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Automatic Street Light Control, Fault Detection and Traffic Density Control

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ABSTRACT: Street light control system which operates automatically is not only easiest but also the intelligent system. The street lights turn on automatically during night and turn off during day. When vehicles pass by the sensor, the light will turn on automatically with maximum intensity. This design can save maximum amount of power. Furthermore, the system has auto-message function which will set off if any light is damaged and will show the address of the damaged light, thus it is easy to be found and repair the damaged light. An idea is implemented in such a way that the lights will be switching on with minimum intensity and will glow with maximum intensity only in the presence of traffic on the roads at night times. In the present days we are facing the traffic problem in the urban areas. It is essential to control the traffic density in an efficient manner in such a way that it can control according to the priority of the more traffic density present in the street by using sensor network and also to make a way for the ambulance to pass by easily. The system also has an exhaust fan fixed to all the routes which can absorb the polluted gases from the vehicles and hence reduces the pollution.

KEYWORDS: LDR's, IR Sensors, 8051 and ATmega328 microcontroller, Transmitter and Receiver, GSM modem, DC fan.

I. INTRODUCTION

Basically, street lighting is one of the major part of a city's infrastructure where the main function is to illuminate the city's streets during night time. Previously, the number of streets in the town and city is very small. Therefore, the street lamps are simple to construct but with the development of urbanization, the number of streets increases rapidly with high traffic density. There are several factors need to be considered in order to design a good street lighting system such as night-time safety for community members and road users, provide public lighting at cost effective, the reduction of crime and minimizing its effect on the environment. At the beginning, street lamps were controlled by manual control where a control switch is set in each of the street lamps. After that, another method that has been used was optical control method. High pressure sodium lamp is been used in this system. This method is widely used in the country nowadays and operates by setting up an optical control circuit, change the resistance by using of light sensitive device to control street lamps light up automatically at dusk and turn off automatically after dawn in the morning. The light dependent resistors are also used to indicate the condition of the lights so that effective maintenance can be done where necessary within a quick span. Due to urban development nowadays, road lighting can be categorized according to the installation area, performance and their uses, for an example, lighting for traffic routes, lighting for subsidiary roads, urban centers and public areas.

Therefore, it highlights the energy efficient of street lighting design using LED lamps through intelligent sensor interface for controlling and managing. The original contribution of this is to design of a streetlight node based on which the system can be set to run in automatic mode, which control streetlight according to Sunrise and Sunset Algorithm and light intensity. Reasonable adjustment according to the seasonal variation can be made using this control

II. RELATED WORK

Realizing intelligent street lamps has been quite difficult. Wireless sensor networks are a promising technology to enable this goal. The key is to take advantage of existing fixed-route vehicles, eg: shuttle buses, to carry our specially

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designed embedded system, the hitchhiker to collect the illumination data over the bus route. The hitchhiker is installed on the roof of the shuttle bus, and collects road lighting readings and the location and acceleration of the bus [1].

GSM based street lights monitoring and control system consists of a microcontroller which on setting of time switches on/off the street lights and dims at 12 mid night for reducing power consumption and when any movement is detected it brightens. This is the smart way of managing street lighting systems. There are basically two modules which include the client side and the server side. The client side consists of the GSM modem which is further connected to the microcontroller. The server side consists of the cell phone it has a core engine [2].

For energy saving on street lights we can install an automatic system which can turn on/off lighting system or the brightness of lamps increase or decrease according of traffic on the road. The system is designed in such a way that light sensors (LDR), RTC and presence sensor placed in all street light circuits will turn on/off lamps automatically. When the lights are turned on every light pole having current sensor informs about fault to the centralized system by using GSM module attached to the circuit via SMS. The information through SMS is received at base station Raspberry Pi (a compute module) analyses the data and the status of street lamps is virtualized with the help of GUI. This will make Fault detection and maintenance of the system easier than the conventional system [3].

If street lamp wires are stolen, street lamps cannot work normally. The electric leakage of street lamps can cause electric injuries. Therefore if a street lamp leaks electricity, there must be a relay for automatic power off to protect the public. The effects of street lamps monitoring includes automatic street lamp's fault cable guarding against theft (voice (short message), and data transmission) street lamp off. The regional state of street lamps off and electric leakage of street lamps, as caused by theft of power supply lines and power supply system faults, can be instantly reported to the management's unit. This study uses the G3-PLC to propose the experiment to the street lamp monitoring and management. A 3-phase G3-PLC connection architecture meaning whichever phase the street lamp terminal controller G3-PLC slave is connected to it, can be connected to the G3-PLC master. When a street lamp condition is abnormal, the street lamp terminal controller G3-PLC slave can send an alarm signal via G3-PLC which informs the concerned person by short message or mail and the abnormal condition of the street lamp can be promptly handled. In addition, the street lamp main controller can control the street lamp on/off via power line by G3-PLC master in order to save energy [4].

