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IoT Based Smart Street Light System

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ABSTRACT

The sole motive of automated streetlight using IoT is the preservation of energy by decreasing the rate of wastage of electricity and manpower. A manual streetlight system consists of lights which are powered from dusk till dawn with maximum intensity despite the availability of light. This continuous wastage of energy can be prevented if the lights switch off automatically. This can be implemented using an IoT Streetlight System. LED Lights combined with LDR can help us regulate the amount of intensity of light unlike HID lamps where it couldn't be possible. The project is implemented on an Arduino board for providing efficient results by regulating the light at various times. The proposed project clearly brings out more efficient way to harness electricity instead of its conventional counterpart.

Keywords: *IoT, smart street light system, LDR, Arduino UNO, PIR sensor, photo resistor*

INTRODUCTION

IoT, as the name "Internet of Things" itself suggests, the environment with different things communicating together for precise working of the system with least human interactions.[3] IoT consists of network of multiple interconnected devices which has a numerous amount of capabilities of interaction with one another as well as the users of the system.[6] In this proposed system, IoT is used by integrating with the street light systems in smart and efficient urban planning.

Depending on the new technology, the cities are striving to convert into smart cities. The authorities tend to find an effective solution for the physical problems regarding the resources and the infrastructure of a city. Most of them can be found at the lower layer (communication layer) of the IoT.

One of the most cost bearing expenses of the city is the street light system. The smart streetlight system using IoT can reduce the amount of electricity consumed up to 50%, thereby saving a hefty amount of electricity by increasing the efficiency of light as well. The system requires the installation of a wireless system to monitor the original energy consumption remotely and take proper measures by conditioning and controlling the power.

The controllers installed in this system consist of a microcontroller along with an LDR sensor, a PIR sensor and a wireless module. The controller will control the amount of lighting in the area depending on the required amount of light. The data that will be captured cab be monitored and transferred to the base station which will enable the station to regulate the amount of electricity. It turns itself ON and OFF depending on the amount of light in the

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surroundings and can regulate the intensity according to the needs.

OBJECTIVES

Currently, a manual lighting system is used in most of the parts of the world wherein the street lights are to the turned ON and OFF as per the requirements i.e. the lights are to be turned ON and off manually whenever required. This for sure has a lot of possibility of human errors occurring. And we can generally see this on a regular basis when the street lights are not turned OFF during the whole day or many of the times the lights are not turned on during the night.

We can really think up on it and take actions for the conservation of energy taking in view the current global environment situations. We can see there is a sheer wastage of energy occurring due to the current system. So there seems to be a need of a proper developed method to overcome these problems. Here seems the need of our proposed system. The major advantage of the proposed system is conservation of energy. This system when implemented will save a huge amount of energy as compared to the current system in use.[1]

SYSTEM MODULES

Let's take a look at the major components of the proposed system one by one. The 3 most major components of the proposed system are Arduino Uno R3, LDR/Photoresistor and PIR sensor. And the most important activities to be analysed by the system are light detection and movement detection.

Arduino Uno R3

Talking of the Arduino Microcontroller, it is based on the ATmega328P datasheet and is the most popular microcontroller in the whole Arduino family. The Arduino Uno microcontroller consist 14 digital input/output pins of which 6 pins can be used as PWM outputs. It has 6 analog inputs, 16 MHz ceramic resonator, USB connection, power jack, reset button and an ICSP header.

The Arduino microcontroller has a vast usage due to various advantages it has few of which are: - first of all is cost, Arduino boards are very inexpensive yet powerful and efficient, open source and extensible hardware and software, easy programming and very handy for even beginners and its cross-platform capabilities. These properties lead to a very vast usage of this microcontroller. [7]

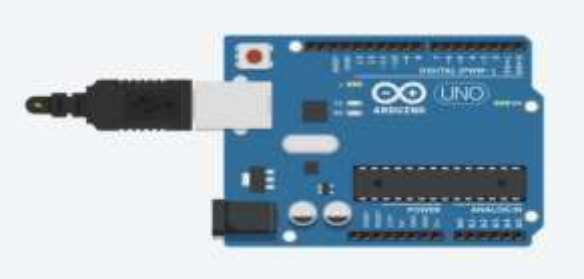

Fig. 1: *Arduino Uno R3.*

LDR

LDR, also called as a photoresistor or a Cadmium Sulphide Cell (CdS) as the name suggests is a resistor whose resistance depends upon the intensity of light falling on it.

