International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 06 | June -2020 ISSN: 2582-3930

CLIMATE ADAPTIVE STREET LIGHT IGNITION USING INTERNET OF THINGS

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Abstract - The system is mainly used for smart and weather adaptive lighting in the street lights. At present in the conventional system, we use sodium vapor, fluorescent lamp and mercury lamp for street lights. All these lamp consumes large amount of energy and the maintenance cost is also high. It requires manual framework where the light is turned ON prior to the nightfall and turned OFF when there is adequate light in the morning. At times these street lights are kept ON unwantedly even during the day time which is total wastage of electricity and money. Timing problem is also a major issue. In this system the street lights are automatically turned ON and OFF based on the surrounding climatic conditions and movement of the objects. The existing fluorescent lamps are replaced by LED (Light Emitting Diode) lamps. For detecting the weather condition this system uses LDR (Light Dependent Resistor) Sensor and for detecting the movement of the object this system uses IR (Infrared) Sensor. This project gives solution for electrical power wastage. It reduces CO2 emission as the conventional street lamps are replaced, it saves money as the electrical wastage is reduced and it also reduces manpower as the system is made automatic.

***Key Words*:** Street lights, LDR sensor, IR sensor, IOT, Climate Adaptive, Smart street lamp.

1. INTRODUCTION

The street lighting is one of the largest energy expenses for a city. Due to the continuous functioning of the conventional street lights there is a huge loss of electricity. The main objective of this system is to minimize the energy consumption, reduce man power and automation of street lights. The automation of the street lights are made by using two types of sensors, such as [1] LDR or Photo Resistor, works based on the light that falls on it. LDR detects darkness to activate the streetlights automatically. If the surrounding environment is bright it automatically turns OFF. [2] IR sensor detects the motion of the object. During the night time, when the movement of the object is detected the street light glows with high intensity. When the movement of the object is not detected the street light turns OFF automatically. The Arduino microcontroller is used for controlling the street lights. The sensor senses the sunlight and sends the information to the microcontroller which acts upon, based on the given condition. Here the operation of manual mode is avoided and every operation is made automatic.

2. PROBLEM STATEMENT

The street light is one of the huge expenses in every city. All the conventional lamps consumes large amount of electricity which leads to wastage of electric current and also increases the expenditure of the country. These lamps produces enormous amount of heat and also emits CO2. Due to these problems the life span of the lamps are reduced. In current street lights it requires manual work to turn ON the lights during the night time and turn OFF the lights during the day time. At times the lights are kept ON unwantedly even during the day time. Hence there is a lot of energy wastage between this ON and OFF of the lights.

DISADVANTAGES OF EXISTING SYSTEM

1) Energy consumption is high.
2) Requires more Man power.
3) Maintenance cost is high.
4) Difficult to monitor all the lights.
5) Timing problem exists.

3. RELATED WORK

In [3] the energy consumption is reduced by minimizing the intensity of the lights when the vehicular movement is not discovered. This system includes two LDR sensor. LDR-1 is used to detect the vehicular movement and LDR-2 is used to check the light status. The system uses GSM technology for communicating the streetlights fault. Although it reduces the electrical wastage by reducing the intensity up to 20% when vehicular movement is not detected, it does not detect pedestrians, bicycle riders which is a major drawback.

In [4] smart street lighting which could significantly reduce power consumption and CO2 emission. To monitor the street light faults the communication is made over the power line. The developed system communicates over power lines using modified frequency shift keying (FSK) modulation. Even though the communication is faster, implementation of this system is technically complex.

In [5], the authors uses the Smart street lighting concept, where it detects the vehicle with the help of its headlight from certain radius and automatically switches ON the light till the vehicle crosses a particular radius and vice versa. The energy used for lighting was taken from solar energy at day time. The disability of this system is that it does not detect the

non-vehicular movements. This causes major issue for bicycle riders, as the sensors don't detect the movement of the objects and hence the streetlight does not glow with full intensity.