III. SYSTEM DESIGN

A. Street light unit

- LDR based light sensor-1 is used to detect day/night.
- LDR based light sensor-2, 3 and 4 is used to detect fault condition of each street light.
- IR proxy sensor is used to detect the presence of vehicle, based on its input Arduino controls intensity of corresponding street light. Also based on IR proxy sensor, Arduino calculates traffic intensity and communicates this information with traffic control unit.
- GSM modem is used to send SMS alert to technician about fault condition of street light. Incase if street light is not repaired by three days, then a complaint SMS will be sent to higher authority.

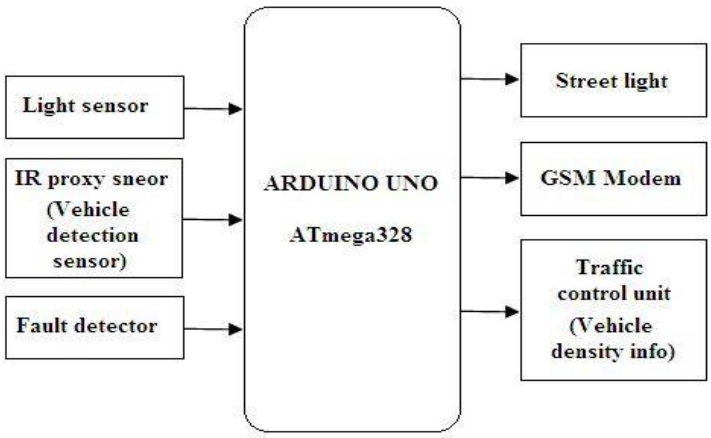

Fig 1. Street light unit

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B. Traffic signal unit

- **4X1 key pad:** This keypad is used to select traffic signal for ambulance unit.
- **4:1 encoder:** This encoder is used to convert 4 bit parallel data + 8 bit address to serial form at baud rate 2400.
- **RF transmitter:** Serial data from encoder is transmitted at 433MHz carrier frequency.
- **RF receiver:** This unit demodulates received data and transfers this serial data to decoder unit.
- **1:4 decoder:** This unit converts received serial data to 4 bit parallel data if received address and configured address matches.
- **Controller unit:** Controller unit read data from decoder and controls the traffic signal accordingly. By default traffic signal runs at predefined time interval. Time period of signal 1 and signal 2 is depends on the traffic density. Traffic density information is fetched form Arduino Uno controller.

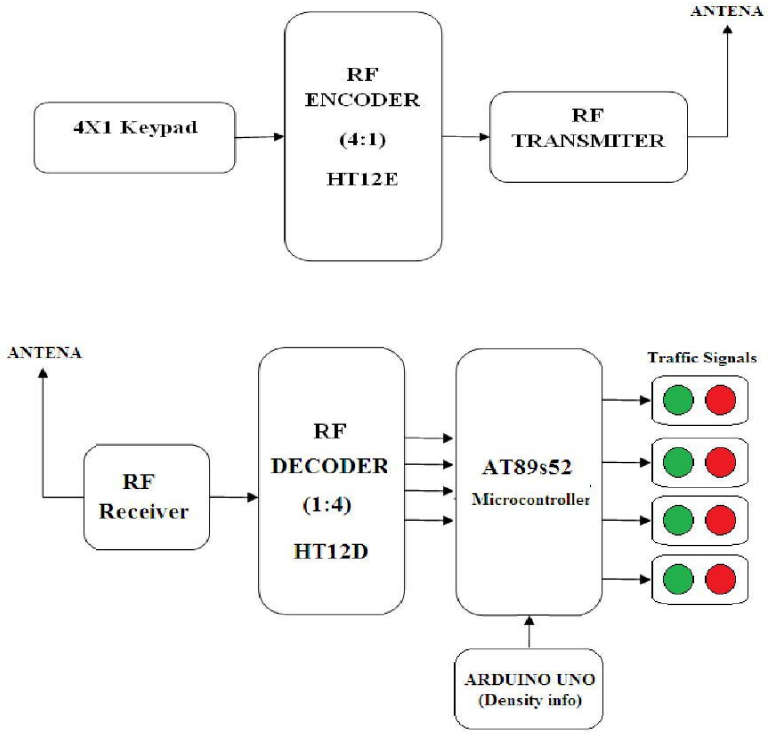

Fig 2. Traffic signal unit

IV. IMPLEMENTATION

Working description:

a) LDR

Resistance of LDR depends on light intensity. As intensity increases, LDR resistance decreases. Hence increases the output voltage. This analog output voltage is converted into digital by internal ADC of Arduino.

Then Arduino compares it with reference voltage level, hence it identifies day/night as well as fault condition of each street light.

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b) IR proxy sensor

In electronics, this sensor is used to detect an obstacle which is one of its common applications.
The transmitter part is an Infrared (IR) Led which transmits continuous IR rays to be received by an IR receiver. The output obtained from the receiver varies depending upon its reception of IR rays. This variation cannot be analyzed, therefore this output can be fed to a comparator. Here operational amplifier (op-amp) is used as comparator.
When the signal is not received by the IR receiver the potential at the inverting input goes higher than that that at non-inverting input of the comparator (LM 339). Thus the output of the comparator goes low and the LED does not glow .When the IR receiver receives signal the potential at the inverting input goes low. Thus the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1, R2 and R3 are used to ensure that minimum 10 mA current passes through the IR LED, photodiode and normal LED, respectively. Resistor VR2 is used to adjust the output. Resistor VR1 is used to set the sensitivity of the circuit. Read more about IR sensor here.

c) Street light

All LEDs are connected in common cathode configuration, which means, active high signal at input makes LED on. Each street light has 3 white LEDs connected in parallel. It has 1K current limiting resistor and 1K pull-up resistors as shown. Input of each street light is driven by PWM channel of Arduino. Duty cycle of each PWM channel decides light intensity of each street light.

d) GSM interfacing

A GSM module has an interface for serial communication with an external peripheral. In this case, the transmit pin (Tx) of the computer's Serial port is connected with the receive pin (Rx) of the GSM module's interface. The transmit pin (Tx) of the of GSM module is connected to receive pin (Rx) of microcontroller's serial transmission pin. And the serial transmit pin of the microcontroller is connected to the receive pin of the computer's Serial port.

e) RF encoder and decoder

This radio frequency (rf) transmission project employs amplitude shift keying (ask) with transmitter/receiver (Tx/Rx) pair operating at 434 mhz / 315 mhz. the transmitter module takes serial input and transmits these signals through rf. the transmitted signals are received by the receiver module placed away from the source of transmission.

One way communication is allowed between two nodes, namely, transmission and reception. the rf module has been used in conjunction with a set of four channel encoder/decoder ICs. Here ht12e & ht12d have been used as encoder and decoder respectively. Parallel inputs (from the remote switches) are converted into serial set of signals by the encoder. These signals are serially transferred through rf to the reception point. The decoder is used to decode the serial format and retrieve the original signals as outputs. These outputs can be observed on corresponding LEDs.