An LDR possesses a very high resistance when high intensity light falls on it, hence current cannot flow through it whereas when there is no light falling on the LDR,

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it has a negligible resistance and current can easily flow through it.[2]

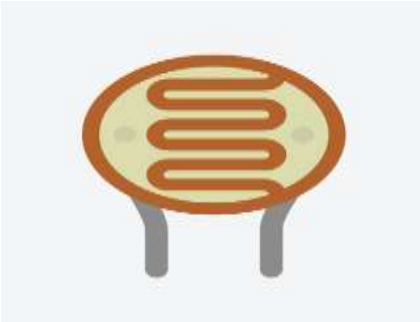

Fig. 2: *LDR/Photoresistor.*

PIR Sensor

In this proposed system the PIR sensor is used for motion detection by using infrared lights in the field of view. The moving vehicles or objects when comes into the field of view of the PIR sensor it triggers the power of lights and hence lights will be turned ON. Similarly, when there is no object or vehicle present in the field of view of the PIR sensor, the lights will remain OFF. [5]

Fig. 3: *PIR Sensor.*

PROJECT FLOW

The activity diagram below represents the working flow of the proposed system.

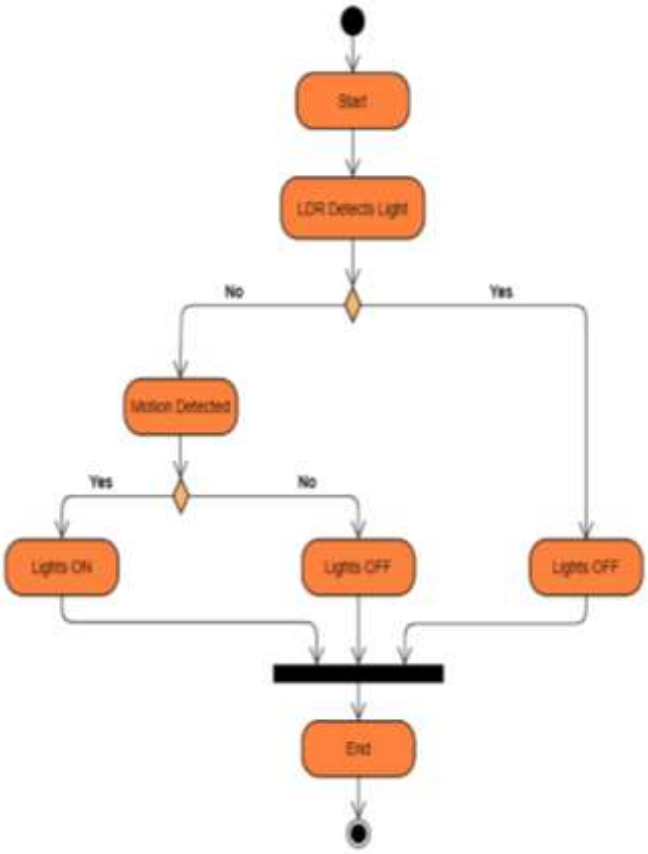

Fig. 4: *Activity Diagram for IoT Based Smart Street Light System.*

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ALGORITHM

LDR used to sense the intensity of light and PIR sensor to detect motion in its field of view. [1]

```
if ( light intensity(dark) )
{
        if ( motion detection(true) )
        {
                LED turns ON;
        }
        else
        {
                LED remains OFF;
        }
}

else
{
        LED remains OFF;
}
```

IMPLEMENTATION

The two major concepts used in this prototype are motion detection and light detection. As mentioned above, for motion detection a PIR sensor will be used whereas for light detection an LDR will be used in this project. The basic concept will be using these sensors for turning ON/OFF the street lights on the basis of the feedback received from these sensors.

