

# IMPLEMENTATION OF SMART STREET LIGHT, TRAFFIC AND ENVIRONMENT TOWARDS SMART CITY

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**Abstract**-Smart streetlight system is one of the enabling technologies for a smart city, giving low-cost, low power outdoor lighting also with benefits for vehicle users as well as pedestrians. In normal cases turning on and off the street light will require time-consuming manual activity, as time is a very important factor. On completion of this project manpower as well as time can be saved as it becomes automated and it provides more accurate results than ordinary Street light. Integration of sensors and Internet - based wireless sensor modules can furnish an optimal platform for an innovative streetlight application. The smart city with help of solar tracker system provides solar charging to the battery which can be used when there is shortage of electric energy. In particular, we build a central web server that offers a dynamic and versatile web interface to obtain the LDR information and real-time sensor data from streetlight. This project aims to design and construct a solar tracker system that follows the direction of the sun in order to produce maximum output for solar powered applications. To get the maximum sunlight in a limited distance, solar panels were placed in bi-facial manner and reflector sand the solar energy from the solar panels is stored in battery. The stored energy is inverted and used for street lights. This automation process is done by the PIC microcontroller with help of LDR, Gas and IR sensors. The street lights switched ON in night and switched OFF in day times. The speed detection and indication are another purpose in the development of this project. Thus, this system integrates many aspects of smart city like street lighting, road-traffic, pollution control.

**Keywords**—smart city, LDR, PIC microcontroller, solar energy, IR sensors, Gas sensors.

## I. INTRODUCTION

The trend of global urbanization is bringing advancement in emerging technology and smart city architecture. Streetlight technology is one of the trends in the development of smart city. The use of streetlights is important and mostly seen in big or small cities in the world. Streetlights can give streets and public places light at night, which can reduce the risk of

an accident and increase the safety of drivers and pedestrians. The risk of driving accidents and foot traffic accidents is lower when the streetlights are present. The main aim of the streetlight system is to illuminate the target location, for example roadways. It also has a psychological impact, which can increase the alertness of street users and offer a sense of personal security. The solar energy is renewable energy which is pollution-free. This energy is used as a source in this project. The maximum power point tracking of the solar radiation optimize output by following the sun across the sky for maximum sunlight. This gives up an approx. increase of output voltage by 15% in winter and 35% in the summer. The pollution of air is expected to drastically increase once the work force is fully enforced. Thus, it is necessary to keep in check the levels of air pollutants in the environment to maintain it healthy. The high speeding of the vehicles causes more road accidents to occur. Thus, we need a reliable speed detection and indication system to track the high speeding vehicles to undertake preventives measures. The concept of smart city integrates information and communication technology (ICT) and physical sensors plugged in to the IoT network to enhance the efficiency of the operations undertaken by the city and social services pertaining to the citizen

## II. LITERATURE REVIEW

1. A.Kimber, J. Roberts, J. Logan, and M. Lambert, *LED Street Lighting: A Handbook for Small Communities* – gives insights about the various forms of street lightings and how it can be implemented and how it can be improved by integrating additional applications in it. It also gives the methodology to make it into a smart street lighting. It focuses on making the street light into an automation.

2. N. Yoshiura, Y. Fujii, and N. Ohta, *Smartstreet light system looking like usual street lights*

based on sensor networks- This describes about the various sensors which can be integrated in this smart street lighting and how those sensors give their inputs and those inputs processed via a microcontroller and then a desired output can be obtained from the output signals from the microcontroller.

3. G. Zhang, K. K. Yau, X. Zhang, and Y. Li, *Trafaccidents involving fatigue driving and their extent of casualties*- This gives the statistical information about the fatalities and casualties occurring in the road accidents and ways of preventing them. This highlights that over speeding is one of the main reasons of fatalities caused due to road accidents. It also suggests ways to prevent the accidents from occurring like detecting the speed and automatically governing it so that head-on collision can be prevented even in glaring lights.

4. S. D. T. Kelly, N. K. Suryadevara, and S.C.Mukhopadhyay, *Towards the implementation of IoT for environmental condition monitoring in homes* – It proposes the methodology of smart monitoring of the domestic environment. This also gives its implementation in a city level by setting it up on the hotspots of air pollution in the cities. This also suggests the transmission of the inputs of the air condition through a IoT.

5. M. Simon and E. L. Meyer, "Detection and analysis of hot-spot formation in solar cells," *Sol. Energy Mater. Solar Cells* - It gives about the detection of the maximum power position in the solar cell. This also provides with the algorithm to implement the tracking of the maximum power point in the solar cell.

