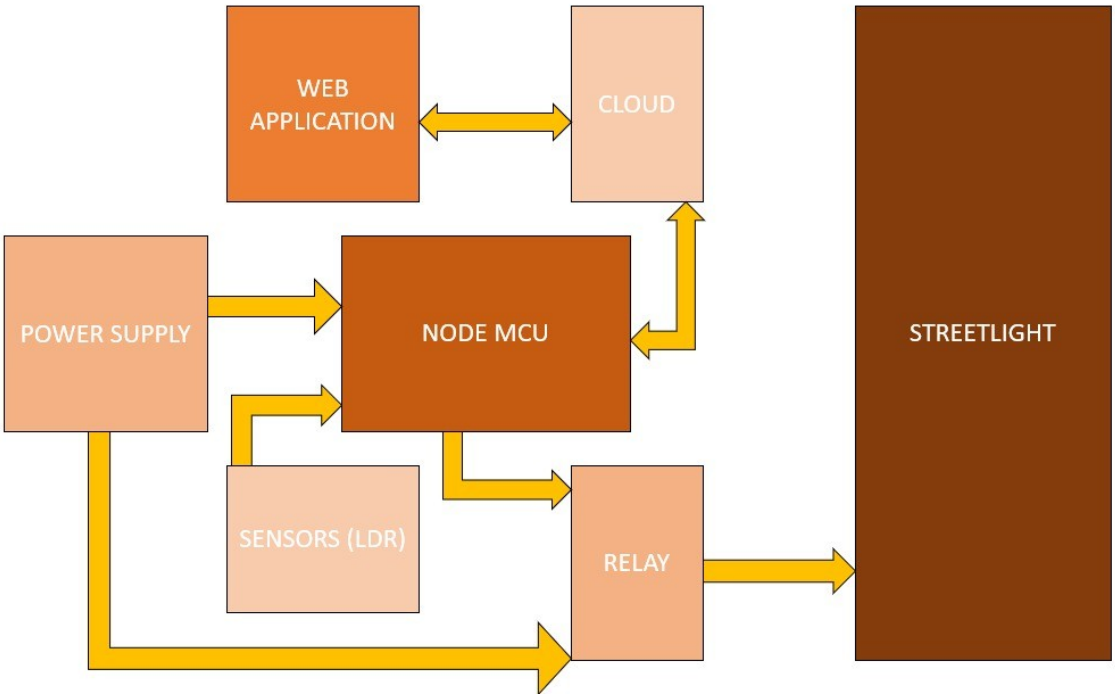

Fig. 5.1. Flow Chart

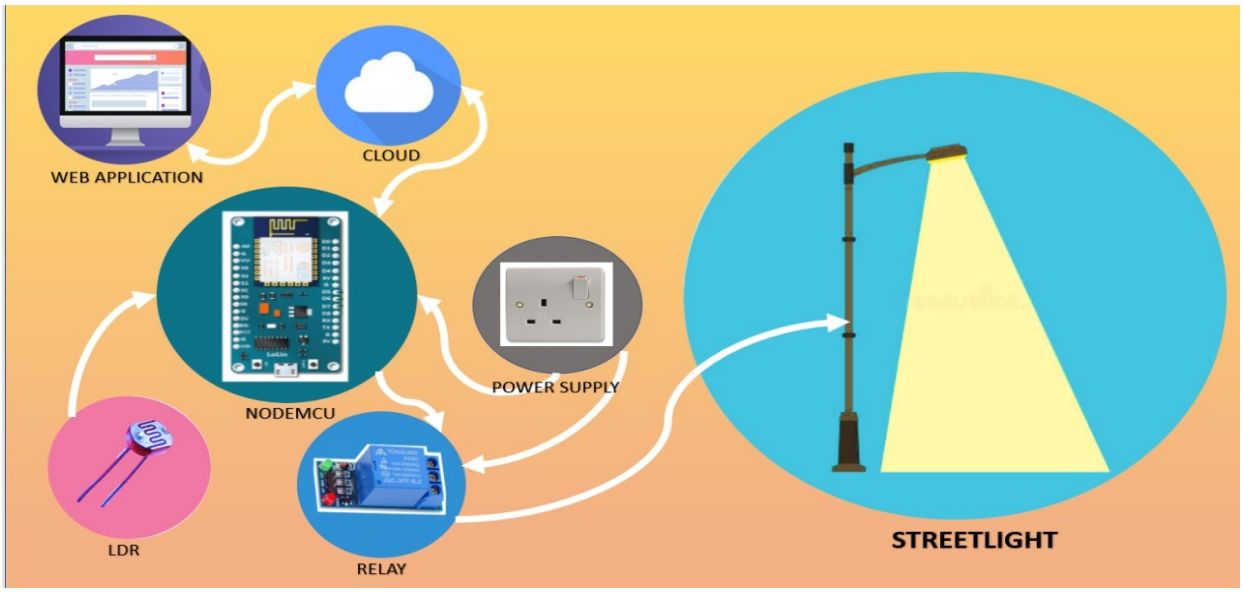

Fig 5.2. Flow Chart of working circuit

Chapter 6: WORKING PRINCIPLE

- The system is installed to a street light pole through which 4 street lights can be controlled and at a position where sunlight is directly focusable.

- The LDR in the circuit senses the amount of light in the environment and feeds it to the controller

- The controller is previously fed with a threshold value on the basis of amount of sunlight sensed at the time of evening. Whenever the LDR input is less than this threshold, the controller switches on the light through the relay.

- The relay is connected to the AC supply and whenever it receives a high signal from the controller, that is, NodeMCU, it switches ON the street lights by shorting the supply and the bulb input wire.

- There might be possibilities where the controller may turn ON the light in unnecessary situation and in such cases human intervention is required. For this we use the self-developed web application.

- The web application allows the user to run in both LDR based readings as well as User input commands. In case of situations like mentioned in the previous point the user input overrides the LDR status and the controller switches ON/OFF accordingly.

- The web application is hosted on a cloud platform called Heroku which can be accessed from any part of the world. This enables the user to control street lights from any where.

- 4 streetlights are controlled through a single controller set up and a single input of the LDR which makes a network of street lights as well.

Chapter 7: ADVANTAGES

- Saves a lot of electricity wasted due to uneven switching ON/OFF of the streetlights.
- Reduces human work.
- Remote areas can be monitored easily sitting in any place in the world.
- Can be the building blocks of a smart city/college.
- The durability of the streetlights increases due to restricted and responsible usage.
- Centralized platform to control and maintain all streetlights in the network

