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# Weather Based Intensity Control For Saving Power Used For Street Lighting In A Smart Colony

[1] Ch.Swetha, [2]G.Vishwanath,[3] G.Sridhar
[1][2][3]SreeNidhi Institute of Science and Technology, Yamnampet, Ghatkesar Mandal, R. R. Dist., Hyderabad

**Abstract: The electric power in most of the countries in the world is utilized in lighting the streets. However, the electrical energy consumed by street lights is not efficiently used because the need of street lamps is not essential in every street in all periods of time. In this project, we propose a system that switches off the light for the parts of the streets which are not in use and turns on the light for the parts of streets which are mostly used when it is dark. The smart street lighting also controls the luminosity of light and performs automatic light dimming which is an aspect that serves to reduce energy consumption. The intensity of light can be controlled based on illumination and the weather conditions. Logically, this system may save a large amount of the electrical power. In addition, it may increase the lifetime of the lamps and reduce the pollutions. We can create a network of the devices which are connected to the street lights and we can control the street lights through web app. the intensity of street lights is changed based on the illumination levels.**

**Index Terms- luminosity, illumination, energy consumption problem.**

## 1. INTRODUCTION

The street lighting is one of the largest energy expenses for a city. Anintelligent street lighting system can cut municipal street lighting costs asmuch as 50% - 70%. An intelligent street lighting system is a system that adjusts light output based on usage and occupancy, i.e., automating classification of pedestrian versus cyclist, versus automotive. An intelligent street light management proposes the installation of the wireless-based system to remotely track and control the actual energy consumption of the street lights and take appropriate energy consumption reduction measures through power conditioning and control. The street light controller should be installed on the pole lights which is connected to Arduino along with various sensors and wireless module. The street light controller installed on the street light pole will control LED street lighting depending on traffic flow, communicate data between each street light. The data from the street light controller can be transferred to base station using cloud technology to monitor the system. The mode of operation of the system can be conducted using auto mode and manual mode. The control system will switch on-off the lights at required timings and can also vary the intensity of the street light according to requirement. The intensity of Street light also changes to the change in the weather conditions

## II. RELATED WORK

We can control the LED street lights without continuous monitoring. We have enhanced the range of connectivity by using a Wi-Fi control method [1]. It is cost effective as well as eco-friendly. Even the intensity of the lights can also be controlled by this eWeLink Wi-Fi controller app. The coverage area has been increased to 95meter in outdoor and 32meter in indoor.The system architecture of the intelligent street light system [2] consists of IR sensors, LDR, PIC16F877A microcontroller, Relay, UART and Wifi Module. LDR"s are light dependent devices whose resistance decreases when light falls on them and increases in the dark. The [3] system starts to work only at low or poor lighting conditions. Piezoelectric crystal strips are embedded on the roads6 at calibrated intervals. There are strips can arranged in many ways depending on the road conditions provided. The [4] Smart City market is estimated at hundreds of billion dollars by 2020, with an annual spending reaching nearly 16 billions. This market springs from the synergic interconnection of key industry and service sectors, such as Smart Governance, Smart Mobility.The [5] system elaborates the design and construction of automatic light control system. Based on the results the microcontroller calculates and automatically detects geographical area and retrieve relevant data for sunrise and sunset in the area, respectively ensures very precise ON/OFF mode of the lighting system. [6] Optimization of energy consumption and lamp life for smart street lighting control system. Naïve exhaustive search algorithm optimizes energy consumption and the lamp life every 30 minutes subject to its constraints. [7] Flexible wireless sensor network for smart lighting applications. Smartness relies on a pervasive communication infrastructure to move

 

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information from "production points" to "consuming points". [8] Smart street lighting control and monitoring system for power saving using VANET. Automatically controls and monitors street lights, can light only to the parts that have vehicles and used Vehicular Ad-Hoc Networks( VANET)

1.Main Central Sensor node-CS.
2.Every node is connected to every other node in Mesh Topology.
3.S1,S2,S3,S4,S5,S6 are Boundary sensor nodes.
4.s1,s2,s3……..,s12 are intermediary sensor nodes.

Now here CS is the Gateway which is connected to the Wifi and receives the commands all the time from the webpage. Other intermediate nodes and boundary nodes are connected with nRF modules. The intermediate nodes don't require wifi connection. Here in this project we implemented a part of this architecture like consider CS,S1,s2 ,s3.