The two required conditions for the street lights to be turned ON are there must be darkness and the PIR sensor should have detected an object in its field of view. The PIR sensor and the LDR sensor works together for this, hence, when both of these conditions are satisfied the street lights will turn ON. [4]

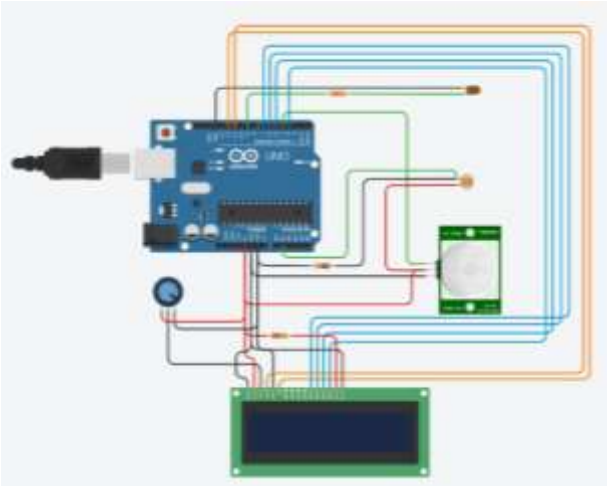

Fig. 5: *Circuit Diagram for IoT Based Smart Street Light System.*

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The circuit connections for the IoT Based Smart Street Light System are to be done as follows:

1) First of all, we ground the GND of the PIR sensor.
2) Also, terminal 1 of the photoresistor has to be grounded with a 1kΩ resistor in series with it.
3) The analog input A1 is given to the terminal of the photoresistor.
4) 5V power has to be given to POWER terminal of the PIR as well as the terminal 2 of the photoresistor.
5) Digital input from the pin D4 is given to the SIGNAL terminal of the PIR.
6) The LED light's cathode is then grounded and its anode is connected to D9 with a suitable resistor (as per the requirement) in series with it.
7) A LCD screen is used in the simulation to show the status of the prototype.

When done with all these connections, the Arduino can be powered to turn ON the system. In the system, when the light is in the turned OFF state it indicates that the PIR or Photoresistor or even both can be acting as the circuit breakers *i.e.* either there is light detected or there is no motion detected by the PIR or even both.

For the street light to turn ON as we've seen the conditions required are that there must be darkness and motion must be detected by the PIR. When both these situations are satisfied the streetlights turn ON.

This process is cyclic and continues every time to turn the lights ON/OFF. The fig.4 represents the activity diagram of this process.[1]

FUTURE SCOPE

With the increased inventions and innovations in the field of Internet of Things, the scope of implementations of IoT is increasing every other day because a new innovation arises in the field every day and there doesn't seem to be any limits or end to these.

The smart city planning projects are focusing on implementing and using these innovations for economical, ergonomic and eco-friendly developments of cities. This indeed is a great opportunity for implementing proposed system. The global market indeed has a lot of arising opportunities for the same. The improvements in the cloud computing can also be integrated with most of the systems now-a-days.

Furthermore, this system can have many more upgradations possible. One of it can be connecting it on a network for wireless controlling and operations. Integrating this system with a few modifications, it could even be used with mobile devices for public as well as private spaces with a lot of ease and convenience of the user coupled with great environmental advantages.

CONCLUSION

This undertaking targets structuring and executing the serious advancement in inserted frameworks for vitality sparing of road lights. Right now, we have a manual framework where the road lights will be turned ON in the night prior to the nightfall and they are turned OFF in the following day morning after there is adequate light outwardly. However, the real planning for these lights to be turned ON is when there is outright dimness. With this, the force will be squandered up somewhat. This venture gives answer for electrical force wastage. Likewise, the manual activity of the lighting framework is totally dispensed with.

The proposed framework gives an answer for vitality sparing. This is accomplished by detecting and moving toward a vehicle utilizing a PIR transmitter and PIR

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Receiver couple. After detecting the development, the sensor sends the information to the microcontroller which moreover the Light to turn ON. Thus, when the vehicle or an impediment disappears the Light gets turned OFF as the sensor sense any item simultaneously the status (ON/OFF) of the road light can be gotten to from anyplace and whenever through web. This venture is executed with brilliant inserted framework which controls the road lights dependent on location of vehicles or some other obstructions in the city .Whenever the snag is recognized in the city inside the predefined time the light will get naturally ON/OFF as per the hindrance identification and a similar data can be gotten to through web. The continuous data of the road light (ON/OFF Status) can be gotten to from whenever, anyplace through web.

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