

# Energy-efficient Intelligent Street Lighting System

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**Abstract**—The street lights play an important part for the person on foot and furthermore to the vehicles which go close by. So these road lights ought to work when there is a low light situation in the encompassing. Additionally, at specific circumstances, these road light are exchanged during the daytime. So there should be a system which can defeat this hindrance of light contamination. Utilizing this framework we are attempting to lessen the vitality utilization which thus will expand the productivity of the road lights. Already proposed system detects traffic flow and automatically turns on the light, and another system does the weather analysis and turns on and off the lights accordingly. In this proposed work, the system combines all the above features, the key features involves motion sensing, automatic dimming control as well as light sensing.

**Key words**—Light Dependent Resistor (LDR) Sensor, Sensors, Light Emitting Diode (LED), Light On Demand (LOD), Real Time Clock (RTC).

## I. INTRODUCTION

In street lighting, the smartly arranged networked lighting using LED have provided the features of automatic dimming control, which not only reduces energy consumption but also offers longer life and less maintenance to cut the system cost. During summer season, the street lights are switched on even when the sunlight is there, and in the rainy season or when fog is detected, we often come across the situation that street lights remain switched off due to that lots of energy is wasted, the proposed system fails to provide the energy efficient system. Even when the traffic is detected the lights should turned on. Specifically addressing the energy efficient smart street lighting, the combination of LED and wifi module offers adaptable dimming in accordance with ambient conditions, occupancy control and automatic fault detection. In addition to dimming control, it also monitors the status of light and power consumption in LED street lights. A smart, efficient LED lighting system is proposed and implemented, exploiting the unique opportunities of both LED, sensor and control technologies. In the system, different sensors and actuators are associated with luminaries to monitor and control the luminary for its performance and its surroundings for adaptive control through the wireless network. Solar powered and wireless

connected groups of LED lights, which are switched on and off based on the presence of low light.

## II. LITERATURE SURVEY

### A. Overview

An overview of Intelligent Street Lighting System Involves three important features which are motion sensing, light sensing and automatic dimming control. A motion detector is a device that detects moving objects, particularly people. A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR based motion detectors. Light Sensor in embedded systems can use to detect the current ambient light level. There are a range of different types of light sensors, including Photo resistors, Photo diodes, and Photo-transistors. Automated dimming Control reduces the output and energy consumption of light sources. This can increase energy savings, better align lighting with human needs, and extend lamp life. Lighting levels could be lowered for long periods due to the presence of daylight.

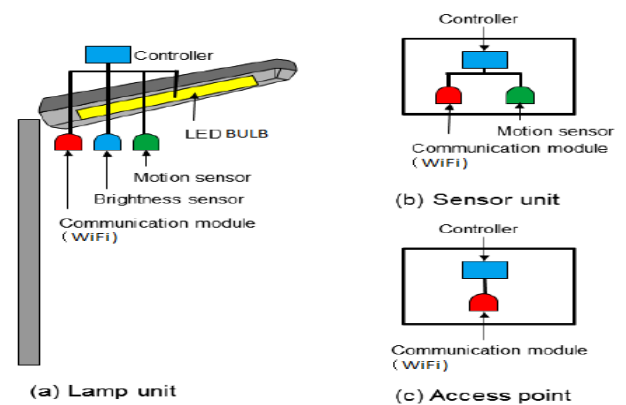


Fig. 1: Components of smart street light

### B. Background

Technology used today is a result of tremendous amount of research work and understanding the actual circumstances in real world. To overcome the circumstances every bit of advancement in the field of technology noted by

the scientist is helpful for future work and analysis of these technologies can be a motivation for future studies.

In the year 2015, Xue huaqiang, Xiao li, Deng huaqiu, analyzed wireless communication of LED street lamps based on Zig-Bee protocol working with 2.4GHz, and designs wireless network node of LED street lamps. The intelligent control system combined with luminance sensing and temperature sensing will be the future direction of development.[02]

In the year 2011, Chun-ling Fan and Yuan Guo, described the development of a street lighting system technology, with the shortages of the current technology. A method of the Zig- Bee based wireless sensor network in LED street lighting system is presented, and an LED street lamp energy-saving control system is discussed.[04]

In the year 2016, Zhixiong Ke, Chun Xiao studied a wireless street light control system based on ZigBee network is introduced which realizes on/off control, power adjustment and fault monitoring. The system gets the street lights parameters and realizes remote monitoring through ZigBee communication.[06]

In the year 2016, Florian Knobloch and Nico Braunschweig proposed a new deterministic model to control street illumination depending on traffic needs for improving energy efficiency. The light on demand (LOD) system incorporates the traffic velocity into the model and generates results that are more relevant to real time traffic needs while ensuring safety and security.[07]

In the year 2011, Mr. S. V. Viraktamath, Prof. Dr. G. V. Attimarad proposed a system which introduced us power saving mechanism for street lights using wireless communication. It is a low cost, remote controlling and monitoring of the street-lights. It provides an effective way to save energy by preventing unnecessary wastage of electricity, caused due to manual switching or lighting of street-lights when it is not required.[09]

In the year 2015, Chen-Wei Yang<sup>1</sup>, Evgeny Nefedov<sup>2</sup>, Seppo Sierla<sup>2</sup>, Paul Flikkema<sup>3</sup> studied a simulation of vehicle and pedestrian traffic is interfaced to a distributed street lighting system based on the IEC 61499 standard, in order to quantify the energy saving potential of a street lighting automation system that exploits real-time sensing information of individual road users while conforming to traffic safety related requirements for road lighting.[11]

In the year 2016, Liuyi Ling, Xiaoliang Wu, Mengyuan Liu., presented the utilization of photovoltaic power applied in LED street lighting and an intelligent lighting

system is developed. Addition to that a Zig bee based wireless communication module has been developed for potential monitoring the LED street lights for future work.

