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Implementation of Smart City Highway Street Lighting with the Fault Detection and Gas Analysing using Arduino Controller

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Abstract: *The most important hierarchy in the recent world is the method for the conservation of power generation. The most of the energy consumption is done by the street lighting system. The sunlight varies from the climatic conditions and automatic switching used now a days are not efficient for power conservation. This project does the automation of street lights according to the climatic and the sunlight present in the region. This system also gives the solution to overcome the problem of the faults occurring in the street lights in the area involuntarily with the WI-FI. The gas analyzing also done to obtain the information about the pollution. The LDR sensor, IR sensor, Arduino controller does the automatic process by switching on and off the street lights.*

Keywords: *IOT, Smart City, Street Light Monitoring, LDR, IR sensor, CT, PT, WI-FI MODULE, gas analyzer*

I. INTRODUCTION

The improved designing on the street light automation is required for the power conservation and proper usage of the street lights. The street lights are the important aspect in the city and is a major part in infrastructure of the city.

They are useful for the people coming to the city in the night, night shift workers, functions etc. Manual controlling of the street lights are not efficient.

The automation based on timings are also not in a effective manner now a days. Hence this system consists of the LDR[light dependent resistor] which gets ON when there is no light rays are present and gets OFF when the light rays are present. The IR[infrared] sensors are used to produce the rays in order to find the presence of the vehicles in the road.

The output of the LDR and the IR sensors are given to the arduino controller for producing signal to ON and OFF the lights. The fault detection is done by the potential transformer and the current transformer which are controlled by the signal conditioning unit. The condition of the street lights is given to the monitoring station with the help of WI-FI.

The pollution level in the atmosphere is done by the gas analyser sensor and its output is also given by the WI-FI. Hence the secured system with the automation of street light, fault detection in lamps, pollution level can be achieved by the system. The power consumption can also be obtained by the system successfully.

II. MOTIVATION

The inefficient usage of the electrical loads like the heating system and the lighting system cause the energy consumption in the residential areas. The infrastructure of the city is mainly depends on the street lights, which illuminate the city during the night hours. The requirement of street light has been increased from earlier days to recent days.

This is due to the increased residential areas and utilization of light energy. Hence the automatic control for the power consumption by the street lights is must.

Night-time safety for community members, road users and to provide the public lighting are the strong factors to be considered for the designing of the street lights. So far the system used for designing is incandescent light, sodium vapor lamp, metal halide light, compact fluorescent lamp, induction light and LED lights.

The conservation of power and the monitoring of street lights can be done through the Sensors, GSM and IOT. The fault in the street lights can be detected by the signal conditioning unit. The IR rays can be used to detect the vehicle movement and the LDR can produce signals to the street light to produce more illumination during the presence of the vehicle. The input to the sensors is given by the arduino controller. This could save energy and avoid accident with fault detection.

III. MATERIALS REQUIRED

A. LDR sensor

The LDR [light dependent resistor] is a light sensitive device and they work on the principle of photo conductivity. The LDR turns ON in the presence of the light and turns OFF in the absence of light. They work based on the resistivity of the material. But for the requirement of the system the LDR is turned ON when there is absence of light and turned OFF when there is no light. When the light intensity is less the LDR gets ON and when the intensity is high the LDR turns OFF. The output of the LDR is given to the arduino controller.

B. IR Sensor

The infrared sensor is used for purpose of detection of the presence of the vehicles. The major use of the infrared sensor are in the wireless applications. It is the electronic instrument which is used to detect the certain characteristics by emitting or detecting the substance by the infrared radiation. They are not visible to the human eyes but the wavelength of the rays. In the electromagnetic spectrum the infrared rays are higher than the visible light rays but are shorter than the microwaves. The rays are transformed into the electric current and are detected in terms of the voltage or the ampere detector. The IR sensor may consume a power of 3 to 5 mA when using the 5V supply. They are called as the Opto coupler when combined with the IR LED and IR photodiode.

