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# SMART STREET LIGHTS

[1]D. Vaman Ravi Prasad, [2]Seetha Shesha Sai, [3]Shashank Swarup, [4]Y. Pramukh Ambedkar

[1] Associate Professor, Department of CSE, Anurag Group of Institutions- India

[2,3,4] B.Tech Student, Department of CSE, Anurag Group of Institutions - India

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## Abstract:

The world has been enjoying the advantages of engineering and technology for better development and efficient usage of resources. Since a decade and more, automation has been playing a massive role in development through the perspectives of technology. Smart cities, Smart homes are booming in major parts of globes and giving growth for the scope for Internet of Things and necessity of automation. Similarly, smart lightening has become an integral part of growth and development. By the stats released by the Indian Government in 2018, it can be known that more than 2 billion rupees are used for establishing and maintaining street lights and 30-40% of the total electricity produced in the country is utilized in the process of street lightening. In the traditional working of street lights, manually a person needs to switch ON the lights when it's dark and when it's not switched OFF during the day time, it's a huge waste of electricity. In many occasions street lights glow even in deserted areas where there is not much need of lightening. So in this case, we need to ensure the lightening of street lights only in dark, and glow only when a vehicle is detected. This process is impossible to implement manually, so automation comes into play here. We in this project, have automated the working of street lights, such that the street lights glow only in dark at 20% illumination and when a vehicle is detected they glow at the brightest. The statistics of the power being consumed is sent to a Thingspeak cloud domain.

*Keywords* — **Microcontroller, ACS 712 Current Sensor, Arduino Uno, WiFi module, Thing Speak.**

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## 1. INTRODUCTION

### 1.1 Motivation

The statistics have proved the wastage of electricity and huge money for lightening streets. Most of the places in India still use illuminous bulbs as street lights which consumes excessive current. If there is a faulty street light, a person needs to register a complaint which can be easily overlooked by the authorities. Deserted streets with high illumination glowing street lights is a huge wastage of electricity. Manual and monotonous work of monitoring street lights can be avoided through automation including the power consumption rates and billing. While automation has taken over most of the work in the world, efficient smart lightening is yet to be achieved. The vague in establishing a perfect street lightening is a major problem to establish a smart city. Our project drives efforts to bridge the vague by using automation technology effectively.

## 2. PROBLEM STATEMENT

**2.1 Problem**: Lightening the streets is a challenging and essential task for every government. A major problem of power consumption arises while deploying street lights for lightening an area. A considerably huge cost and man work is required to maintain them. The main problem arises when lights are left ON in the day time due to any pone individual's negligence. In a deserted road, if the light is glowing in the absence of any vehicle or any moving body it is a waste of electricity. It was also found that around 150 crores are spent on maintaining street lights by the Indian government in 2017 and 38-40% of the total power generated is consumed by street lights. Automation can be an effective solution for the power wastage in this scenario.

**2.2 Statement**: A proper solution would be enabling lights to glow only in the night. Manually handling this is impossible. So, automation through IoT comes into picture here. Raspberry PI micro-controller is used in this project to control all the tasks. An Infra-Red (IR) sensor is used to recognize the moving body and illuminate the LED lights. The lights glow only in the dark by being detected by LDR sensor. The LED street lights glow only upto their 15% intensity when the path is deserted but glow to their brightest when a moving body is detected. The total data of power consumed is sensed by the voltage sensor and recorded statistically into ThingsSpeak. Parameters like vehicle count is also recorder for efficient monitoring of road traffic in areas. The future prediction of power consumed is also analyzed. The fault detection mechanism is applied in order to know the faulty street light.

## 3. RELATED WORK

The research paper "Intelligent Street Lights" published by Procedia Technologies, Y M Jagadeesh and team proposed an idea of managing LEDs using obstacle detection through IR sensor and Atmega 128 microcontroller. Another research work done by Parkash, Prabu V, Dandu Rajendra illustrates the working of smart street lights using PIC microcontroller. Which uses LDR to manage switching ON and OFF the LEDs and current sensor to calculate the current consumed. This project has come into implementation in China and Singapore. In Indian states, Telangana, Delhi and Gurgaon the authorities have automated the working of street lights in such a way that they use only solar power to function and operate through LDRs such they switch ON only in dark.

