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Improved Automatic Street Light Control System

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Abstract-The network of roads is ever increasing with the development of country and so the demand for more street lights. Street lightning consumes considerable amount of power as it is operational almost half of a day. Presently the control of street light system is manual and therefore laborious and error prone. Using automation to control street lights would result in reduced energy consumption which can otherwise be put to good use. It would also reduce work load of the utility personnel responsible for control work. This is not a new proposal and previous work has been done using LDR/IR sensor technology. However such work was not found to be completely foolproof and therefore we have redesigned the concept based on modulated IR in order to make the sensing system more immune to ambient Light/IR noise. In present work we have tried to design an automatic street light control system based on modulated IR sensors to detect moving people/vehicle on the road. The scheme is to switch on lights only in the required regions of road. The details of methodology used, hardware design, software design, practical tests and results are presented.

Keywords: Street Light, AVR, IR sensor, Energy saving, Automation, Control system, GSM etc…

I. INTRODUCTION

There has always been a need of outlining a proper framework for the street lights. A good framework must ensure that sufficient light is provided during required times of day and must consume as little power as possible. The concept of smart street lights is evolving in recent days.

Smart lighting system involves providing light only when required through some means of intelligent decision making. This greatly helps in cutting down power consumption. Since power is produced in limited quantities, the saved amount can be used for other purposes.

At present manual switching of street lights is used. The lights are switched ON and OFF at specific times of the day. This is definitely laborious considering the vast networks of roads in a town/city. Finite amount of energy is always wasted in operating the system and there is extra work load on utility supply system.

To resolve the problems mentioned above in the conventional lighting system we need a lighting system that is well equipped with recent inventions and technology. As it is well known to everyone that the natural sources to generate power are limited and we are wasting so much of energy meaninglessly.

So if we can use automation in this particular case so that all the street lights can be switch on and off automatically when it is really necessary that would be of great help. And we can use controller circuits to implement a model so that all the street lights can only glow with its maximum intensity when there is activity in its region otherwise it should glow at a minimum given intensity. This way we can save a huge amount of power.

Semi automation or complete automation would be a good solution towards reducing work load and power consumption. Presence aware street lighting system is such an idea. Here lights are switched ON only when required through some object detection system. It remains on until required and automatically switched off when moving entity passes away from it. Also the lights are automatically switched depending on time of day. Many design ideas have been proposed to realize this concept most of them based on LED-LDR or IR LED-Photodiode sensing arrangement. The main problem with this sensing system is that it is not foolproof and is easily affected by ambient light conditions. Thus one can expect false trigger when operational.

In present work we have re-designed the idea by making use of modulated IR sensing system. This makes the sensing system more immune to ambient light. Thus false triggers are considerably reduced. Again the cost of system is quite low and is therefore a candidate for practical consideration. As usual the sensor signal processing, decision making and relay control is done by microcontroller system. For the

purpose of demo a section of road is considered. Microcontroller system is used to process the signals from all sensors. Decision regarding switching of lights is made based on collected data. And lights are actually switched with the help of electronically controlled relays.

II. RELATED WORK

Automatic street light control system is a evolving field and there is quiet a work done in his area. There is one work by Hengyu Wu et al where street lights control system based on AT89S52 as control core is presented. It is a combined product of the following technologies: a digital clock, a timer, a Liquid Crystal Display (LCD), a statistics of traffic 80wing magnitude, a photosensitive induction, an infrared control and alarm function. This street light system also includes a time cut-out function, and an automatic control pattern for even more electricity conserving, namely when vehicles pass by, the light will turn on automatically, later turn oft: Furthermore, this system has auto-alarm function which will set off if any light is damaged and will show the serial number of the damaged light, thus it is easy to find and repair the damaged light. [1] There is another work by Radhi Priyasree et al where system is designed to have safer roadways with intelligent light system to reduce power consumption. This system has automatic street light intensity control based on the vehicular movement and switching ON and OFF of street lights depending on the light ambiance. This will help in reducing the power consumption during hours of meager road usage. The street light module is installed consequently for every certain distance. This paper also aims at reducing road accidents by detecting consumption of alcohol by the driver. This can be implemented using alcohol sensor module which contains skin sensor, breath alcohol sensor and proximity sensor. The skin sensor and breadth alcohol sensor detects the presence of alcohol content and the proximity sensor helps in detecting any kind of malpractice. The novelty of this paper is to effectively reduce the energy consumption of the street lights by controlling the street light's intensity, sensing both human as well as vehicular movement and injury and death caused by drunk driving can be prevented by prior sensing of the alcohol content in drivers by a simple and economical way. [2] Then there is work done by Kapse Sagar Sudhakar et al where the author has designed Automatic Street Light Control System to prove its power saving abilities. Relay based switching is used here. The system is claimed to be 100% automatic. At the dawn of day the system automatically switches ON lights. Light Dependant Resistor (LDR)is a used for sensing day light presence. The author claims that such type of system is also useful for reducing energy consumption. [3] There is similar work by Sakshee Srivastava where system is developed to automatically control and manage street lights. Here the author aims about how to control the power consumptions at the streets and eliminate manpower. This includes controlling a circuit of street lights with specific Sensors, LDR and Microcontrollers during day and night. [4]