C. Arduino Controller

The arduino is the open source code microcontroller which is based on the AT mega328 microcontroller. It has 14 digital pins and 6 analog pins. It works on the operating voltage of 5V though the input voltage is 7V to 20V. The flash memory of the arduino is 32KB and SRAM is 2KB and EEPROM is 1KB. It works with the clock speed of about 16MHZ. It has one inbuilt LED in it in pin 13.

D. Relay

The relay is basically used for the ON and OFF process. The relay consists of the normally open and normally closed coils. When the normally open coil in the relay gets magnetized by the electrical signal it becomes normally closed and it gives signal to the lamp to get turned ON. The electromechanical relays are electromagnetic device that converts the magnetic flux produced by the electrical control signal that is either AC or DC crossing the terminals of the relay circuit.

E. Signal Conditioning Unit

In this system the signal conditioning system consists of the potential transformer and the current transformer in it, to provide the required data about the current and voltage that are given to the lamp. If the current to the lamp is zero then it is said to be in the fault. The current transformer gives the current flowing to the lamp and the potential transformer gives the voltage in the lamp. If the current and the voltage is zero then it gives signal to the arduino. The signal conditioning does the process of range matching with the predefined value of current and voltage to the lamp.

F. GAS Analyser

The gas analyser is used in the system to get the information about the atmospheric pollution and to give information to the arduino and to WI-FI module. The carbon dioxide, carbon monoxide, sulphur dioxide, oxygen, nitrogen oxide are present in the atmosphere in very large amount. This may cause the pollution in the air which people breathe. This gas analyzer detects the amount of gases that cause pollution and provides the information to the control centre.

G. Wi-Fi Module

The Wi-Fi module is the automatic information sender from the devices to the control station. It gets the output of the arduino controller about the status of the system and its parts like lamp condition, faults present in lamp, atmospheric gas ratio and the pollution level. The message of the Wi-Fi module is displayed in the webpage that has been created. Hence information about the system can be achieved immediately.

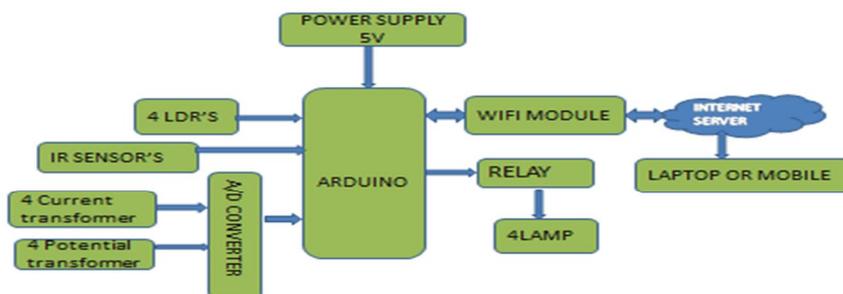


Fig.1: Block diagram of system

IV. CIRCUIT OPERATION

The light dependent resistor [LDR] detects the presence and absence of light with the intensity of sun light. The LDR gets turned ON when there is no light and the street light will be in dim. The IR sensor senses the presence of the vehicle in the region by emitting the infrared rays to the particular distance. If the vehicle cut the ray it generates the signal to the arduino and the arduino provides signal to relay and relay turns on the street light to glow brightly. The relay coil gets magnetised and get attracted from the normally open to normally closed condition and turns ON the light. The power supply is given to the system by the transformer and is regulated to the required level. The signal conditioning unit consisting of the current and potential transformer does the range detection and provides the information about the current and voltage flowing to the lamp. The predefined level of voltage is set in the signal conditioning unit. If the current or voltage flowing through the lamp is zero then the signal is given to arduino and arduino provides the result through the WI-FI module to the webpage. The gas analyser connected to the arduino gives information about the atmospheric air mixture and it is also displayed through the webpage immediately to the monitoring station.

