AUTOMATIC STREET LIGHT OPERATING SYSTEM

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Abstract - *Per capita electricity consumption of a county is an indication of development of the county among others. In developing countries like India, generation growth of electricity is not meeting the consumption growth of electricity. The demand of electricity is more than the generation every time. By efficient utilization of electricity, balance between the generation and demand can be achieved.*

Automating the street light system for efficient switching of street lights helps in reducing the electricity consumption drastically. In this paper, it is shown here that how Automation can be achieved using Arduino microcontroller. And its operation according to the seasonal changes is possible with flexible adjustments of system from PC using a specially designed computer software application in Java.

Key Words: *Street Lights, Electricity, efficient utilization, Arduino microcontroller, Java application.*

1. INTRODUCTION

India is a country where a major chunk of population is still not connected to the power grid. In order to supply power to them, India will need to create either newer sources of power or reduce the power demand by implementing energy efficient devices at all levels. Creating a new power supply is a very big task and also involves too much of economical investment. So, efficient utilization of electricity is preferred. Global trends in street lighting show that 18-38% of the total energy bill goes towards street lighting and therefore this is one domain that needs major attention if we look at improving efficiency of power consumption with an objective of saving energy [1].

After mid night there is less requirement of light in the streets as there is no passage of people. We can automate the Street light system to switch off the street lights during day time and switch off alternative street lights at mid night. We can save more than 25% of normal consumption using this system.

2. EXISTING SYSTEM

The present normal system of street lights is manually operated where there is more wastage of power

due to lack of punctuality in switching timings. Also, manual operation requires more man power. Working of street lights even day time is commonly seen in outsides. But operation of large number of street lights for longer times imposes more burden on the generation and distribution system. This improper operation leads not only energy wastage, but causes reduction in the lamp life and increase in maintenance cost too.

3. PROPOSED SYSTEM

The efficient switching of street lights can be achieved by automation rather than switching manually. There are two main factors of automation. They are reliability and flexibility of operation. And an automated should be designed at greater flexibility of operation, most reliable and easy interfacing capabilities.

In this proposed system, automating the street lights is done with Arduino microcontroller [3].Arduino is a fast and powerful programmable microcontroller which has greater control capabilities and used in wide range of applications. It can be easily interfaced with Personal Computers (PCs).Operating parameters for the operation of microcontroller like operating mode, street light ON period time, threshold level of sensors and communicating ports are adjusted from specially designed graphical user interface application in PC.

To meet greater reliability, a secondary control unit is designed with timer circuit. The secondary unit is set such that whenever the microcontroller fails to operate or malfunctioning, it controls the system with predefined less flexible operation of street lights and gives an indication for failure of microcontroller to the control room.

4. WORKING

The operation of the street lights starts from control room where the operator decides the system requirement like ON period of lights, threshold levels of sensor. The working of the module can be understand from the block diagram shown below Fig. (1).

All the street lights are divided into two alternative groups. One group consists of odd numbered (1st, 3rd, 5th.....) street lights and other group consists of even numbered (2nd, 4th, 6th.....) street lights.
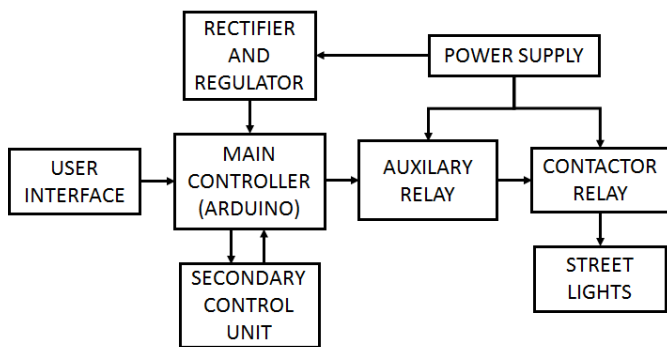
Fig -1: Block diagram of working module

