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Design and Development of Intelligent Wireless Street Light Control and Monitoring System Along With GUI

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ABSTRACT

Now-a-days, it became essential for people work during nights and returning back to homes late nights; also increasing crime rate during night times. This can be best achieved by implementing proper solar based lighting system on Streets. The efficient monitoring and controlling of this lighting system must be taken into account. We will get more power consumption, saving money through solar panel. Also saving precious time, decrease the huge human power through from the LDR, IR Sensors. The Street lights are controlled through a specially designed Graphical User Interface (GUI) in the PC. The Zigbee technology can be used for the street lights monitoring and controlling at the PC end.

Keywords **-** *Solar, control system, lighting system, ZigBee, IR and LDR sensors.*

I. INTRODUCTION

Lighting systems, particularly within the public sector, are still designed per the previous standards of reliability and that they don't usually profit of latest technological developments. Recently, however, the increasing pressure associated with the raw material prices and also the increasing social sensitivity to CO2 emissions are leading to develop new techniques and technologies which permit significant cost savings and larger respect for the environment. In the literature we will notice three solutions to those issues. The first one, and maybe the most intuitive, is the use of recent technologies for the sources of light. The LED technology is thought as best solution but it offers several edges. I have already thought of this risk, coming up with advanced street lighting system based mostly on LEDs. Researchers [1-4] have already thought of this risk, coming up with advanced street lighting system based mostly On LEDs.

The second resolution, and perhaps the most revolutionary, is to use of remote management system based mostly on intelligent lampposts that send info to a central management system, simplifying the management and maintenance. Researchers [5],[8] have developed street lamp system. Finally, the third solution is to use of renewable energy Sources instead of typical power sources, therefore taking care of the environment. In this field, solar energy is the most often Used resource. Our work aims at unification of the three prospects, making an intelligent lamppost managed by a controlled system that uses LED based lightweight supply and is powered by Renewable energy (solar panel and battery). The Control Unit is to tackle the afore mentioned problems, an effective way is to implemented through a network of sensors to gather the relevant info associated with the Control Unit and maintenance of the system, transferring the data in wireless mode using the ZigBee protocol.

The ZigBee remote sensing and management systems are widely described in the literature; we can cite here as examples the applications for the lighting systems. The ZigBee remote sensing and management systems are widely described in the literature; we can cite here as examples the applications for the lighting systems [7-12].

II. GENERAL CONCEPT OF THE SYTEM

In this project we are using Solar panel for generating power and it will be stored into the rechargeable battery from that we are giving power supply to the street lights using relays.

In my project there are two modes of operations: AUTO & MANUAL Operations.

AUTO: In this automatic mode operation we are using LDR Sensor (Light Dependent Resistor) for measuring light intensity for switched ON or OFF the street light using relays. The main principle of LDR is when the light intensity is low; light is going to be ON otherwise it's going to be OFF. For the efficient reduction of power wastage IR (Infrared) Sensor is integrated. If any vehicle or obstacle is detected using IR sensor at that time it will check the light intensity level using LDR sensor then light will go ON or OFF.

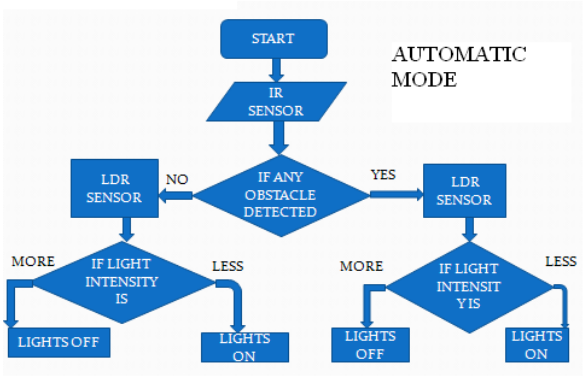

***Figure 1**.Flow Chart for Automatic mode operation*

MANUAL: In this manual mode, the street lights are controlled through a specially designed Graphical User Interface (GUI) in the PC. The Zigbee technology can be used for the street lights monitoring and controlling at the PC end.

The system consists of a group of measuring stations in the street. (One station located in each lamppost) and a base station located nearby. The system is designed as a modular system, easily extendable. The LDR Sensors are used to observe street conditions as the light intensity of daylight and, depending on the conditions they activate or off the lamps. Other factors influencing the activation are: climatic conditions, seasons, geographical location, and many possible alternative factors. For these reasons every lamp is designed independent to decide about the activation of light.

