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Sensor-Based Automatic Street Lighting System

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ABSTRACT –
The project is designed to detect vehicle movement on highways to switch ON only a block of street lights ahead of it (vehicle), and to switch OFF the trailing lights to save energy. During night all the lights on the highway remain ON for the vehicles, but lots of energy is wasted when there is no vehicle movement.

Keywords – street lighting, automatic system, embedded system, automatic street lighting.

I. INTRODUCTION

Manual control is prone to errors and leads to energy wastages and manually dimming during mid night is impracticable. Also, dynamically tracking the light level is manually impracticable. The current trend is the introduction of automation and remote management solutions to control street lighting [1].
There are various numbers of control strategyand methods in controlling the street light system such as design and implementation of CPLD based solar power saving system for street lights and automatic traffic controller [1], design andfabrication of automatic street light control system[3], automatic street light intensity control and road safety module using embedded system [4], automatic street light control system [5], Intelligent Street Lighting System Using GSM [6], energy consumption saving solutions based on intelligent street lighting control system [7] and A Novel Design of an Automatic Lighting Control System for a Wireless Sensor Network with Increased Sensor Lifetime and Reduced Sensor Numbers[8].

In this paper two kinds of sensors will be used which are light sensor and photoelectric sensor. The light sensor will detect darkness to activate the ON/OFF switch, so the streetlights will be ready to turn on and the photoelectric sensor will detect movement to activate the streetlights.
This proposed system provides a solution for energy saving. This is achieved by sensing an approaching vehicle using an IR transmitter and Receiver couple. Upon sensing a vehicle movement, the sensors transmit the data to Microcontroller which further instructs the LEDs to light up. Similarly, as soon as the vehicle goes away, the LED gets switch off as the sensors can't sense any object.

II. STREET LIGHTING SYSTEM COMPONENTS

The system basically consists of LEDs, Photodiodes, IR transmitters and receivers. All these are supplied power using a 12 V Power Supply. A detailed description of components is as follows :

A. LDR (Light Detecting Resistor)

The theoretical concept of the light sensor liesbehind, which is used in this circuit as a darkness detector. The LDR is a resistor as shown in Fig. 1, and its resistance varies according to the amount of light falling on its surface. When the LDR detect light its resistance will get decreased, thus if it detects darkness its resistance will increase. [9]

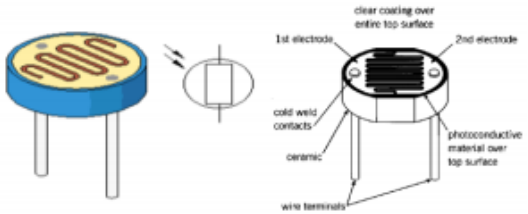


Fig.1 LDR

B. Photoelectric Sensor

A **photoelectric sensor (FIG. 2)**, or **photo** eye, is a device used to detect the distance, absence, or presence of an object by using a light transmitter, often infrared, and a **photoelectric** receiver. They are used extensively in industrial manufacturing.

A Photoelectric sensor has three types of Sensing modes which are :

I. Through Beam - A through beam arrangement consists of a receiver located within the line-of-sight of the transmitter. In this mode, an object is detected when the light beam is blocked from getting to the receiver from the transmitter.

II. Reflective - A retro-reflective arrangement places the transmitter and receiver at the same location and uses a reflector to bounce the light beam back from the transmitter to the receiver. An object is sensed when the beam is interrupted and fails to reach the receiver.

III. Diffused - A proximity-sensing (diffused) arrangement is one in which the transmitted radiation must reflect off the object in order to reach the receiver. In this mode, an object is detected when the receiver sees the transmitted source rather than when it fails to see it.

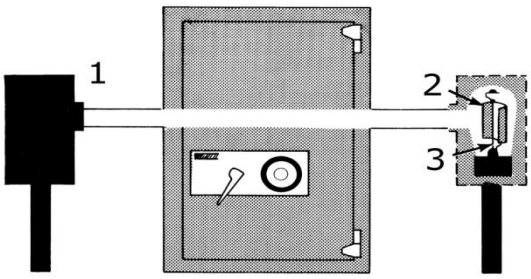


FIG.2 A through-beam photo-electric sensor

C. Power Supply

We are using a 230 V transformer to convert the unregulated AC power to DC Power for our system to work properly**.**

D. Microcontroller

In this project, we are using a 8051 Series Microcontroller. The 8051 Microcontroller is manufactured by Intel Corporation and is one of the most popular Microcontrollers in use today. There have been several cloned version of this microcontroller to suit specific needs, and they are collectively termed as the MCS-51 family of microcontrollers, which includes chips from vendors such as Atmel, Philips, Infineon, and Texas Instruments.
8051 Microcontroller finds application in typical usage spaces like control systems, telecom applications, robotics as well as in the automotive industry. This MC is extensively used in developing advanced embedded system based projects due to its advantages like larger memory, faster speed.
The pin diagram of which has been shown below:

