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GSM Based Remote Control System of High Efficiency Intelligent Street Lighting System Using A Zigbee Network of Devices and Sensor

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Abstract: ***This paper replaces the traditional methods in control, maintenance and implementation of street lighting system. It uses GSM based remote-control system will optimize management issues and increase the efficiency of street lighting systems. It uses ZigBee-based wireless devices which enable more efficient street lamp-system management, thanks to an advanced interface and control architecture. It uses a combination of sensors for control and also guarantees the system parameters such as intensity, power consumption and so on. The information is transferred point by point using ZigBee transmitters and receivers and is sent to a control terminal used to check the state of the street lamps and to take appropriate measures in case of failure. It also discusses an intelligent system that takes automatic decisions for luminous control (ON/OFF/DIMMING) considering surrounding light intensity and time of the day both at the same moment The processor present in the system is programmed to check the working condition of components in certain intervals if there are any mal function if possible it corrects by itself else the information is send to maintenance team using GSM module. The proposed system closely resembles the smart street light system with very small changes.***

Keywords: Automation, LED, control system, lighting system, sensors, wireless networks, ZigBee, GSM module, solar, presence sensor, hall sensor, IR and LDR**.**

1. Introduction

In the present world mostly street lighting system belongs to public sector. This consumes 20% of the total power and also it will contain many hurdles in the maintenance such as replacing the damaged one's and also has to check weather all the lights are in working condition or not and switching on and off daily at particular times and also cost factor also is very high. At present many technologies developed in all fields than also the street light system is designed and developed on old methods so to improve the stands of street light system we are trying to implement recent technologies in this field to. And most of the companies are showing much importance to latest technologies by considering some of the factors such as safety of the pedestrians and night travellers and so on.

In the existing system by making small changes there are many possibilities to develop street light system according to our present day life without wasting time, power and money to.

The first and foremost possibility is replacing the existing lamp with the LED(light emitting diode) lamp which consumes less power and reliability time is very high when compared with other lamps.

The second possibility is to replace the power supply from power lines to solar energy which is available at free of cost. The third possibility is adding some extra circuitry which consists of sensors such as presence sensor, emergency device, working sensor, light sensor, and IR(infra red) sensor. By which the maintenance of the system become less complex when compared with old method.

The last and very important possibility is by adding automated and remote control system based on intelligent lamp post that send information to the base station regarding the working condition using the recent technologies such as GPRS(general packet radio service)/ GSM(global system for mobile communication) by which we can provide simplified management and maintenance issues.

Solar energy is the most renewal energy which is very plenty and most important resource. By the unification of all the possible methods which are mention above we developing a high efficiency and intelligence based remote control street light system using Zigbee devices and network of sensor in which solar power is the energy source and LED is lighting device. In this paper i am trying to design an advanced street light system with all advance technologies.

2. General concept of the system

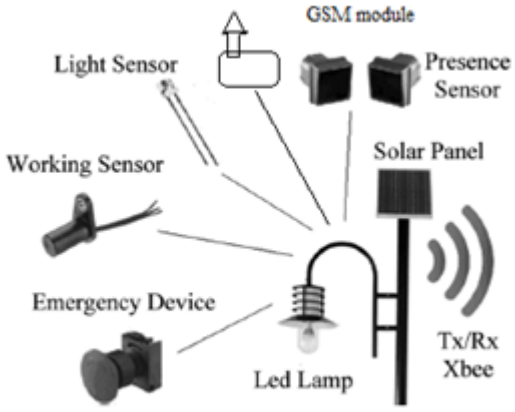
The basic concept of this street light system is in the street there will be many observing station to which collectively base station is location in nearby area to all streets. This each lamp post contains many sensors to observe different factor to either to turn on or off the light. This depends on the different factor such as season, climatic conditions and geographical location and so on. In this system to main Zigbee technology is used which is cheap and efficient and also easy to handle. The below figure shows the schematic diagram of the street light system with few lamp posts and nearby base station.

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Schematic image of the system.