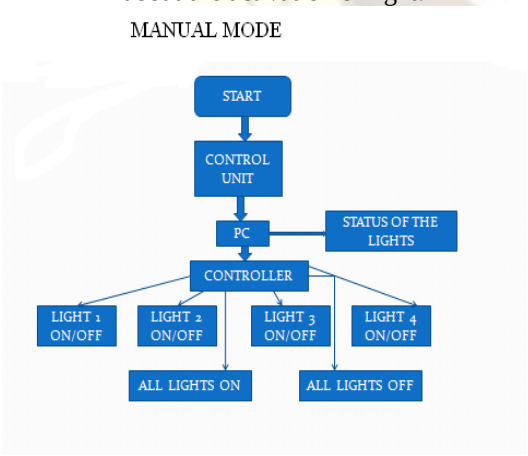

***Figure 2**.Flow Chart for manual mode operation*

A.LDR SENSOR

A photo resistor or light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity; in other words, it exhibits photoconductivity.

Photo resistors come in many types, it can be found in many consumer items such as camera light meters, street lights, clock radios, alarm devices, outdoor clocks, solar street lamps and solar road studs, etc.It is made by two cadmium sulphide (cds) photoconductive cells with spectral responses Similar to that of the human eye. The cell resistance falls with increasing light intensity. Applications include smoke detection, automatic lighting control, and Batch counting and burglar alarm systems. Temperature range for Storage is - 40°C to+85°C, Operating range is -60°C to +75°C, Power supply is 18 to30VDC, For all sensors in the LDR series Adjustable excitation is 4kHz to 33kHz Measuring range from 10mm to 50mm.

B.IR SENSOR

Infrared Sensor is an electronic device, That detects the infrared radiations to sense the aspects of its surroundings, It detects motions that measures the IR light from objects in the field of view, It's invisible to human eye because body temperature radiates to infrared wavelength, It's made by pyroelectric materials (which generates exposed to heat), IR light is longer than visible light wave length but smaller than microwaves. Distance measuring Range is 5- 300cm (Needed), Temperature is -10 to 60 Celsius, Power Supply is 5to5.5 V, power Consumption current is 33mA.

The IR sensor receiver is a three terminal device used to decrease the size of circuit, which consists of three terminals, VCC, ground and output signal. When any obstacle detected, the sensor receives the signal and sends it to controller. The controller senses the particular light on or off.

C.CONTROL UNIT

The Control unit controls all the lighting system through a graphical user interface (GUI) application window we can control all the lights and we can monitor and status of the lights. The sensors transfer the collected information to a PC.

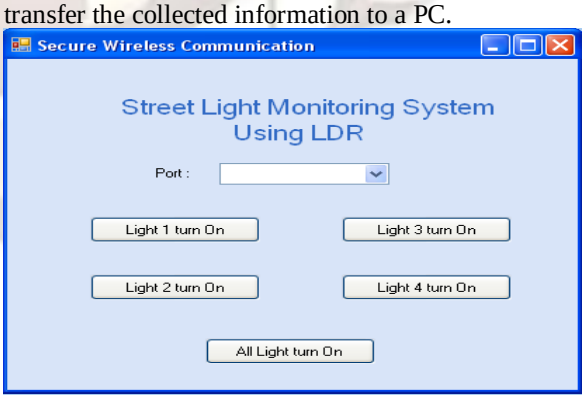

***Figure 3.**Street lights Control and Monitoring using GUI application.*

The Control unit can be extended so that other electrical Systems, not solely lampposts are connected, and might send data regarding power consumptions to a central system.

D.WIRELESS ZIGBEE NETWORK

ZigBee is wireless communication technology primarily based on IEEE 802.15.4 norm for communication among multiple devices in a WPAN (Wireless Personal space Network).ZigBee is intended to be less complicated than other WPANs (such as Bluetooth) in terms of price and consumption of energy. The ZigBee Personal space Network consists of a minimum of one Coordinator, one (or more) Devices and, if necessary, of one (or more) Router. The bit rate of transmission depends on the frequency band.

ZigBee transmission vary, depending on the atmospheric conditions and therefore the transmission power, ranges from tens to hundred meters since the transmission power is deliberately kept as low as necessary (in the order of few mW) to keep up very low energy consumption. In proposed system, the network is made to transfer data from the lampposts to the central station. Data is transferred purpose by purpose, from one lamppost to another one where every lamppost has a distinctive address within the system. The chosen transmission distance between the lampposts assures that in case of failure of one lamp within the chain, the signal will reach other operational lamppost while not breaking the chain.