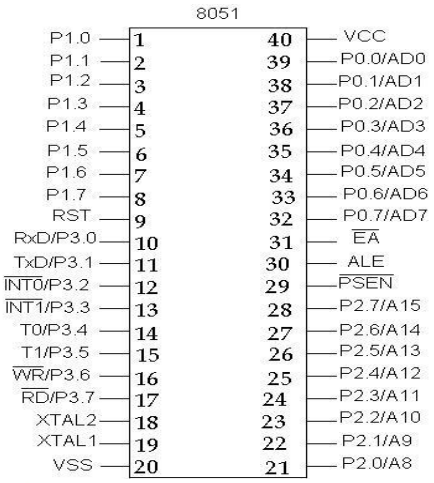


FIG.3 Pin Diagram of 8051 µC

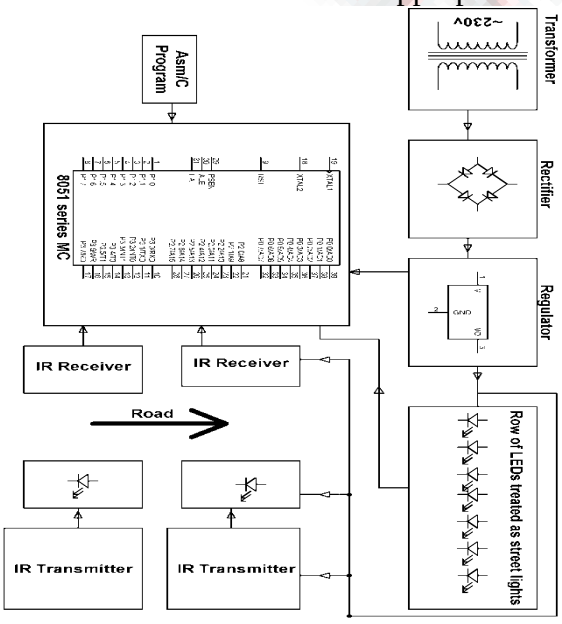
Certain industry estimations have pegged that 8051 alone takes up over 50% of the total embedded chips market. FIG. 4 depicts the internal architecture of a 8051 series microcontroller.

III. STREET LIGHTING SYSTEM CIRCUIT DIAGRAM

While we have discussed in detail, regarding various components being used in the mentioned Street Lighting system, we will now discuss the circuit diagram in detail.

As the vehicle passes by, the trailing lights switch OFF automatically. Thus, we save a lot of energy. So when there are no vehicles on the highway, then all the lights remain OFF. However, there is another mode of operation where instead of switching OFF the lights completely, they remain ON with 10% of the maximum intensity of the light. As the vehicle approaches, the block of street lights switch to 100% intensity and then as the vehicle passes by, the trailing lights revert back to 10% intensity again. High intensity discharge lamp (HID) presently used for urban street light are based on principle of gas discharge, thus the intensity is not controllable by any voltage reduction. White Light Emitting Diode (LED) based lamps are soon replacing the HID lamps in street light. Intensity control is also possible by Pulse Width Modulation (PWM) generated by the microcontroller. Sensors used on either side of the road senses vehicle movement and sends logic commands to microcontroller to switch ON/OFF the LEDs. Thus this way of dynamically changing intensity ON/OFF helps in saving a lot of energy. The project uses an 8051 series microcontroller.

Further the project can be enhanced by using appropriate sensors for detecting the failed street light and then sending an SMS to the control department via GSM modem for appropriate action.



IV. RESULTS AND DISCUSSIONS

The point of making this project has already been detailed out in the Abstract part of this paper. With this project, we aim to correct the currently energy guzzling street lighting system.

In countries like India, where power continues to remain a luxury for many, such kind of a street lighting system will go a long way in helping us to save energy as the lights will automatically switch off, once the vehicle has passed by.

In this project the first thing to do, is to prepare the inputs and outputs of the system to control the lights of the street.

V. CONCLUSION

This paper elaborates the design and construction of automatic street control system circuit. Circuit works properly to turn street lamp ON/OFF after designing the circuit (which controls the light of the street as illustrated in the previous sections) LDR sensor and the photoelectric sensors are the two main conditions in working the circuit. If the two conditions have been satisfied the circuit will do the desired work according to specific program. Each sensor controls the turning ON or OFF the lighting column. The street lights have been successfully controlled by microcontroller. With commands from the controller the lights will be ON in the places of the movement when it's dark. Furthermore the drawback of the street light system using timer controller has been overcome, where the system depends on photoelectric sensor. Finally this control circuit can be used in long roadways between the cities [9].

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