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## Intelligent and adaptive illumination for street lights using IoT

Ragul R.

[ragul.r@ckcet.ac.in](mailto:ragul.r@ckcet.ac.in)

CK College of Engineering and  
Technology, Cuddalore, Tamil Nadu

Thamizharasan S.

[Thamizharasan.s@ckcet.ac.in](mailto:Thamizharasan.s@ckcet.ac.in)

CK College of Engineering and Technology, Cuddalore,  
Tamil Nadu

Dr. N. Kamalakannan

[kamalakannan.n@ckcet.edu.in](mailto:kamalakannan.n@ckcet.edu.in)

CK College of Engineering and  
Technology, Cuddalore, Tamil Nadu

Sivasubramaniyan V.

[Sivasubramaniyan.v@ckcet.ac.in](mailto:Sivasubramaniyan.v@ckcet.ac.in)

CK College of Engineering and  
Technology, Cuddalore, Tamil Nadu

Mukesh Kumar S.

[Mukeshkumar.s@ckcet.ac.in](mailto:Mukeshkumar.s@ckcet.ac.in)

CK College of Engineering and Technology, Cuddalore,  
Tamil Nadu

### ABSTRACT

*The main purpose of this project is to design an Intelligent and adaptive street lighting system, which ensures continuous lighting for the rural people as they mainly depend on renewable energy sources. This project "INTELLIGENT AND ADAPTIVE STREET LIGHTS ILLUMINATION CONTROL USING IOT" is to minimize the energy cost & electricity losses and also reduce the manpower used in manually switching on-off the streetlights. This smart streetlight operates only when required and works autonomously on successive nights even when sunlight is unavailable. Nowadays people are looking for smart systems, with less energy consumption along with less maintenance. On considering the above, these Intelligent streetlights are upended with IoT powered adaptive system, to identify the faulty situations and communicate the same to the maintenance using the IoT-NodeMCU.*

**Keywords:** IoT, Intelligent, Adaptive, Arduino, Solar PV, Streetlights

### 1. INTRODUCTION

The solar streetlights comprise solar panels, which utilize the solar energy during daytime and the photovoltaic cells convert the solar energy into electrical energy, which in turn are stored in the lithium-ion battery. The specially designed Light Emitting Diode (LED) which is more energy efficient as they emit very little heat. These Intelligent Solar streetlights can automatically sense the outdoor light with the help of a Light Dependent Resistor (LDR) and if required it will switch on in Dim mode.

In addition to this, a PIR sensor was integrated using Arduino Nano, which in turn senses the object's motion and will switch on the lights to bright mode.

In the Adaptive mode, the fault identification system, continuously monitors the performance of the battery, LEDs, Charge Controllers & PV cells and if any, changes in the

performance parameters will identify using appropriate sensors and Arduino Nano and intimate the same to the central maintenance by using IoT platform.

In this way, this adaptive system incorporated in the Intelligent solar street lights ensures zero failure time and provides continuous lighting to the rural people.

### 2. MOTIVATION

The Motivation of this project is to address the rural electrification problem by providing uninterrupted street lighting to the rural areas with the help of Internet of Things (IoT) technology and Renewable Energy Sources.

### 3. MATERIALSRIALS AND METHODS

The Fault identification system, which is specially designed for rural street lights will continue monitoring the performance of the battery, LED, Charge Controllers & PV cells and if any, change in the performance parameters will identify using appropriate sensors and Arduino Nano and intimate the same to the central maintenance by using IoT platform. This system is known as adaptive street lighting..

### 4. CHARACTERIZATIONTION

The Passive Infrared sensor is used to detect the motion around 7 meters near the street lights and when there is any activity created by pedestrians, cyclists, and cars these LED lights will get brightens if there is no movement across the sensor and the LED dims automatically.

In the Fault Identification system, a voltage sensor will continuously monitor the battery and the charge controller, when the measured voltage varies  $\pm 5\%$  from reference 12 Volts the system identifies a fault and will alert the maintenance team.

Similarly, a current sensor is used to monitor the performance of the LED by measuring the load current and when the measured

signal was less than 2 Amps it will indicates the same to the person concerned.