## 4. EVALUATION PARAMETERS

There are three major parameters recognized to evaluate this project.

1) The ON and OFF operation of street lights depending on the value in LDR.
2) The management of LEDs by using the value of IR sensor. Using PWM the intensity of LEDs are managed such that initially, in dark, glow at 20% intensity and when an object (vehicle) is detected by the IR sensor the lights glow at the brightest.
3) Current is calculated through ACS 712 Current sensor and fault detection mechanism is applied using the LDRs below the street lights and portrayed on a graph over ThingSpeak.

Based on these three parameters, testing strategies are performed to ensure the efficient working of the project.

## 5. PROPOSED SYSTEM

This project will have a prototype of street lights. An LDR is placed above the street light. Depending on that LDR's value the operation of switching the lights ON and OFF is managed. In case of dark the lights illuminate in 20% intensity. When an object is detected at the IR sensor placed prior to the series of street lights, three street lights illuminate to their brightest. An ACS 712 current sensor is used to calculate the current consumed. An LDR is deployed below each street light, at the neck. This helps in identifying the faulty street light. For instance if the environment is dark and the LDR placed at the neck of the street light recognizes low levels of brightness, it denotes that, that particular street light is faulty. The WiFi module seamlessly transfers data to the ThingSpeak cloud domain based on the Write API key.

## 6. FEASIBITY STUDY

Feasibility Study is a preliminary study undertaken to determine and document a project's viability. These results of this study are used to make a decision whether to proceed with the existing project, or table it. If it indeed leads to a project being approved, it will before the real work of the proposed project starts, be used to ascertain the likelihood of the project's success.

## 7. SCOPE AND APPLICABILITY

### 7.1 Scope:

- By using this project we can save more power. That is we can reduce the wastage of power.
- Here no need of man. The circuit itself checks the presence of vehicle and also checks weather it is day or night time. Once we switch on the circuit it automatically performs all this actions without man handling.
- The illumination of the LED light managed via PWM is another additional point for power consumption.
- This project on a large scale is being implemented in Amaravati, Raipur, Hyderabad, Delhi, Gurgaon and developed nations like China, USA and United Kingdom.

### 7.2 Applicability:

- Smart Cities
- Gated communities
- Highways

### 7.3 Software Required

1. Operating System- Windows
2. Technologies - C
3. IDE - Arduino

### 7.4 Hardware Required

1. Arduino Board
2. WiFi Module
3. ACS 712 current sensor
4. LDR
5. Adapter
6. LED

## 8. METHODOLOGY

### 8.1 Brightness Detection

To enable automation to the extent such that LEDs glow only in dark, we assign Light Dependent Resistor. The light dependent resistor senses the brightness in the environment and gives the resistor values. According to the LDR values we operate the ON and OFF behavior of the LED lights.

### 8.2 Vehicle Detection

Infra-Red (IR) Sensor is used to detect the vehicle according to which the operations of lightening the street light with the maximum intensity is done. The altering of brightness in LEDs is done via PWM (Pulse Width Modulation).

### 8.3 Importance of Microcontroller

In this project we use an Arduino UNO microcontroller which acts as the heart of the system. Arduino UNO manages all the operations required to implement in the project.

### 8.4 Data Over Cloud

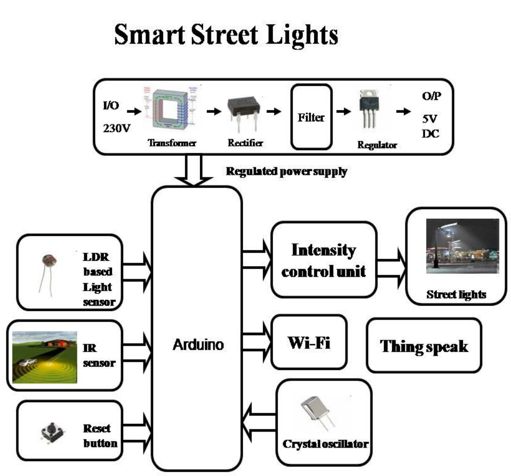
Several data is seamlessly uploaded to cloud using the WiFi Module. The statistical data, for every 15 seconds is uploaded to ThingSpeak cloud platform which can be available for the user with unique ID and Password by accessing internet.