Chapter 8: DISADVANTAGES

- Requires high initial investment compared to conventional streetlight systems.
- Risk of theft and damage is higher.
- Rechargeable batteries may have to be replaced once in a few weeks or months.

Chapter 9: APPLICATIONS

The system can be used and applied in variety of scenarios. Some applications are:

- To huge college campuses, lighting is one of the essential things to be done and streetlights are plenty. Installing this system to these could bring down the difficulty of handling the lighting problems.
- Newly planned colonies/layouts/areas can employ this system to make the lighting of the colony/layout/area much more efficient and easier.
- Government Units & Municipalities – Government organizations can save large sums of money by using an automatic solar street light system for outdoor lighting. It is forecasted that we will have 359 million
- Areas which are mainly donned by children can make good use of automatic street light systems. They are safe & secure & provide uniform lighting & the right amount of luminosity to parks.

Chapter 10: RESULTS

The IoT based streetlight system is a prototype designed to increase the efficiency and decrease the amount of electricity consumed due to irresponsible and irregular or untimed switching ON/ OFF. The light in the environment is sensed through the LDR and on the basis of this reading the lights are turned ON/OFF by the controller through a 4 channel 5V relay. A single controller controls a network of 4 streetlights making it more efficient and less costly for the entire system. In a few situations where the light is switches in due to some other reasons, manual intervention is required. This is fulfilled by a web application developed by the team. The commands received from the web application overrides the LDR status and can be controlled by the user from anywhere in the world. This reduces difficulty in switching ON/OFF of each and every streetlight in a huge area like college campus, colonies, layouts and other related areas.