## III. PROPOSED SOLUTION

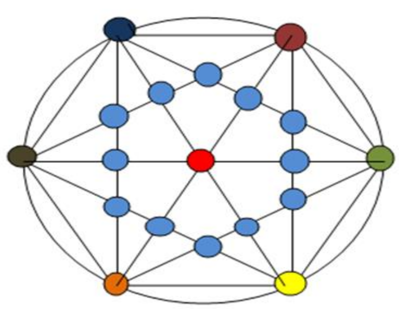

*Fig1. Architecture of the proposed system*

*Fig2. NodeMCU*

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Expressive Systems, and hardware which is based on the ESP-12 module. It needs 3.3v to 5 volts power supply.

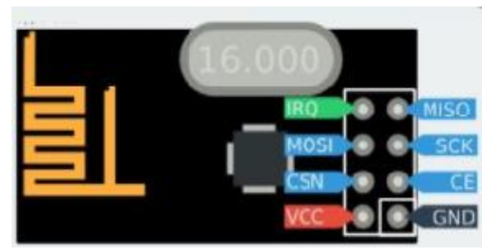


*Fig3. nRF module*

It uses the 2.4GHz band and it can operate with band rates from 250 kbps up to 2 Mbps. If used in open space and with lower band rate its range can reach up to 100 meters. It is majorly used for receiving and transmitting messages from one device to other device. We used 3 nRF modules to make connections between the main node and the sub nodes.

*Fig4. LDR Sensor*

Photo resistors, also known as light dependent resistors (LDR), are light sensitive devices most often used to indicate the presence or absence of light, or to measure the light intensity. When the LDR sensor is exposed to light, the resistance drops dramatically. It also needs 3.3v power supply.

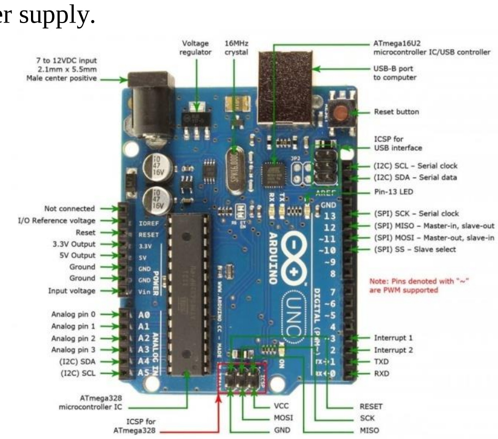

*Fig5. Arduino ESP8266*

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Arduino UNO is a widely used open-source microcontroller board based on the ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. It can be powered by a USB cable or by an external 9volt battery, though it accepts voltages between 7 and 20 volts.

***i. i. Create Webpage for Admin***

Admin enters the commands from the webpage after connecting to the WIFI Webpage is Build using basic HTML and JavaScript to send commands to the cloud.

***ii. Subscribe MQTT broker***

Subscribing the MQTT means, sending the command which has come from the webpage to the Gateway or the Central Sensor. It passes on the command to the gateway.

***iii. Make connections at the Gateway***

We used NodeMCU as the main Gateway, it has included wifi module and made connection with LDR and nRF module.

***iv. Passes on the command to the next nodes***

Central Sensor node is connected to other nodes, and the commands are transferred to the next nodes via nRF module present at other nodes. Other nodes can also check LDR sensor value at their respective nodes but the previous node's light intensity is followed to the next nodes via nRF's present at every node until every light gets accessed.

***v. Algorithm***

1. Admin needs a Connection to the WIFI
2. Admin enters a command in the webpage
3. On pressing enter, the command hits the MQTT broker in the cloud
4. From the cloud, the command is transferred to the main Gateway
5. If command is LightON

5.1. LDR checks the intensity in the weather
5.2. Compares both the command and sensor value
5.3. Switches ON the light with required brightness
5.4. Sensor data is then again sent to the webpage for reference
5.5. Using nRF module main gateway transfers the command and the sensor value to the next node.
5.6. The above step continues until each node gets monitored with the incoming command

6. Else if command is LightOFF

6.1. Switch off the light without checking LDR value.
6.2. Goto step 5.2 after a certain duration of time.

Let us consider for time being that the command from the webpage is "LightON". The command is treated as a string. When the admin clicks enter, the command is send to the cloud, as soon as the cloud receive a command, Now LDR sensor at the main node or Gateway senses the light intensity present in the sunlight and then compares it with the inputted command.

It then turns on the light with required brightness based on the weather intensity and passes the sensor value to the webpage for reference. It also sends the command and the sensor value to the other nodes connected to it via nRF module. Likewise, all the street lights connected in mesh topology gets the command and the sensor value via nRF .If the admin sends command as "LightOFF". When the admin clicks enter, the command is send to the cloud, as soon as the cloud receive a command , the same command reaches the gateway in the form of a string. Then directly the lights are off without checking intensity at the LDR.