In [6], the authors introduced a wireless street lighting system. In this system the street lights are made automatic streetlights to increase the productivity and accuracy of the system. The accessibility of the street lights are made flexible by connecting it wirelessly. The control of the system can be done anywhere and anytime. Emission of the carbon dioxide is reduced. Temperature and Humidity sensor is used for monitoring the weather and the actions are taken accordingly. Although the timing problem is reduced, maintenance cost of all the street light is increased tremendously.

In [7] the main objective of the project is to save electrical energy. Automation of the street lights are made in a cost effective manner. Power consumption of the street lights are reduced by replacing the conventional HID (High Intensity Discharge) with LED lamps. This system includes two types of sensors, such as LDR sensor and photoelectric sensor. LDR sensor detects the darkness to activate the streetlights automatically and the photoelectric sensor detects the movement of the object and activates the streetlight with full intensity. When the movement is not detected the street lights intensity is reduced to 20%. Monitoring all the street lights are very difficult, since it does not have any fault detection system for street lights.

4. SYSTEM DESIGN AND ARCHITECTURE

The hardware components used in the system includes, Arduino microcontroller, LDR sensor, IR sensor, LED, Battery, Solar panel, IOT module, and Power supply.

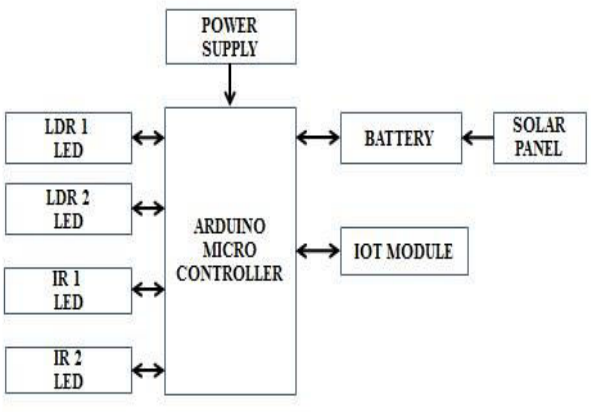

Fig. 1. Architecture of the proposed system

The software component used in the system is Arduino IDE for writing the code in C or C++.The system consists of LDR sensor to examine the day-night variations. It also consist of IR sensor to examine the movement of the objects. The results from the LDR and IR sensor is transferred to the Arduino microcontroller. The streetlight control system is powered by solar panels.

5. SYSTEM DESCRIPTION

1) ARDUINO UNO

Arduino uno is a microcontroller board based on ATmega328. A microcontroller is a simple computer that can one program at a time. It consist of both the micro controller and software (IDE) that runs in computer, which is used to write and upload the code to the physical board. It has 14 digital input/output pins of which 6 can be used as PWM outputs, 6 analog inputs, a USB connection, a power jack and a reset button. It does not require any interpreter and operating system. It is very strong in controlling the inputs and outputs. In Arduino IDE (Software) programming language is either C or C++.

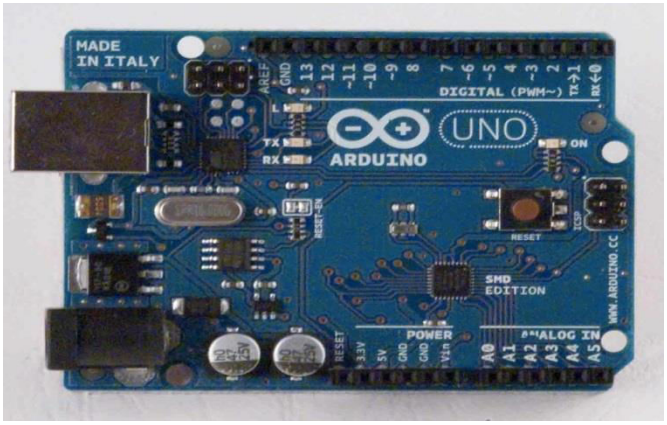

Fig.2. Arduino uno microcontroller

2) LDR SENSOR

LDR is a Light Dependent Resistor. It is also called as Photo Resistor. It is Light sensitive device. It is made up of semiconductor materials such as Cadmium Sulphide , Lead Sulphide. A LDR works on the principle of photoconductivity.