### 8.5 Expected results

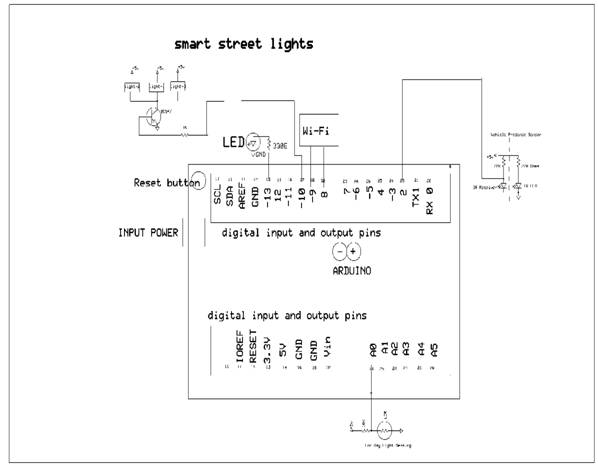
The following points indicate the series of results that are expected after successful implementation of the project.

1) LEDs glow only in the dark by using LDR and considering its value.
2) LEDs glow at low intensity (20% illumination) initially.
3) LEDs glow at high intensity when an obstacle is detected by IR sensor.
4) Efficient data transfer to ThingSpeak cloud through WiFi module.
5) Accurate fault detection of street lights done and displayed on ThingSpeak.

## 9. BLOCK DIAGRAM



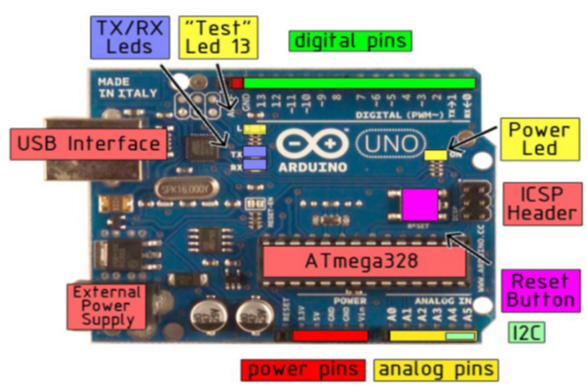

## 10. ARCHITECTURE




## 11. HARDWARE COMPONENTS

### 11.1 Arduino board

An Arduino microcontroller is an efficient microcontroller that can be used for efficient computing operations and IoT applications. It is the heart of the project. Arduino UNO contains ATmega 328 microcontroller which performs all the operations.



**ATmega 328**

**11.1.1 Features**

• High Performance, Low Power AVR® 8-Bit Microcontroller
• Advanced RISC Architecture
-131 Powerful Instructions – Most Single Clock Cycle Execution
- 32 x 8 General Purpose Working Registers
- Fully Static Operation
- Up to 20 MIPS Throughput at 20 MHz
- On-chip 2-cycle Multiplier
• High Endurance Non-volatile Memory Segments
- 4/8/16/32K Bytes of In-System Self-Programmable Flash progam memory (ATmega48PA/88PA/168PA/328P)
- 256/512/512/1K Bytes EEPROM (ATmega48PA/88PA/168PA/328P)
- 512/1K/1K/2K Bytes Internal SRAM (ATmega48PA/88PA/168PA/328P)
- Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
- Data retention: 20 years at 85°C/100 years at 25°C(1)
- Optional Boot Code Section with Independent Lock Bits
In-System Programming by On-chip Boot Program
True Read-While-Write Operation
- Programming Lock for Software Security