### C. System Architecture

- 1) Arduino MEGA2560- It is a micro controller used in the system to manage the functioning of different sensors.
- 2) Power Supply Power supply is provided to the micro-controller. Around 12V power is required for the micro- controller. Variable DC power supply is recommended, it allows us to adjust the voltage level as per the need.
- 3) WIFI Module ESP2866- It is a self contained system on chip that has integrated TCP/IP protocol stack to provide Arduino connection on wifi network
- 4) Light Emitting Diode (LED): LED is a semiconductor that emits light when activated. MCU outputs a PWM signal to constant current driver to adjust the current going across a LED Street Lamp according to the environment brightness. It saves around 80 percent of energy.
- 5) Light Dependant Resistor (LDR) Sensor: A light sensor is used to sense devices illumination level of the street light and surrounding brightness of the sunlight to a micro-controller in order to maintain the constant lighting level of the street light. An LDR is used to sense light i.e. if light falls on the LDR the LDR turns on and the street light is off or else the LDR turns on the light.

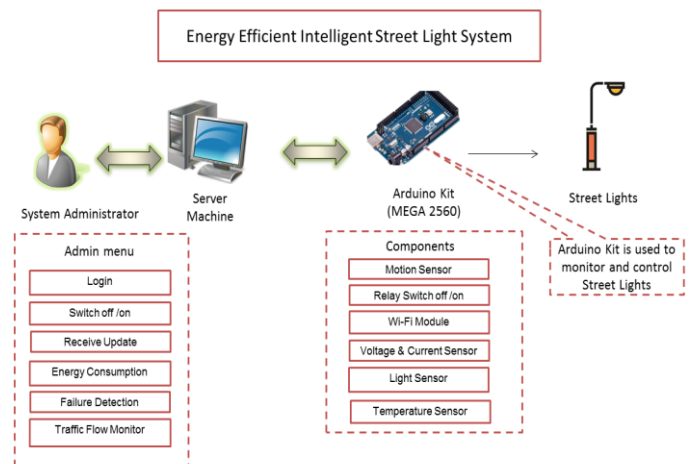


Fig. 2: System Architecture of Intelligent Street Lighting System.

#### D. Brief Working

- Street lights can be switched on/off using a relay switch.

The switch is controlled by android board having built in Wi-Fi connection. Street lights are to be smartly switched on/ off using detected light/traffic but admin has a choice to manually start/stop the light.

- Energy consumption- Each street light is configured with a voltage and current sensor, we measure the amount current and voltage flowing through the light. Sensors also indicate if there is any failure in the light. Energy consumed is also logged on the server.
- Traffic status- Motion sensor is used to count number of vehicles passing by every hour. This value is also synchronized with server to analyze street light operations for next week.
- Monitor Street lights for failure- If there is no current flowing through the current sensor and light status is ON then we consider the light in failed state and report it to server
- Monitor street light/temperature sensor- Temperature sensor reports running temperature of the Street light. In case of failure of light, we can check the log of temperature and current sensor. Light sensor is used to detect day and night conditions for on/off operations

#### E. Algorithm

Divide and Conquer strategy is applied in order to implement the proposed system. The divide and conquer strategy works by recursively breaking down a problem into two or more sub-problems of the same or related type, until these become simple enough to be solved directly. Here, the system is triggered upon the condition of day or night and presence of body within its area of perception. The system is divided into different modules that individually work upon their designated task and further combine to give a meaningful result.

Step 1: START

Step 2: System initialize.

Step 3: Check whether day or night.

Step 4: If day, set light intensity 0 percent (light switch is off) else GOTO Step 6.

Step 5: GOTO Step 3.

Step 6: Set light intensity 60 percent.

Step 7: Check whether there is some motion caused due to presence of vehicle or pedestrian.

Step 8: If motion is detected increase light intensity to 100 percent else keep it 60 percent.

Step 9: GOTO Step 3. Step 10: STOP

#### F. Applications

1) Airport Area: The road of airport or technical development zone is wide, and with less surrounding buildings, so there will be less interference, which makes them the best place to apply wireless street light system.

2) University Campus: The wireless street light system can be implemented inside the university campus

#### III. SUMMARY

#### IV. CONCLUSION AN FUTURE SCOPE

This paper gives us the conclusion that it provides us the option on the existing street lighting system. The proposed system has a feature of automatic dimming control which eventually lessen the energy consumption and also the overall cost is reduced. The ideal alternatives we get with the movement sensor and time control module will be the effective ones in securing power sparing. The higher amount of energy consumption associated with street lights is mainly contributed by the inefficient system, in which luminaries require high amount of energy. Wireless sensor network (WSN) with its predictive nature and easy to monitor and control capability is the back bone of large variety of Cyber physical systems (CPS) applications in every domain. The road of airport or technical development zone is wide, and with less surrounding buildings, so there will be less interference, which makes them the best place to apply wireless street light system.

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