The two groups of lights are fed from two separate phase lines and a common neutral line. Alternative lights can be ON by powering either of the phases. If supply is given to both of the phase wires, all lights will be switched ON.
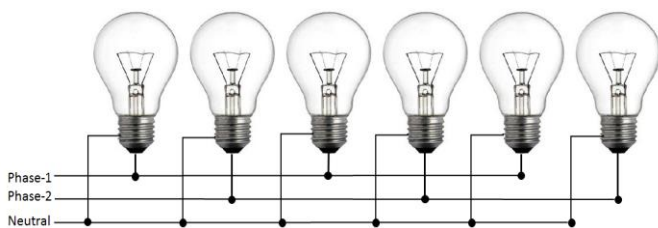

Fig -2: Connection of street lights

The high power street lights can't be connected to Arduino microcontroller directly as the power handling capacity of Arduino is very low compared to street light (about 5V and 40mA/pin)[2]. The Arduino output pins are connected to an auxiliary contactor which feeds operating coil of field contactor. Loads (Street Lights) are connected to field contactors via phase-1 and phase-2.

The operator is given by a Graphical User Interface (GUI) in the PC. There are FOUR modes of operations available in the given control panel. They are

a) All OFF
- All lights will be OFF
b) All ON
- All lights will be ON
c) MANUAL
   I. Phase-1 ON: Only Phase-1 Lights will be ON
   II. Phase-2 ON: Only Phase-2 Lights will be ON
d) AUTO
- System goes into auto mode

When user hits the apply button in the control panel, parameters in the control panel are sent to Arduino trough USB serial chord. The Arduino is programmed to receive the data and stores it in the EEPROM. Up to the user changes the mode of operation and hits the apply button, this data is read by Arduino and executed continuously.
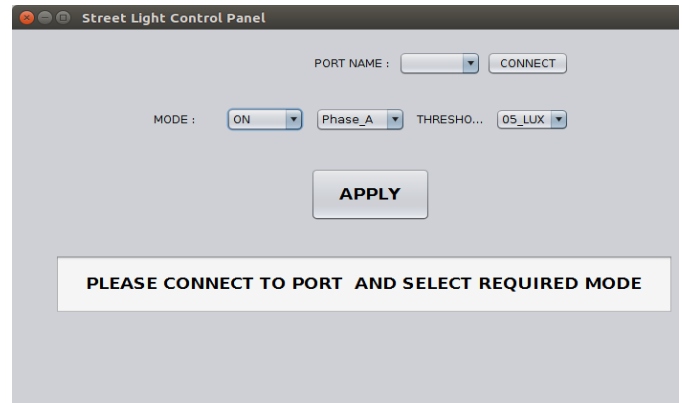

Fig -3: Control Panel in PC

5. AUTO MODE

The most useful mode in the system is AUTO mode. In this mode of operation, system works on LDR (Light Dependant Resistance) sensors and timers in the Arduino. LDR is a light-controlled variable resistor. The resistance of a LDR decreases with increasing incident light intensity; in other words, it exhibits photoconductivity.

The voltage across LDR in a voltage divider circuit as shown in figure (4) is continuously monitored by analog input pin of Arduino. The analog voltage is converted to light illumination and compared with the user selected threshold lux level of operation in PC. If it is found lower than the threshold level lights are switched ON.
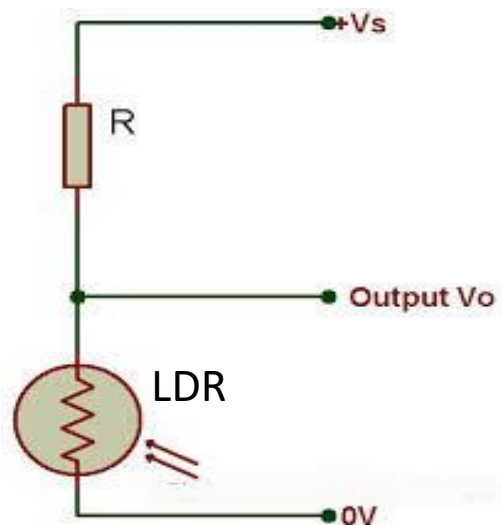

Fig -4: Control Panel in PC

But accumulation of any dust or objects on the LDR sensor will raise the voltage across it and results to malfunctioning of the system. To overcome this difficulty, wiper is used along with the LDR. Whenever the voltage across LDR increases due to low light, the wiper is set to wipe the LDR. The voltage is read by the Arduino second time and compared with threshold value.