This shows the schematic diagram at the lamp post

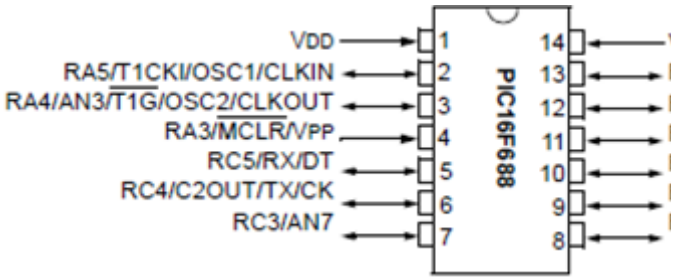


Schematic image of an on-street station.

3. Processor and led lamp

3.1 Processor

In this project PIC 16F688 as a controller, it is a 14 pin dual in line packaged flash based controller and it is 8 bit CMOS microcontroller with nano watt technology. The main reason for choosing this processor is it consumes low power, high performance RISC CPU and clock oscillator frequency of 20MHz.and also it has 12 I/O pin and many other advanced features.



3.2 LED Lamp

In the last 2 decade of period there is a vast and rapid increase in the LED technology so to design the efficient street light system with reduced power consumption.LED light is high efficient, easy to handle and had the capacity to convert the light into monochrome white light. This is highly effective in dimming and had high life span of nearly 1000 days. it will not ultra violet light and it consumes less current it lies in mill amperes and amperes. The below figure shows the HB LED which recent development in LED technology.



Figure: LED Street light

3.3 Zigbee Technology

Zigbee is a wireless communication technology it works on protocol IEEE 802.15.4 for the communication among multiple devices in the WPAN (Wireless Personal Area Network). This technology is intended to less complicated than any other wireless technology such as wi-fi(wireless fidelity), Bluetooth. This can be said in terms of cost, maintenance and consumption of energy etc.

The Zigbee network mainly consists of three modules they are receiver, transmitter and router. This can be said otherwise as one or more coordinators and one or more devices as transmitter and receiver respectively. The bit rate of transmission depends on frequency band. The maximum and minimum bit rate of this technology is 20-250 kbps.

On ISM band that is in 2.4MHZ band it uses maximum bit rate is of 250kbps, 40kbps is used at 925 MHz and 20kbps is at 868MHz. The Zigbee transmission range varies by depending on the atmospheric conditions and therefore the transmission power and range varies in between the tens and hundreds of meters since the transmission power must be kept as low as necessary to maintain the low energy consumption.

In this technology the receiver is very sensitive so error rate is very less or negotiable. The module needs to be supplied the voltage of 3V DC and the power consumption lies within the order of 50 mA. The receiver module will also provide the sleep mode when power consumption is in the range of micro amperes.

This network of communication is implemented with the help of radio frequency modules. They operate in the free band i.e., ISM band at frequency of 2.4MHz.

The main purpose of proposing the system is to transfer the data from the lamp post to the base station. In process the data is transferred step by step, from one lamp post to the other which is nearby where as every lamp post has the distinctive address within the network. The distance between the lampposts must make sure that in case of failure of one lamp within the chain, the signal will reach the other lamppost without breaking the chain.

In this network we connect the devices up to 65000 and the life span of battery is in the range of 100 to 1000 days. The

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main application of this wireless technology is control of the network.

3.4 Sensor

In this there various sensors such as presence sensor, light sensor, emergency device and working sensor all these work together and sends the information to the micro controller which processes and checks or compares the predefined values if there are any change in the values the information will be send to the base station.

A. Light Sensor

A light sensor is used to sense the brightness of the sunlight in the surroundings and provides the information to the controller, it compares the measured with the predefined values if there are any changes it glows the lamp to support the sunlight but in general it will not be required at the day but on some cases such as cloudy days, but it is required in the early morning and desk. The main purpose of this measurement is to ensure the minimum level of illumination of the street. Light sensor must be very high sensitive to the visible spectrum and it provides a photocurrent high enough for the low light luminance levels. So considering all the above reasons we use the phototransistor TEPT5700 as a light sensor. When the lamp glows in support with day light it need to glow with power so without wasting the power the controller enables the electric power saving mode because the lamp always operate in combination of sensor and microcontroller.