ZigBee wireless communication network has been implemented with the utilization of radio frequency modules. They operate within the ISM band at the frequency of 2.4 GHz. The receiver sensitivity is high and therefore the chance of receiving bad packets is low (about 1%). The modules ought to be provided by 3V DC supply, and then the power consumption is within the order of 50 mA. The module supports sleep mode where consumption is smaller than 10μA.

III. REALIZATION OF THE SYSTEM

The operational test system operating in real conditions is shown in Fig. 4. The proposed system can be used for upgrade of existing typical lampposts, as well. Power is provided by a battery, recharged from a solar panel throughout the daytime. The capacity of the battery depends on explicit parameters of the application. In the designing part of a photovoltaic system the irradiation curves of the positioning has been studied to work out the inclination and orientation of the surface of solar panels that permit the optimal operation. For the sizing of the panel it's necessary to calculate the annual energy needed to power the lighting. The charge controller manages the processes of the battery charge and power provide. Current generated by photovoltaic panels is handled by the controller to produce an output current for battery charge. The charging method should be conducted consistent with the battery knowledge (capacity, voltage, chemistry, etc.)

Figure 4. View of the test system.

IV. POWER MANAGEMENT AND CONSUMPTION

The system was designed to operate stand-alone, supplied by the energy from a solar panel. The benefits from this type of power are important thus avoiding the tedious and expensive wiring and connection to external power network, enabling considerable savings and ease of implementation. The system is intended to be low-power, minimizing the battery capacity and also the energy acquired from the solar panel. These goals were achieved through the utilization of the ZigBee module for transmitting and receiving data, using LED lamps as replacement of normal lamps and using special power-saving solutions for microcontrollers and radio modules.

The program that controls the system is designed primarily to avoid wasting energy. Firstly, as a result that the system works solely in the darkness, avoiding waste of energy throughout sunlight hours when the sole active device is the solar panel that recharges battery. Secondly, the sensors enable the system to operate solely when necessary. Thirdly, the
System employs highly economical LEDs to ensure correct illumination and assure energy savings. Finally, when the system is disabled, all devices (wireless module and microcontrollers) are in the sleep mode, that permits negligible power consumption. The wake-up is triggered by the change of conditions (emergency device, presence sensor, etc.). The selection of the battery depends on the conditions where the system is installed.

V. ESTIMATION OF PRICES AND SAVINGS

This proposed system may be criticized as being expensive however we must consider its advantages: slightly higher Prices of the lampposts are compensated by lack of costly Wiring and the availability of power network and considerably lower prices of maintenance. Energy savings are of utmost

importance today. The goal is, therefore, the reduction of operating prices of street lighting with the creation of a system characterized by straightforward installation and low power consumption, powered by a renewable supply of energy through solar panels with no harmful atmosphere emissions and minimizing light pollution. Making a short comparison with the normal street lighting systems: Supposing that one lamp is switched on for 4,000 hours per year. One streetlight has a median consumption of 200 W and the price of energy is of 200€ yearly. If suppose a 5 km long street, it is necessary to install 125 street lights (one each forty meters), with yearly energy consumption of 25.000€. With the system presented in this paper, every lamp uses about 20-25 W (95% of energy consumed by the LEDs).With an equivalent example as before, energy cost decrease to 5.000€ (savings of 80%).Based on the field tests another possibility of energy Savings becomes evident. Classical system consumes energy independently if it is needed or not. It is active for about 10 hours daily and the total number of working hours is about 300 per month, versus 87-108 hours proposed system, savings of about 66% to 71% are expected.

Finally, since the system is powered by solar panels (with batteries), the energy price does not depend on provider costs. Consequently, the sole price to consider is that of the installation and implementation of the system; with following Savings thanks to lower maintenance and energy savings.

VI. CONCLUSION

In this paper a proposal of an intelligent wireless street light control and monitoring system is described that integrates new technologies, offering ease of maintenance and energy savings. This is obtained by using the highly economical lamp post technology supplied by renewable energy provided by the solar panels and by using the intelligent control unit of the lampposts. By using LDR and IR sensors we can save some more power and energy, and also we can monitored and controlled the street lights using GUI application, we can get the status of the lights in street or highway lighting systems. The proposed system is especially appropriate for street lighting in urban and rural areas where the traffic is low at times. The system is versatile, extendable and totally adjustable to user needs.

VII. ACKNOWLEDGEMENT

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