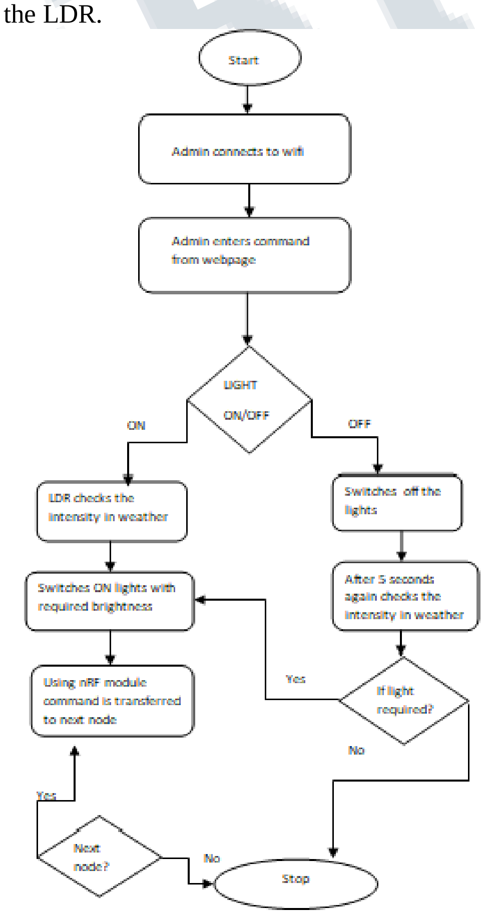


***Fig6. Flow diagram***

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## IV. IMPLEMENTATION

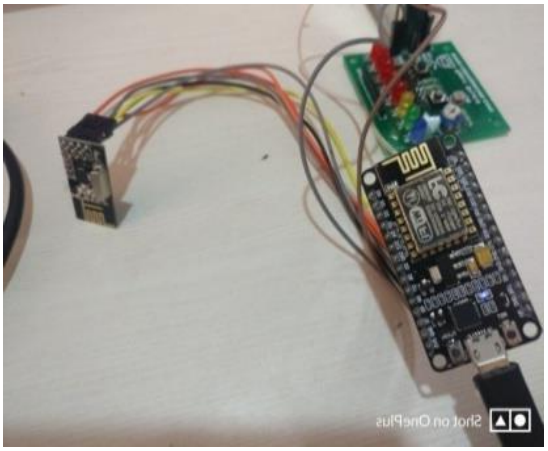

*Fig7. NodeMCU ESP8266 is connected to nRF module and LDR sensor*

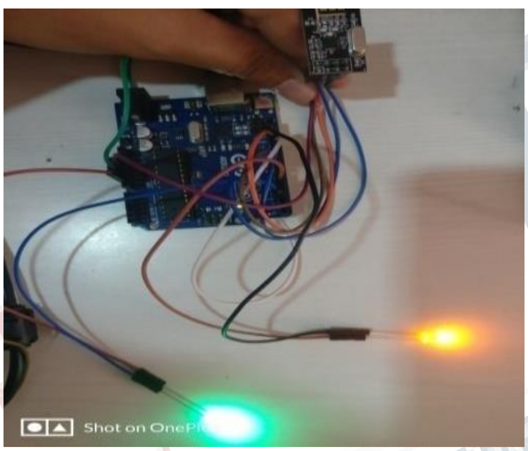

*Fig8. Arduino UNO is connected to nRF and Leds*

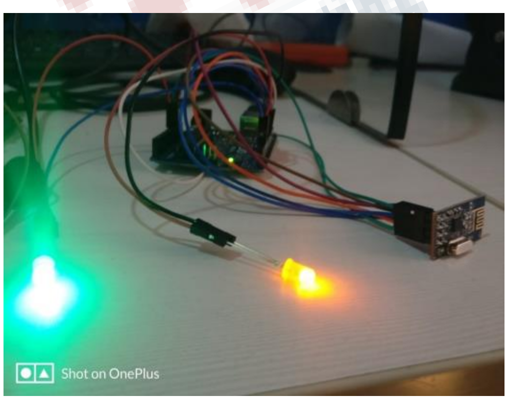

*Fig9. Arduino at node2 is connected to nRF and leds*

## V. RESULTS AND DISCUSSIONS

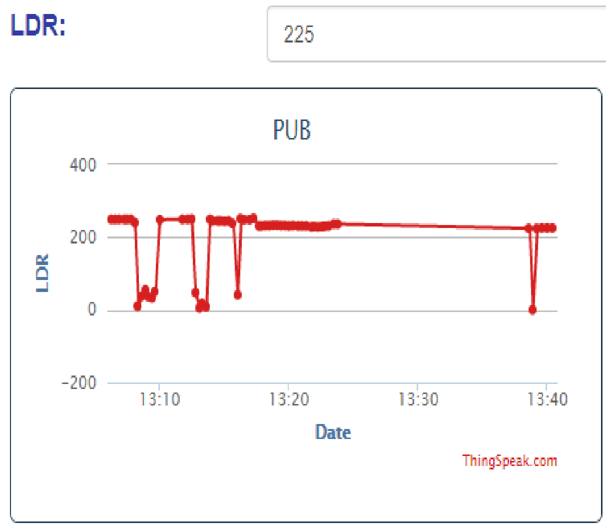


*Fig10. Graph shows the weather intensity with respect to modified date*

The above graph shows weather intensity that has been noted by the LDR sensor and the date on which the device is activated.

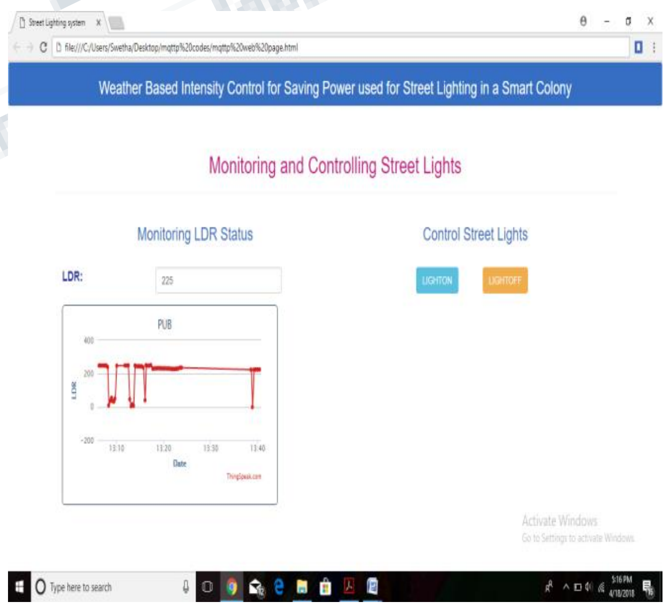


*Fig11. Web application to conrol and monitor the street lights*

| S.NO | DATE | TIME | LDR VALUE | LIGHT STATUS |
|---|---|---|---|---|
| 1 | 10-04-2018 | 18:17:21 | 93 | ON with Low Brightness |
| 2 | 10-04-2018 | 18:45:23 | 56 | ON with Low Brightness |
| 3 | 10-04-2018 | 20:30:18 | 13 | ON with High Brightness |
| 4 | 11-04-2018 | 07:12:56 | 123 | ON with Very Low Brightness |
| 5 | 11-04-2018 | 10:11:45 | 356 | OFF |
| 6 | 11-04-2018 | 13:01:15 | 398 | OFF |