If still the light is found low, it is assumed as evening, the two phases are powered to power all lights and timer is started. When the timer reaches the user defined time in the PC, one phase is de-energized which results in alternative street lights to ON. In the early morning, when sunlight falls on the LDR, the voltage across LDR is changed. This changed voltage is identified by the Arduino and all lights all set to OFF by de-energizing both phases.

The reliability of the system can be improved by providing substitute timer circuit which is secondary control unit for this system. The secondary control unit consists of 555-timer circuit which does the operation of Arduino when Arduino is failed to operate. The circuit diagram of secondary control unit is shown in the figure (5). When Arduino inactive state is recognized by secondary control unit, the user has no control over the system and operation of system is according to the predefined timings in secondary control system by design. This leads the system operation more reliable and continuous.
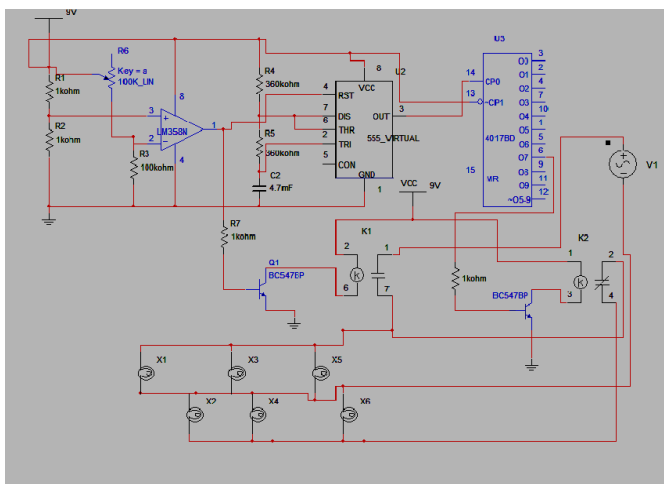

Fig -5: Circuit diagram of secondary control unit

Secondary control unit consists of a Wheatstone bridge with LDR, 555-timer and IC 4017 counter. Outdoor light is sensed by LDR and error voltage is created across the bridge. The sign of the error voltage is amplified with IC 174 comparator to enable or disable 555-timer and relays in the system. When light is low, comparator enables the 555-timer along with relays and powers all the lights. The pulses generated by 555-timer are counted with help of counter. When the counter reaches the state

corresponding to 6 hours from the starting, alternative lights are set to ON by de-energizing one phase.

5. RESULT

The implementation of hardware prototype is shown in figure(6). The corresponding results attained for the prototype is tabulated in the given table 1.

Table -1: Response of lights for corresponding modes of operation

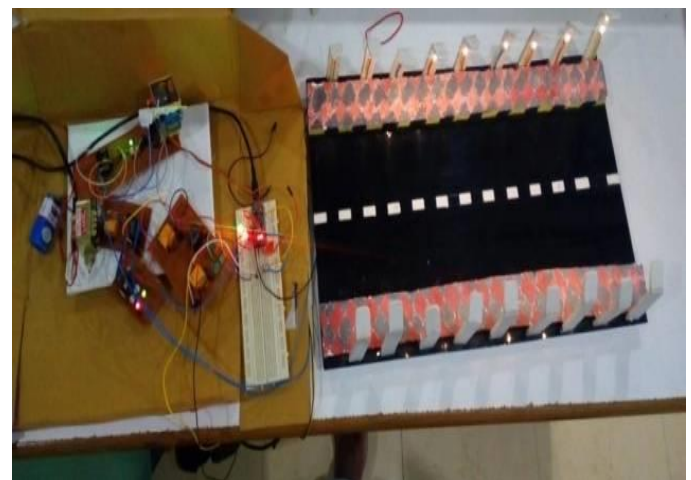| SNO	MODES	RESPONSE
1	ON	Phase A & B are ON
2	OFF	Both phases are OFF
3	AUTO	Works according to user interface
4	MANUAL	Selected phase(A or B) in the control panel is set to ON

Fig -5: Hardware prototype

3. CONCLUSIONS

This type of novel design gives efficient utilization of electricity, hence energy will be saved. Well-designed GUI helps in user-friendly operation. This unique design which operates automatically with well protected sensors leads reliable operation. Finally this project is simply one time investment and reliable which can easily reimbursed in a few months.

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