III. PROPOSED SYSTEM

Figure 1 shows the proposed block diagram of control system. Figure 2 shows the actual physical arrangement. Modulated IR based Tx – Rx arrangement is mounted on opposite sides of road to detect people/vehicles. IR sensor output is monitored by Atmega16 processor. If processor detects vehicle presence then it triggers relay corresponding to that pole, the pole after it and also deactivates the one before it. Thus as the vehicle moves past the road lights in front of vehicle are switched on and those on back are switch off. This arrangement provides for efficient utilization electrical power. The saved electrical power can be used elsewhere. The use of modulated IR makes the system immune to ambient IR noise and hence foolproof. This way improvement in previous designs is achieved.

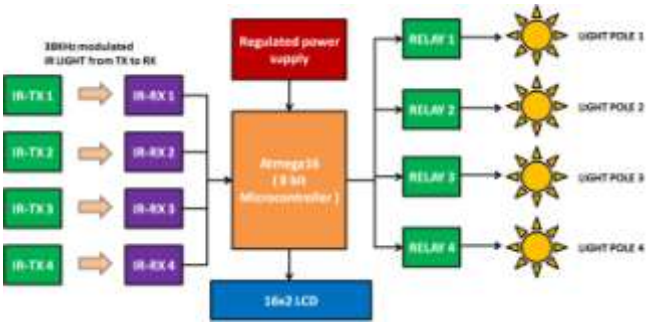

Fig -1: Proposed control system

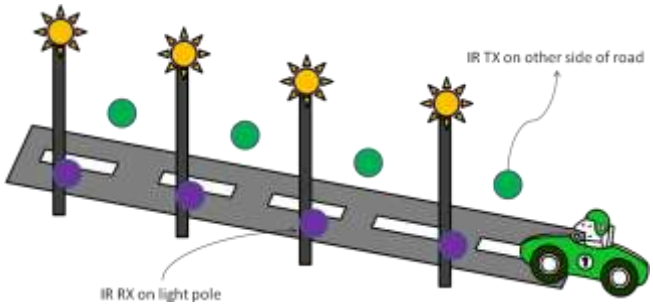

Fig -2: Physical arrangement of system

IV. HARDWARE DESIGN

For the sake of simplicity, hardware design is divided into different sections as follows.

- AVR Atmega16 processor board
- 38KHz modulated IR sensor and its interface with AVR Atmega16
- Power control relay and its interfacing with AVR Atmega16
- LDR circuit and its interfacing with AVR Atmega16

4.1 AVR Atmega16 board

Here a general purpose board using Atmega16 MCU is developed. Atmega16 is a 40 pin RISC based MCU. It is run at 16MHz and powered by +5V regulated power on board.

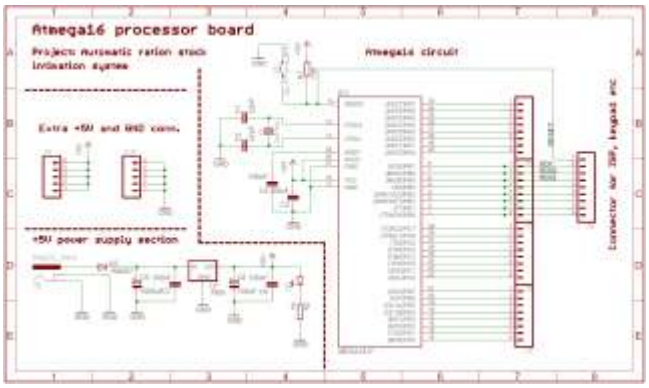

Fig -3: Atmega16 processor board

4.2 38KHz modulated IR with Atmega16

Modulated IR sensor using IR LED, NE555 and TSOP1738 was designed and TX-RX arrangement made using the same. The sensor has 2 interface pins. One for trigger and other for digital output.

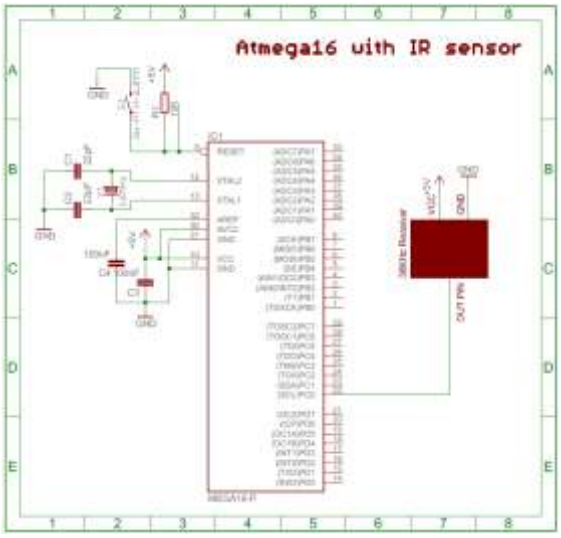

Fig -4: Modulated IR with Atmega16

4.3 Power control relay with Atmega16

For controlling power to the street light bulbs electromechanical relay is used. The relay itself is controlled with Atmega16 processor. Here optically isolated relay drive mechanism base on PC817 is used.