### III.WORKING PRINCIPLE

This focuses on the proposed overall system including its main stages, hardware/software components, the proposed algorithm and how the proposed system works. The information from the external environment such as voltage from the solar panel, the gas composition, the external lighting and speed of the vehicle are acquired using sensory control units, gas sensor, light dependant resistor, and infrared sensors.

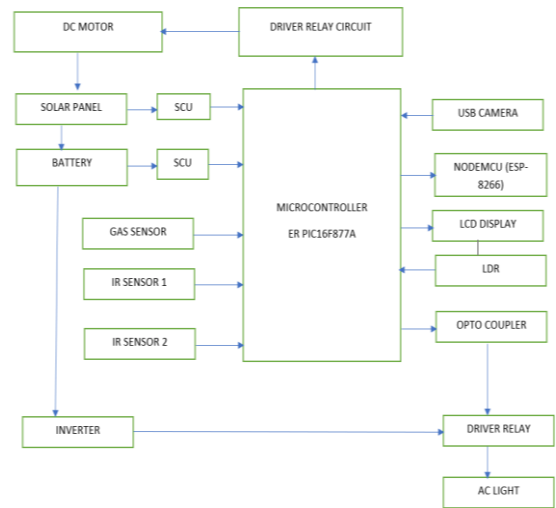


Fig.1-Blockdiagram of Smart Street lighting

The smart street lighting is made automated by the use of LDR (light dependant resistor) which gives the input of the intensity of light and whether or not to turn ON or OFF the street lighting. This input is given to the PIC microcontroller and it sends the output signal to the driver relay circuit to provide the needed voltage to turn ON the street lighting. The source used here is renewable solar energy. This is made possible by using a solar panel. The solar panel is placed on the top of the system. This solar panel rotates so as to track the maximum power point where the power is optimised efficiently. The voltage input of a particular position of the solar panel is given to the PIC microcontroller. Thus, many positions are compared and solar panel is rotated to the maximum position by using brushless DC motor. In this method the maximum power point can be tracked. The gas sensor provides with the composition of the pollutants present in the atmosphere. This input is given to the PIC microcontroller and it compares with the standard values and determines the extent of pollution and indicates it. The IR (infrared) sensors placed at a known distance from each other calculates the time at which the vehicle passes through and thus we can calculate the speed with the known details. This speed is compared with the permissible speed and if the calculated speed is beyond the permissible speed, then the information is sent to the control center through the wifi module. The optocoupler isolates the electrical circuits.

#### IV. COMPONENTS DESCRIPTION

##### 1.1 LDR

Light dependent resistors or LDRs are often used in circuits where the presence or level of light is to be detected. They can be called by a variety of names, such as light dependent resistor, LDR, photo resistor, or even photocell or photoconductor.

The LDR senses the intensity of light in the environment and it provides the signal to the other circuits for processing and input. When light falls on this device, the resistance decreases. So when LDR is held in a dark spot, the resistance is high.

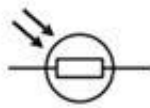


Fig.2-light dependant resistor (LDR)

##### 1.2 Gas Sensor

Gas sensors are used to measure concentration of the target gas at an electrode by oxidizing or reducing. It has a high sensitivity and long life.

A gas sensor is a apparatus detecting the presence or concentration of gases in the atmosphere. The sensor generates a corresponding potential difference based on the concentration of the gas by adjusting the resistance of the material within the sensor which can be calculated as output voltage.

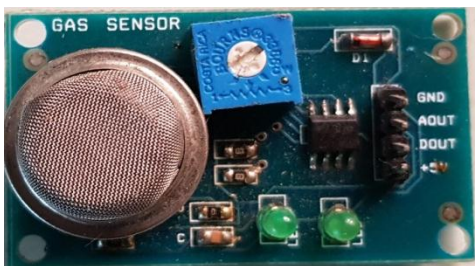


Fig.3-Gas sensor

##### 1.3 PIC 16F877A

PIC Microcontrollers are used for more specific applications. PIC16F877A shown in Fig.2 is widely used because of various reasons like its large memory capacity and adequate input/output ports etc. It has 44 pins and is an 8 bit dual-in-package processor. It has high performance RISC CPU and

single word instructions . Also possess direct, indirect and relative addressing modes. The watch dog timer is enabled with its own on-chip RC Oscillator for reliable operation. It is employed for commercial, industrial and extended temperature changes.