B. Presence Sensor

The main motto of using this sensor in this project is to find the presence of pedestrians or vehicles. In the countries like India we don't have passage in night time especially in rural areas if the lights glow thought out the night there will be large wastage of power so to eradicate this we are using present sensor.

If it identifies or finds the passage then it gives input to turn on the lamp or group of lamps according how the connections are established else the lamps will stands ideal. This completely depends on the pattern of the street single or the cross roads if it is single road then single sensor is sufficient else it requires multiple sensor at each end or corners. for more precise we can use more number of sensors. The main hurdle of this sensor is it placement i.e., height at which it has to be placed, if we place at long height it cannot identify the short passengers such as kids and so on if place at low height it will detect all unwanted things too and turns on the light so the sensor must not be placed at too high or too low so it should be at medium height to eliminate the mistakes to prohibit the unwanted wastage of energy. The height of the sensor should be decided according to the requirement of the user and his needs. In this project we are using SE-10 PIR motion sensor which offers more performance and efficiency. And cost factor is also low when compared with other sensors.

C. Working Sensor

This sensor is used to control the operations of the lamp post. It helps to improve fault maintenance and system management. This also know as hall sensor which helps to know whether the lamp post switched on or not, otherwise we can say mainly this sensor is used to recognize the switched on condition. This helps to recognize the false positives, because the identified parameters compare with the predefined or storied values. if the sensor is detecting faulty values it will not be send to the user the values are given to the microcontroller and additional logic of the system it detects the fault and eliminates such values.

This is mostly hall sensor which is used as working sensor. The captured information is send by using zigbee network of devices to the base station where the operator is present or observes the data according to the received data he sends the technician to the lamp post where the lamp is broken down to replace the broken one. The current of the station is nearly 1.5A which is sufficient for the sensor to detect the fault is necessary. Here we have chosen ACS756 as a hall sensor which has a precise solution and cost efficient and it works on or sensitive to AC and DC currents which is helpful for communications system. It helps to store values in the microcontroller's memory which flows to the LED to operating conditions in normal. This is established in power consumption measurements. The combination of hall sensor and emergency devices are used as supervision module or the control.

D. Emergency Device

This is button which connects the complete sensor network which is used in emergency situations such as system failed conditions when this button is pressed then the light turns on for present time and to turn it off. Again the same burn has to be pressed. This prevents the system being active when it is not necessary but anyhow the system will be inactive in the day time because is it not needed to support sunlight. In addition to the above sensors we can also use temperature sensor which continuously checks the temperature of the LED which affects the life span. While choosing the sensor one main thing has to be considered the chosen sensors must be able to sense the both AC and DC currents.

E. Control Unit

This deal with the working process of the system, the information from all the sensors are given to the microcontroller according to the controller responds because of embedded softer present in the controller. The light sensor always senses the luminance intensity when it is less than the set threshold value then the controller checks the emergency device status according to that the controller turns on the lamp. The presence sensor senses the passage of pedestrians or the vehicle only than the controller turns the lamp on otherwise we can say start signal is supplied and lasts it also checks the status of hall sensor if there are any malfunction in the lamp station in any of the working sensor then the information is send to maintainer or the base station controller.

4. Conclusion

In this paper the new intelligent and smart street light system is designed with wireless technology for maintenance and network of sensors for controlling.

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In this we had high efficiency LED lamp which consumes less energy with high life time and which are supplied with renewable energy of solar panels. And the main advantage in this system is the information is send to the base station. This system is high precise and efficient due to the sensor technology and the network of devices, if any fault or malfunction is detected the information is directly send to the controller. The cost is efficient and précised. This system can be used in both urban and rural areas where the traffic is very low in the night times. In the future this system can be adapted to any future new technologies and make more efficient for the existing system.

5. Future Scope

After the implementation of this system we came to notice that this system can be applicable to any type of system where we have regular observation in needed and it makes maintenance so simple and cost effective. In future any new wireless can simply replace the Zigbee without making a lot of effort.

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