| 7 | 11-04-2018 | 18:25:29 | 102 | ON with Low Brightness |
| 8 | 11-04-2018 | 22:29:01 | 08 | ON with Very High Brightness |
| 9 | 13-04-2018 | 14:30:21 | 298 | OFF |
| 10 | 13-04-2018 | 16:23:29 | 201 | OFF |
| 11 | 15-04-2018 | 11:04:59 | 364 | OFF |
| 12 | 15-04-2018 | 19:50:10 | 105 | ON with Medium Brightness |
| 13 | 15-04-2018 | 20:08:03 | 98 | ON with Medium Brightness |
| 14 | 15-04-2018 | 23:21:08 | 05 | ON with Very High Brightness |
| 15 | 16-04-2018 | 06:02:10 | 37 | ON with Low Brightness |
| 16 | 16-04-2018 | 08:08:39 | 125 | ON with Very Low Brightness |
| 17 | 16-04-2018 | 12:29:30 | 256 | OFF |
| 18 | 16-04-2018 | 17:03:25 | 209 | OFF |
| 19 | 16-04-2018 | 20:09:56 | 41 | ON with Medium Brightness |

***Fig12. Observations on LDR value and the status of light***

## VI. CONCLUSION

In this paper, we have proposed an optimum solution to reduce the usage of electricity used for street lights from 50-70%. Life time of street Lights is also increased. This system has less human intervention and one can control and monitor the street lights in an area from anywhere around the world. With the technique we used to control and monitor street lights, we can predict the weather conditions .

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