It is used to detect the light. The resistance of the photo resistor decreases with increasing incident light intensity. Greater the intensity of light, lower the resistance of the LDR.

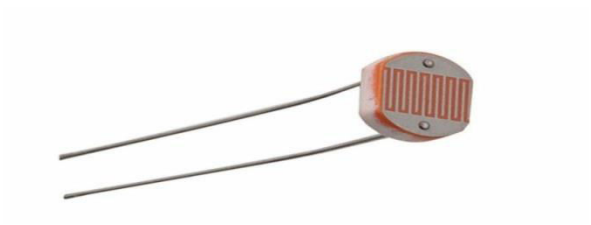

Fig.3. LDR sensor

3) IR SENSOR

IR sensor stands for Infrared sensor. IR sensor consists of two parts, the emitter circuit and the receiver circuit. The emitter is an IR LED and the detector is an IR

photodiode. The IR photodiode is sensitive to the IR light emitted by an IR LED.

Fig. 4. IR sensor

6. SYSTEM IMPLEMENTATION

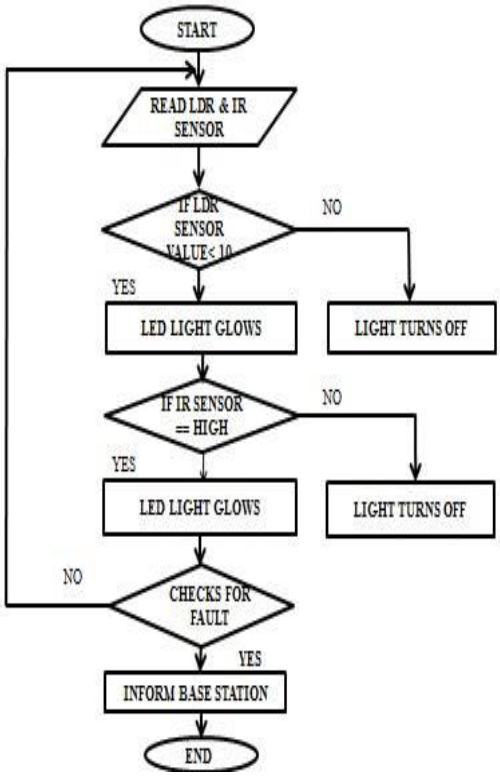

Fig.5 Workflow of proposed system

To design the energy efficient street lights, we use low cost microcontroller such as Arduino. To reduce the consumption of energy in the street lights we are replacing the high pressure sodium vapor lamps by LED (Light Emitting Diode) which consumes less energy. For detecting the movement of the vehicle the IR sensor is used. It detects the movement of any object and then it automatically turns ON the street lights and when the movement is not detected the lights are turned OFF. For detecting the darkness it uses LDR sensor which automatically activate the street lights and it deactivates the light when there is sufficient sunlight in the environment. In the case of any malfunctions the alternative street lights are automatically turned ON and OFF based on the weather and movement and it also sends the notification about the malfunctions of the street lights through the IOT module.

The result from the LDR, IR sensor is transferred to the arduino microcontroller. The arudino microcontroller further works on the result from the sensors and activates the lights using the code written in arduino IDE.

7. RESULTS

The system uses solar panels as a source of battery. The above developed prototype is shown in the Fig.6, Fig.7 and Fig.8.