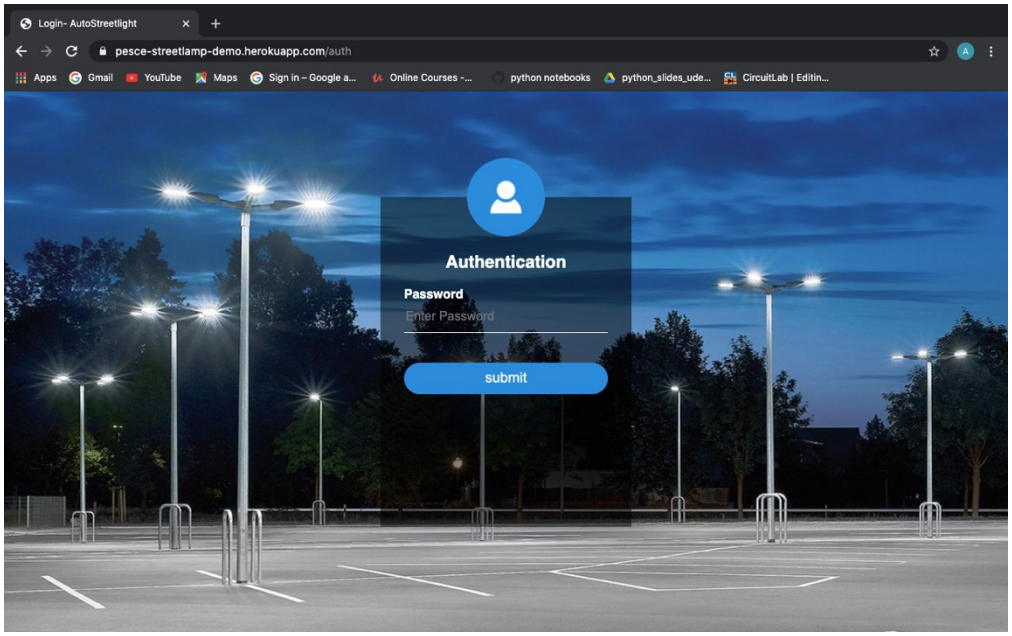

Fig. 10.1: Authentication page of web app

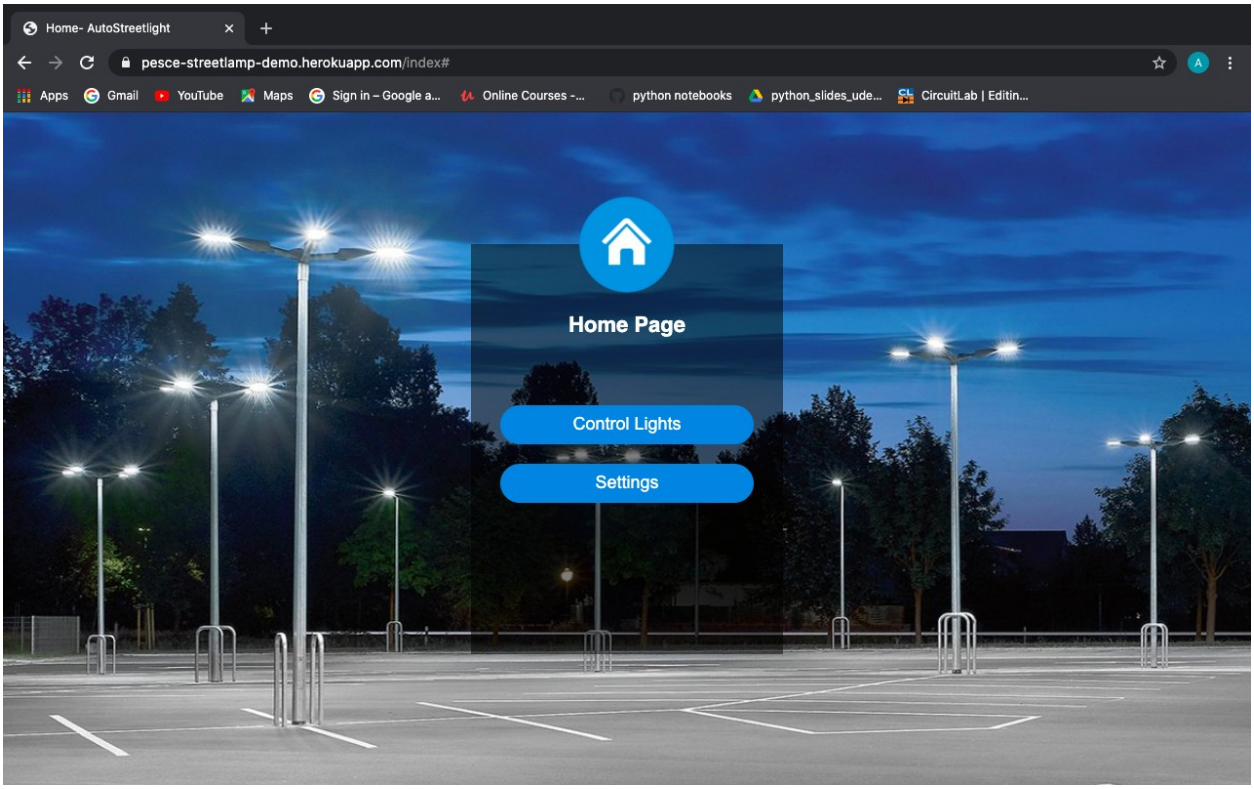

Fig. 10.2: Index/Home page of web app

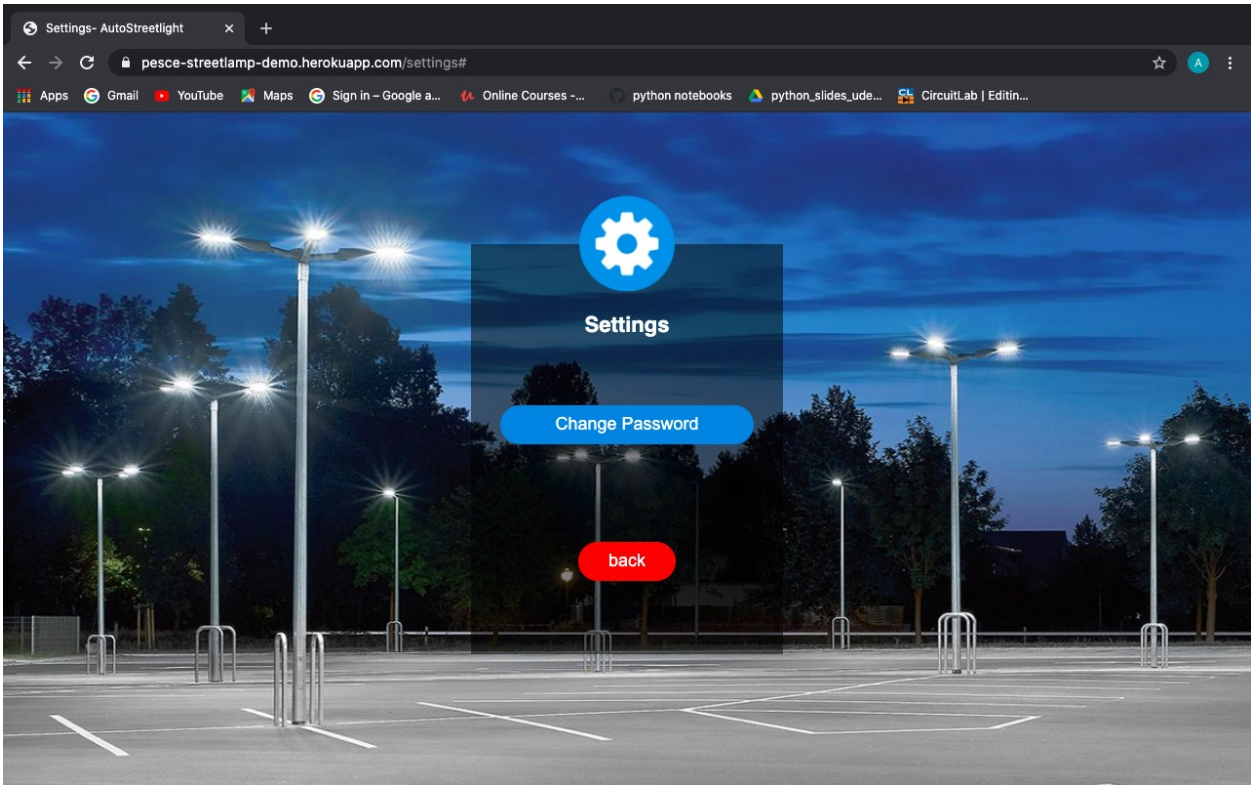

Fig. 10.3: Setting page of web app

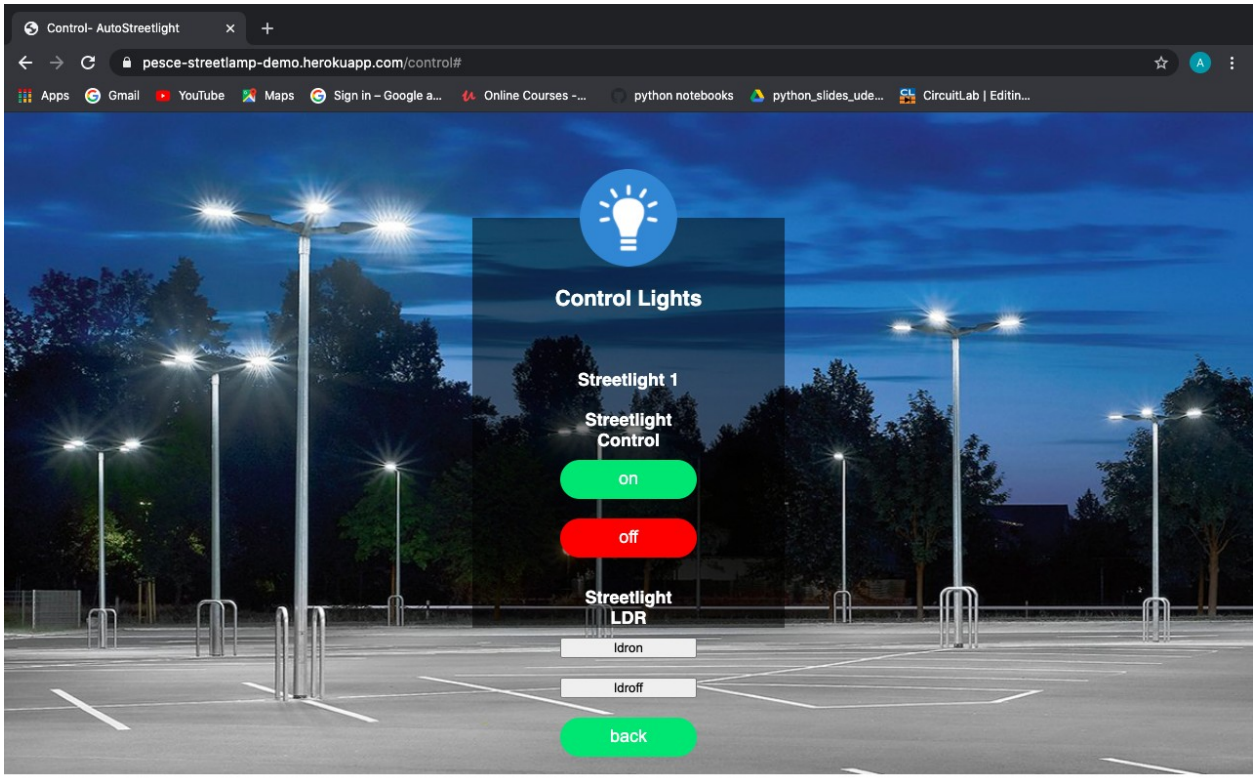

Fig. 10.4: Control page of web app

Chapter 11: CONCLUSION AND FUTURE SCOPE

11.1 CONCLUSION

This project "IoT Based Street Light Controller" is a cost effective, practical, eco-friendly and the safest way to save energy and this system the light status information can be accessed from anytime and anywhere. It clearly tackles two the problems that world is facing today.

- Saving of energy in a very efficient manner
- Reduction of Human Labor

By adopting to this system cuts down the cost of conventional system by 50-60% which improves the economy of the country and saves a huge amount of investment makes this cost efficient. So, this improve efficiency in every walk of life. Keeping in mind that the urgent need for energy conservation. So IoT Based Street Light Controller is an excellent and effective solution. It combines safe lighting with consumption of minimal amount of power. 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.