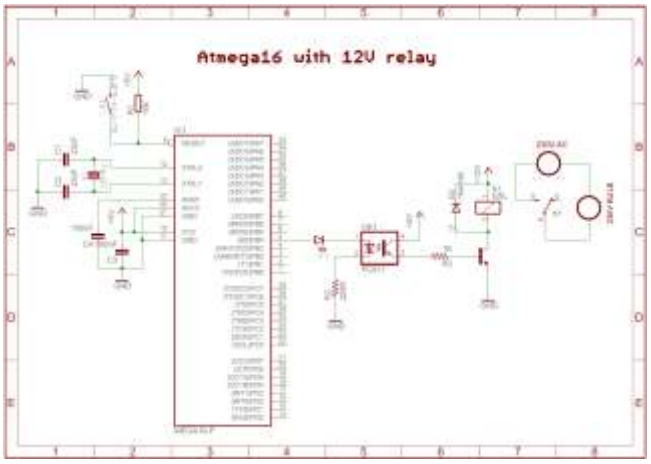

Fig -5: Power control relay with Atmega16

4.4 LDR circuit

For detecting day/Night time and for sensing health of bulbs LDR's are used. LDR are read using ADC unit of Atmega16. Amega16 has onChip ADC unit with a reference voltage of 5V.

4.5 Power supply

A 12V @ 2A and 5V @ 2A SMPS power supply is used to power the entire system. Out of this the 12V supply power the processor board and relay boards. While the 5V supply powers the IR sensors and LDR sensor circuits.

V. SOFTWARE DESIGN

Software part involves writing embedded C code for Atmega16 processor. Following points were considered while writing the code.

- System start
- Check day/night time by reading respective LDR.
- Indicate control system start.
- Check health of street light bulbs by switching them one by one and reading corresponding LDR output using ADC unit of Atmega16.
- Indicate system ready.
- Check each IR sensor in turn to see if object present in vicinity.
- Switch corresponding light if object detected.

- Keep doing this until day time. Day time sensed using Day/Night LDR

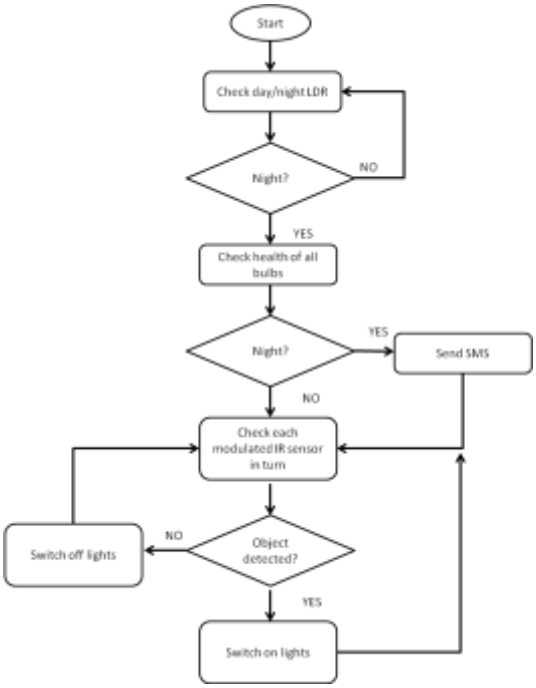

Fig -6: Flowchart for Atmega16 code

VI. RESULT

Figure shows the actual demo setup of system. The system was thoroughly tested in lab for multiple times and was found to be working as desired. All street lights went on and off when model car was detected in the vicinity of light pole. This was as desired. Particularly it was observed that the modulated IR sensing mechanism makes the system completely immune to ambient IR noise. Thus a advantage is achieved over previous designs. Again the day/time detection and health detection of light bulbs using LDR also works as desired.

Fig -7: Complete setup

Fig -8: IR sensor mechanism

VII. CONCLUSIONS

The system runs as per the initial design plan and is therefore found a viable option for actual practical implementation. The modulated IR sensing mechanism makes the system completely immune to ambient IR noise. Thus advantage is achieved over previous designs. Again the mechanism for checking the health of bulbs and indication using SMS makes it very convenient for the utility personnel to do the repair work. However for actual implementation certain refinements would be necessary. Single board development would reduce the size of implementation and save space and price. Use of SMD components would further benefit the same way.

ACKNOWLEDGMENT

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