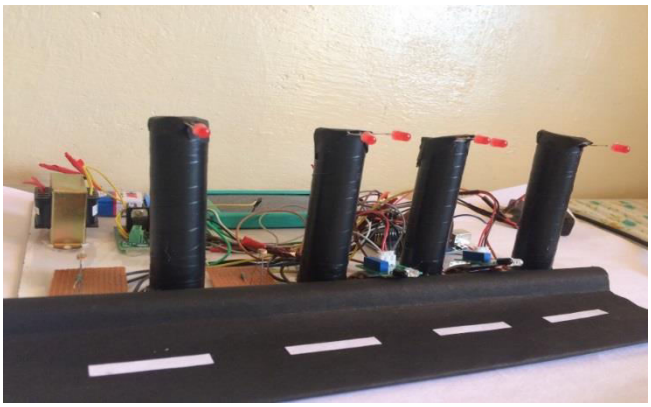

Fig. 6 Prototype of the system

In the Fig.6, the prototype of the system is shown. In this system, it consist of two LDR based street lights which is named as street light 1 & street light 2 and street light 3 & 4 works based on IR sensor.

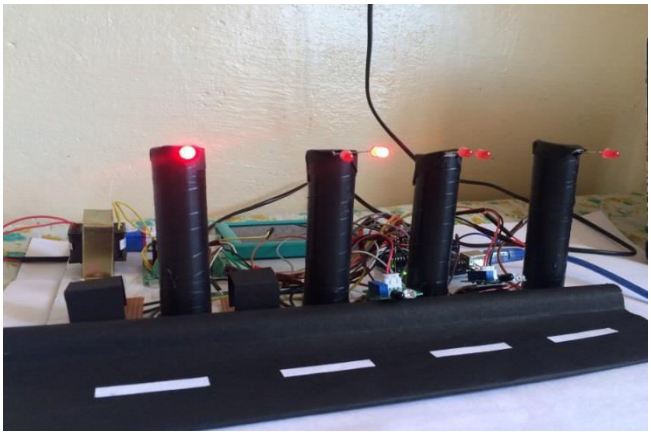

Fig.7 Street light 1 & 2 glows based on LDR sensor

In the Fig.7, the street light 1 and the street light 2 glows based on the day and night variations. Since it is night time the street lights are turned ON automatically.

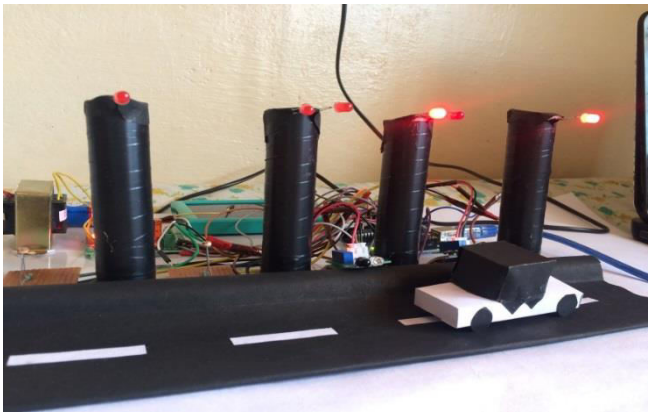

Fig. 8 Street light 3 & 4 glows based on IR sensor

In the Fig. 8, the street light 3 & 4 glows based on the IR sensor. As the IR sensor detects the car (object), the street lights switches from LOW to HIGH. Hence this system provides sufficient light for slow-mover such as pedestrian and bicycle riders and also reduces the power consumption.

8. CONCLUSION

In this paper, we proposed a smart and weather adaptive lighting in the street lights which provides an efficient method for minimizing the energy consumption and it also monitors the status of the street light and its fault. Sodium vapor lamp consumes large amount of energy and the maintenance cost is also high. In this system the sodium vapor lamp is replaced by LED lamps, which have longer life, emits cool light, can be used for fast switching.

It clearly tackles the two problems that the world is facing today, saving of energy and also disposal of incandescent lamps, very efficiently. This makes the system more reliable when compared with the conventional one.

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