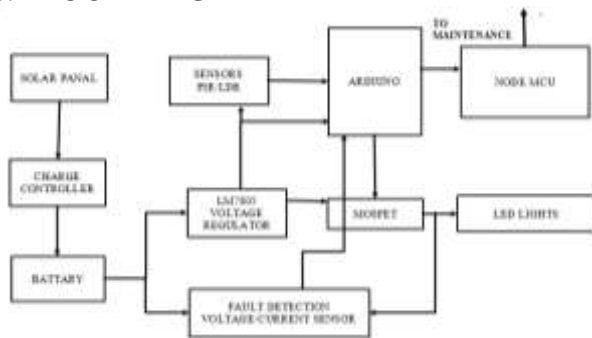
**5. WORKING**

The photovoltaic cells convert solar energy into electrical energy, which will be stored in the lithium Ferro phosphate battery having a capacity of 12V 7Ah. A solar charge controller is used to manage the battery charging & discharging and the integrated MPPT controller tracks the maximum power in the solar panels.

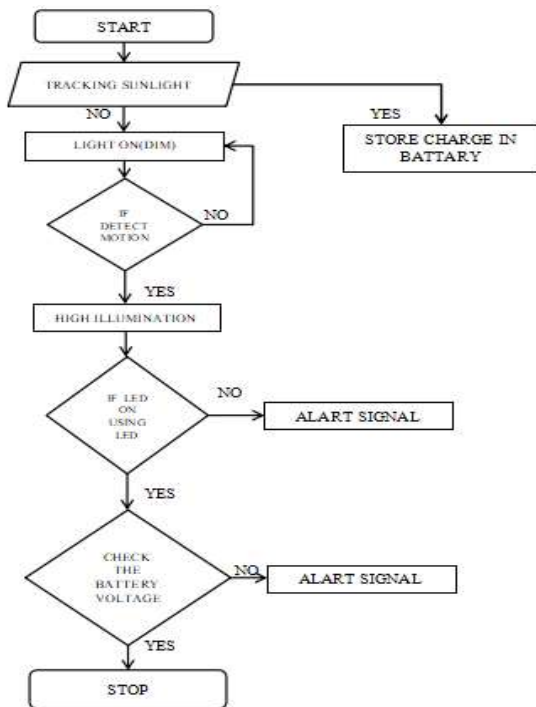
The Arduino Nano is programmed for the required operation of a dim and bright light system using the Passive Infrared Sensor (PIR). The MOSFET driver drives the LED strips through the appropriate command received from the Arduino Nano.

The fault in the battery, charge controller, and PV cells was detected with help of the voltage sensor and current sensor. The identification of change in reference values of voltages & currents will be informed to the maintenance person concerned through IoT – NodeMcu and thereby avoids the system failure.

**6. BLOCK DIAGRAM**



**7. FLOW CHART**

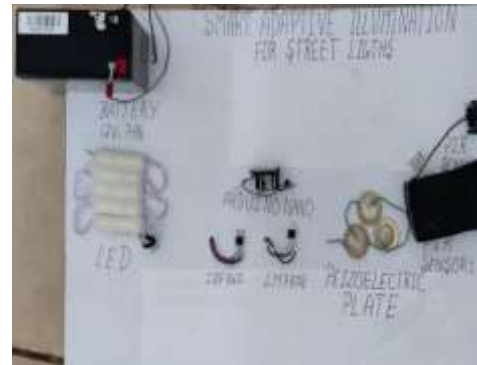


**7. RESULT & DISCUSSION**

Intelligent Solar Street light with an adaptive fault detection system has been tested in the renewable Energy laboratory.

The 12V Solar power is used as a power supply unit and the solar charge controller is used to charge the rechargeable batteries, these batteries provide power for the system operation, and the fault is detected using the appropriate sensor. Node Mcu – an IoT platform quickly communicates the fault through SMS.

**8. HARDWARE**



**9. CONCLUSION**

We have implemented Smart Adaptive system for Intelligent solar Street Lights using Internet of Things (IoT).

Whenever the motion sensor detects the motion or movement the illumination of the light will be increased or else the light illumination will be kept low.

The Intelligent system incorporated in this solar streetlight will facilitate the street lights to autonomously turn on during the night hours and will turn off based on the atmospheric condition. This will reduce power consumption and saves electric energy.

The Adaptive fault detection system powered by IoT ensures zero failure time and provides continuous lighting to the rural people.

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