11.2 FUTURE SCOPE

- The design in the prototype discussed in this report is only to turn ON/OFF the streetlights in a vast area. The same prototype may be modified to detect defects in the bulbs bringing down the maintenance costs.

- Facility can be provided to not only control lights but also to protect the system from electrical fluctuations.

- A set of PIR motion sensors can be provided in order to light up areas where very less people visit to turn ON only when movement detected.

- The web application can be improvised to monitor the status of streetlights at any point of time.

- The web application can be provided with facilities to compute the amount of time and the amount of electricity consumed by a network or a particular street light to know the usage of the streetlights

- The bulbs in the streetlights may be replaced with LED array. This will bring down the consumption of electricity. With LED array, brightness monitoring can also be done effectively cutting down the wastage to minimum.

Chapter 12: REFERENCES

1. IOT based smart street light management system. Published in: 2017 IEEE International Conference on Circuits and Systems (ICCS). Date of Conference: 20-21 Dec. 2017. Date Added to IEEE Xplore: 29 March 2018. INSPEC Accession Number: 176623 - https://ieeexplore.ieee.org/document/8326023

2. International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-2S2 December, 2018
   Vinothkumar N, Subhash V.K, Viswanathan T, Surya Prakash S

3. International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-6C, April 2019
   Rakesh Roshan, Om Prakash Rishi

4. Smart Street Lights. Published in: 2013 Texas Instruments India Educators' Conference. Date of Conference: 4-6 April 2013. Electronic ISBN: 978-0-7695-5146-3. INSPEC Accession Number: 14147868 - https://ieeexplore.ieee.org/document/6757123

5. Comparison of LED and CFL lamps and their impact on electric power network. Published in: 2012 IEEE 15th International Conference on Harmonics and Quality of Power. Date of Conference: 17-20 June 2012. INSPEC Accession Number: 13174736 - https://ieeexplore.ieee.org/document/6381219 (future scope)