Fig.4-PIC16F877A Microcontroller

##### 1.4 IOT COMMUNICATION PROTOCOL

The ability to assist an HTTP server and/or an MQTT broker in communication with devices. The ability to aggregate and combine communication from different sensing devices and to route communication to a particular device (possibly via GSM/GPRS). The ability to bridge and convert various protocols to provide HTTP-based APIs that are filtered through the device's MQTT message.



Fig.5-NodeMcu Esp-12

##### 1.5 LCD Display

LCD Display as shown in the fig.3 module is Liquid Crystal Display screen. It is available in wide range and is preferred inspite of the other seven segment displays and the other multi segment display LCDs. A number of commands have to be provided to the display before inputting the data. It is user friendly incase of data and commands. By using the serial port, the dual transmission of data is done to the LCD display and the GSM/GPRS module.



Fig.6-LCD Display

### 1.6 IR SENSOR

An infrared sensor is an electronic device, that emits radiation to detect certain aspects of the environment. An IR sensor can measure an object's heat and also detect the motion. Such types of sensors only monitor infrared radiation instead of emitting it, which is called a passive IR sensor. All the objects radiate same form of thermal radiation through the infrared spectrum. Such forms of radiation are invisible to our eyes, but an infrared sensor can detect. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode of the same wavelength that is sensitive to IR light as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages can change in relation to the magnitude of the IR light received.



Fig.7 - IR sensors

### 1.7 OPTOCOUPLER

This IC is used to provide electrical insulation between two circuits, one part of the circuit is connected to the IR LED and the other to Photo-transistor. The digital signal given to the IR LED will be reflected on the transistor but the two will not have a hard electrical connection. This comes in very handy when you are trying to isolate a noisy signal from your digital electronics, so if you are looking for an IC to provide optical isolation in your circuit design can there be the right option for this IC.

### 1.8 Relays

Relays are used where an independent low-power signal is required to control a circuit, or where multiple circuits must be controlled by one signal. A relay is an electro-magnetic device which is useful for switching on and off a light bulb if you choose to use a low voltage circuit.

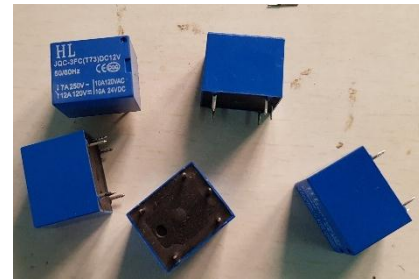


Fig.8- relays

### 1.9 Solar panel

A PV module is a montage of photovoltaic cells installed for placement in a framework. PV cells use sunlight as a source of energy and generate direct current electricity. The panel used has a capacity of 100W.



Fig.9-Solar panel.

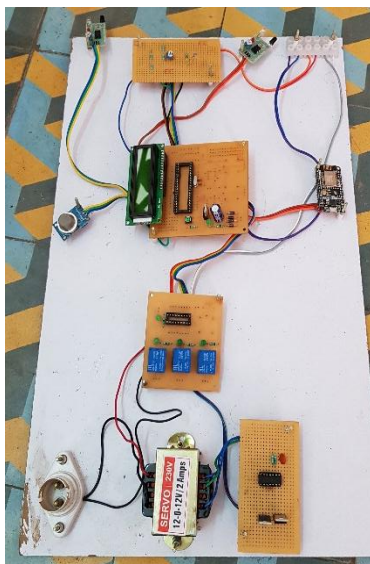
## V. RESULT AND DISCUSSION

Thus, the model of smart street lighting was implemented which provide the solution for manual street light control and automation by making use of the light dependant resistor and also provides solution to control the level of emission of toxic gases in our environment. It also provides the solution for the smart control of road accident control by checking the over speeding and indicating it. A suitable penalty can be imposed to the traffic rule offender. The power is efficiently given by the use of renewable solar energy optimised by maximum power point tracking by the processing by the PIC microcontroller and external movement or rotation enacted by the BLDC motor.



**Fig.9**– Maximum power point tracking mechanism of Solar panel.

Thus, we provide an efficient smart street lighting with many useful integrated applications which can be used in the smart city schemes.



**Fig.10** – working kit of the smart street light

## VI. CONCLUSION

In this study, we have proposed a combined solution to implement the smart street lighting which integrates road traffic control and pollution control into it. Utilized hardware/software components, system architecture and proposed methodology details have been presented. This system can be used in the establishment of smart city.

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