V. RESULT

Thus the automation of street light is achieved by the light dependent resistor and the brightness of the street light is increased during the presence of vehicle or the object by the disturbance in the infrared rays produced. The fault is detected immediately by the signal conditioning with the transformer in it. The gas amount in atmosphere is also taken and is given to the system. The arduino provides information to the wifi module for result and the switching ON and OFF of the street lights.

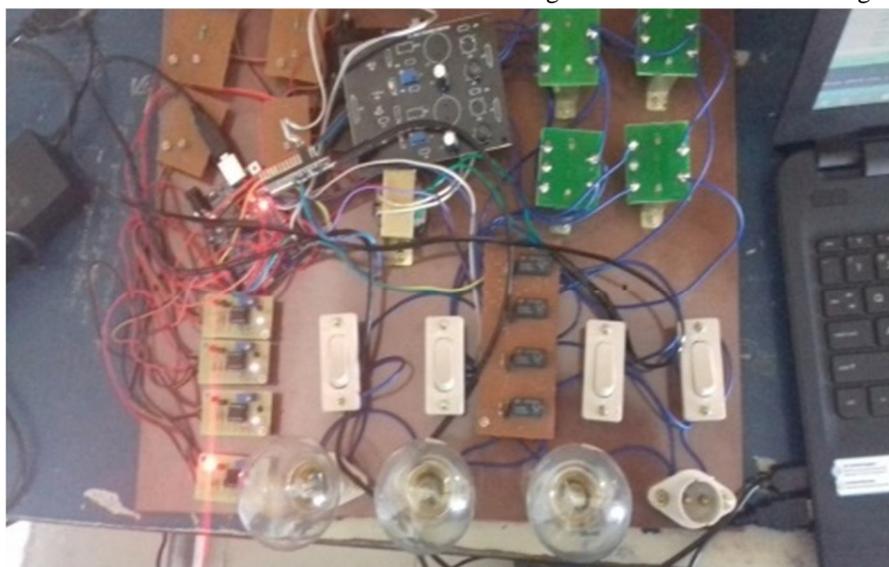
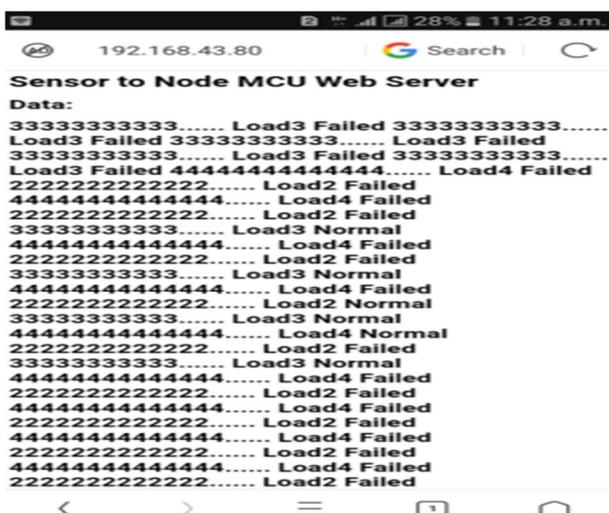


Fig.2: Hardware Module



Fig.3: Hardware Output

A. Webpage Result



VI. CONCLUSION

Hence the power consumption is achieved by the proposed system with efficient automation of the street lights and the fault detection. Hence the fault can be replaced immediately and effectively. The proposed system also provides the information about the gas mixture in the atmosphere. The highway street lights condition can be improved and the rural and urban people can be benefited. The system is economical and low power is only required for the process.

VII. FUTURE SCOPE

India has approximately 4 million street lights, which consumes one of the major part of electric power out of total electricity generated. There are different lights and tubes used in street poles in different areas of our country. Other lamp are replaced by LED lamps in order to save energy. From this huge amount of money can be saved which can be used to urban development of our nation by the government.

In future scope, the electricity can be replaced by our natural gift solar energy which are mounted in the top of street light pole. It will be used in various applications .If we use solar energy, it is more economical and pollution free energy generation .In future research noise sensing can also be extended. The street light poles are useful for charging the E-vehicles by solar energy.

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