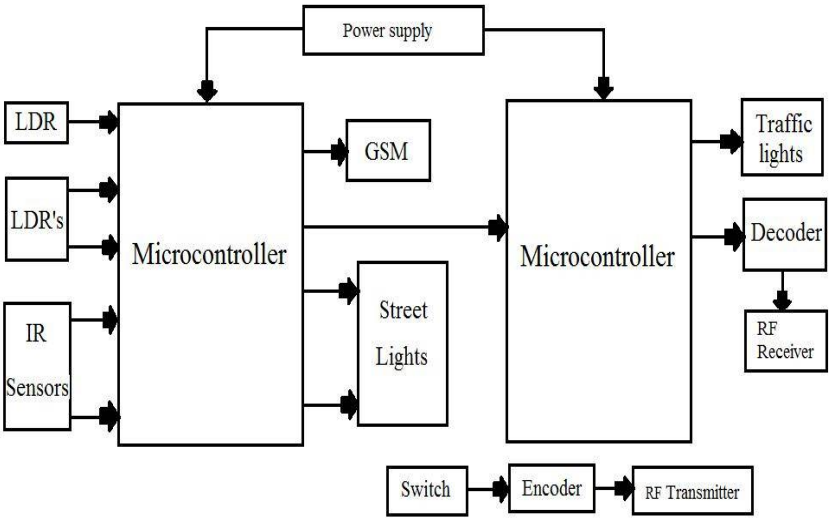

Fig 3. Block Diagram

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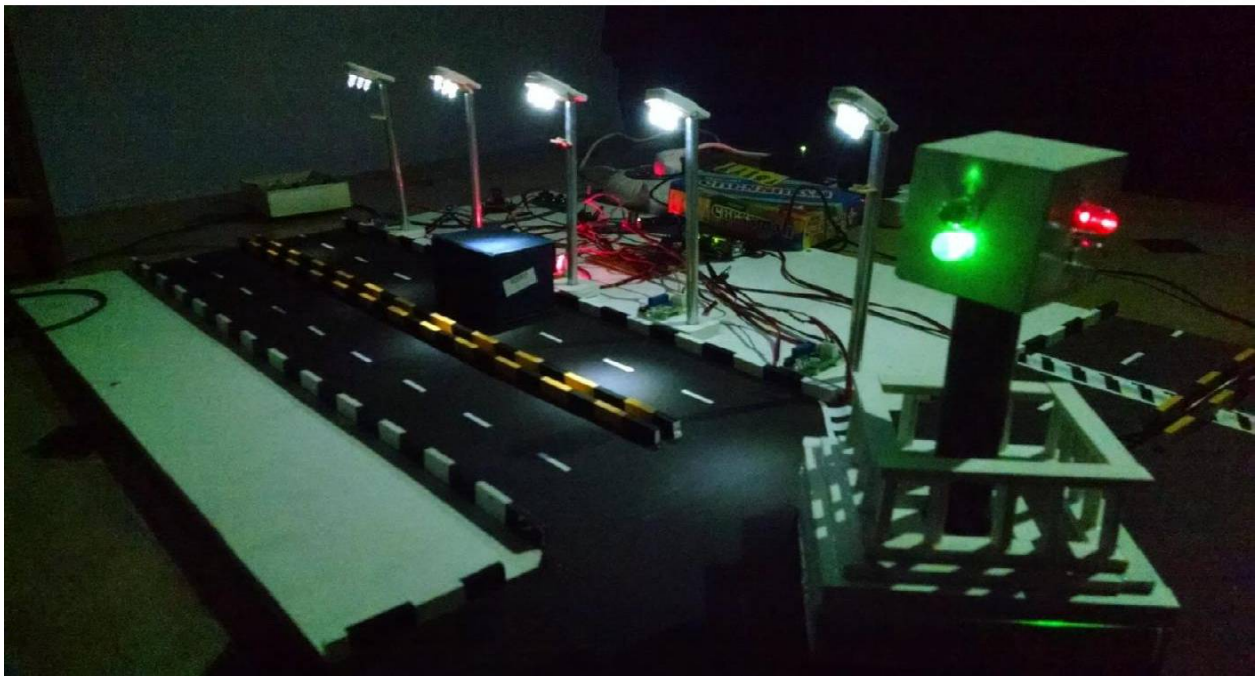
V. RESULTS

This paper highlights the maximum power saving by making the street lights to glow with minimum intensity during night time and to glow with maximum intensity only in the presence of any obstacle. It also reduces the air pollution by absorbing the polluted gases released from the vehicles. The traffic density is also minimized so that traffic problem can be resolved and can also make a way for the ambulance to pass through easily.



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VI. CONCLUSION

This technology of AUTOMATIC STREET LIGHT CONTROL AND FAULT DETECTION is a cost effective, practical, ecofriendly and the safest way to save energy. It clearly tackles the two problems that world is facing today, saving of energy and also disposal of incandescent lamps, very efficiently. According to statistical data we can save more that 40 % of electrical energy that is now consumed by the street lights on the highways and that the maintenance is also a big issue which is not carried out in an effective manner. The LEDs have long life, emit cool light and can be used for fast switching. Through the proposed project we can save energy and do effective maintenance.

Hence, such systems are very much useful for the government to reduce the utilization of conventional power. Therefore, such systems are once implemented on a large scale can bring significant reduction of the power consumption caused by street lights. This initiative will help the government to save this energy and meet the domestic and industrial needs.

For these reasons our paper presents far more advantages which can over shadow the present limitations. The technology has scope in various other applications like for providing lighting in industries, campuses and parking lots of huge shopping malls.

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