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Sensor Node Development for Street Light Monitoring System

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ABSTRACT: The paper presents the development of a low cost sensor node for street lighting based on the criteria needed by the industry. The function of the sensor node is to sense or detect the motion or movement of an object or a car. The sensor node will act or response when it detects an object moving past its position or location. The street light will turn on and transmit data to another pole. Once the object has passed the sensor node, the light will turn off. The paper focuses on the development of a cost effective sensor node. This sensor node will save the power supplied to the light by preventing it from turning on all night. This will also help to reduce maintenance cost and save on power consumption.

I.INTRODUCTION

Development of a good transportation network is important in order to fulfill people needs. This includes streets, roads and highways that have to be adequately illuminated so that a sufficient visibility is guaranteed in order to decrease the accident rate and increase the flow of the vehicles and safety. However, these streets and roads are illuminated constantly for more than 13 hours daily. This will lead to a huge amount of electrical power to light all the streets and roads. Hence the development of sensor nodes capable of sensing motion or moving objects is crucial. In this system, if there is an object moving past the sensor node, the street light will turn on. Otherwise, the street light will remain off. The type of sensor node needed should have criteria such as low energy consumption. If the sensor node itself just use low energy consumption, it will also help to increase the lifetime of the battery.

As we all know, the street light system will turn on at dawn and turn off after sunrise. Even though there is a sensor mechanism which turns on and off according to the weather conditions, it still exposed to light pollution and cause wasting of electricity. Besides that, the spending cost for energy is high. By designing a low cost sensor node, it helps to reduce cost production of sensor since there are a large amount of street lights in India. The development of sensor nodes based on low cost, low power and a multifunctional sensor has received high attention from various industries [1]. Based on papers published in various journals on smart street lighting system, smart street lighting system is a technology that support green environmental work and evolves with the advance in wireless communication and low energy consumption. This shows that a low cost sensor node has its own advantage of being eco-friendly.

The objective of this study is to develop a low cost sensor node for smart street lighting system and analyse the develop sensor node in term of its functionality and energy consumptions. The scope of this project focuses on the development of sensor node for LED type of street light only. The study also focuses on testing and analyses part that has been used in the development of low cost sensor node.

Various published references have proposed designs Streetlight Monitoring Control System depending on Wireless Sensor Networks. Based on Echelon Corporation studies, it shows that using street lighting monitoring system could cut streetlight energy costs by 30 % while increasing roadway safety [2]. If this system applied in streetlight department, it will help to reduce energy consumption and maintenance cost. Another published reference proposed the development of the system through Vehicular Ad-Hoc Networks (VANET) technologies. VANET help to know the presence of vehicles, theircations, their directions, and their speed in real time. The system ensure that about 65% energy can be saved and increase the lifetime of the lamps about 53% [3].

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II. WORKING PROCEDURE

The working procedure of the Smart street light using IR sensors is explained below. The following are the different steps included in building a Smart street light.

1. LDR pin 1 is connected to A0 (analog) port of Arduino Uno board.
2. Connect all the IR sensors to port numbers 2, 3, 4, 5 and 6 respectively (digital) which is the input signal to the Arduino board.
3. Connect the ground of all the sensors to GND port.
4. The LED's which are the output signals, are connected to port number 8, 9, 10, 11 and 12 respectively.
5. Again connect the ground of all the sensors to GND port.
6. Power is passed to the Arduino (7-12V).

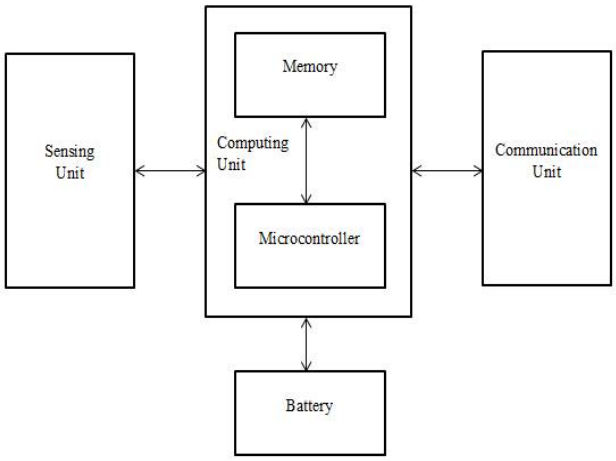

Fig. 1. Block Diagram

Following the functionality testing, the current for each sub module is analysed. This to ensure feasibility and efficiency of the developed product. The heart of Arduino circuit is the low power, high performance Arduino micro controller is programmed by embedded assembly programming language for implementing these tasks; this program is stored and operated by means of storage device EPROM, while coming to the functional block i.e. LDR, these LDR's are in expensive, smaller in size, less complexity, highly reliable, low power applications, minimum risk with greater accuracy. The project is successfully implemented in many areas based on the experimental verification proving that it can save the electrical power to greater extent removing the manual work completely; the system became the origin for upcoming advanced intelligent systems in saving both human and electrical power.

Table 2: Analysis on energy utilization

Type	Current	Voltage
IR sensor	0.6mA	5V
LED	5mA	5V
nRF24L01 (Tx and Rx)	56.3 mA	3.3V

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From the analysis presented in Table 2, the energy consume by the transceiver module is the highest. This has opened another research area which is to minimize number of packet transmitted. Based on the algorithm, the sensor node will only send information to base station once a day. This to help reduces number of packets transmitted. However, sensor nodes also need to exchange packets between them. Therefore, future research will look into methods to reduce number of packets hence improve the energy efficiency of the product.

VI.CONCLUSION

In this paper, a development of low cost smart streetlight monitoring system was presented. Many factors should be taken into a consideration before it can be fully implemented. An Atmega 328 has been used as the microcontroller as it is cheaper and readily available in India. In addition, the specifications and features are quite similar to other more expensive model. If the development of sensor node can be further improved, it could become one of the lowest cost sensor nodes in industry. As a conclusion, developing a low cost sensor which can save the power consumption for streetlight monitoring system will help in the development of green technology product.

Further improvements could be implemented in the system in order to design a better sensor node. This can be achieved by designing a sensor node which has more compatibility especially in the aspect of endurance or durability. In addition an analysis on total power consumption used daily could be made by displaying the result or by computer simulation.

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