**11.1.2Peripheral Features**

- Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
- One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
- Real Time Counter with Separate Oscillator
- Six PWM Channels
- 8-channel 10-bit ADC in TQFP and QFN/MLF package
Temperature Measurement
- 6-channel 10-bit ADC in PDIP Package
Temperature Measurement
- Programmable Serial USART
- Master/Slave SPI Serial Interface
- Byte-oriented 2-wire Serial Interface (Philips I2C compatible)
- Programmable Watchdog Timer with Separate On-chip Oscillator
- On-chip Analog Comparator
- Interrupt and Wake-up on Pin Change

**11.1.3 Technical features of Arduino**

- Microcontroller ATmega328
- Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6
- DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin 50 mA
- Flash Memory 32 KB of which 0.5 KB used by
- bootloader
- SRAM 2 KB
- EEPROM 1 KB
- Clock Speed 16 MHz

**11.2 LED and IR sensor**

IR LED is used as a source of infrared rays. It comes in two packages 3mm or 5mm. 3mm is better as it is requires less space. IR sensor is nothing but a diode, which is sensitive for infrared radiation.

This infrared transmitter and receiver is called as IR TX-RX pair. It can be obtained from any decent electronics component shop and costs less than 10Rs.

Following snap shows 3mm and 5mm IR pairs.
Color of IR transmitter and receiver is different. However you may come across pairs which appear exactly same or even has opposite colors than shown in above pic and it is not possible to distinguish between TX and RX visually. In case you will have to take help of multi meter to distinguish between them.
Here is how you can distinguish between IR TX-RX using DMM:

- Connect cathode of one LED to +ve terminal of DMM
- Connect anode of the same LED to common terminal of DMM (means connect LED such that It gets reverse biased by DMM )
- Set DMM to measure resistance up to 2M Ohm.
- Check the reading.
- Repeat above procedure with second LED.
- In above process, when you get the reading of the few hundred Kilo Ohms on DMM, then it indicated that LED that you are testing is IR sensor. In case of IR transmitter DMM will not show any reading.

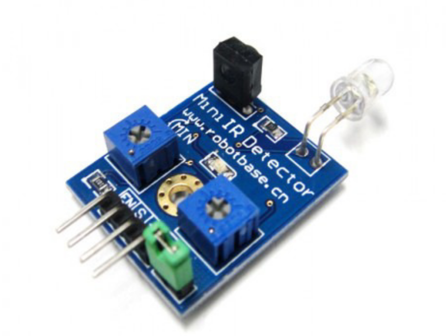
Following snap shows typical DMM reading obtained when IR receiver is connected to it as mentioned above. Second snap shows how sensor's resistance increases when it is covered by a finger. Note that, these are just illustrative figures and they will depend upon sensor as well as DMM that you are using.

While buying an IR sensor, make sure that its reverse resistance in ambient light is below 1000K. If it is more than this value, then it will not be able to generate sufficient voltage across external resistor and hence will be less sensitive to small variation in incident light.

**11.2.1 Features:**

1. Especially suitable for applications of 950 nm
2. Short switching time (typ. 20 ns)
3. 5 mm LED plastic package
4. Also available on tape

**IR Obstacle Detection Sensor**

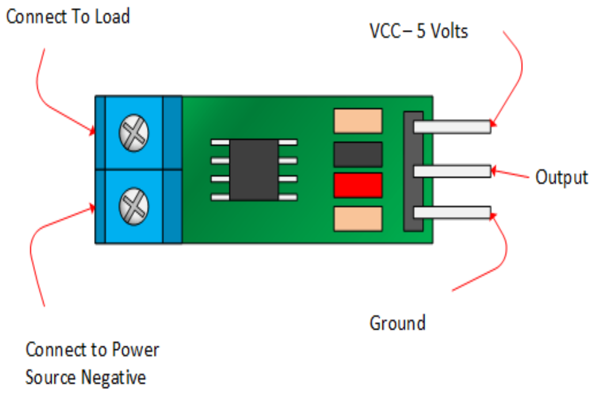



**LED**

**11.3 ACS Current Sensor**

An ACS712 5A current sensor is used to detect the current that is being consumed. The Module pins and connections for current sensor is described below.



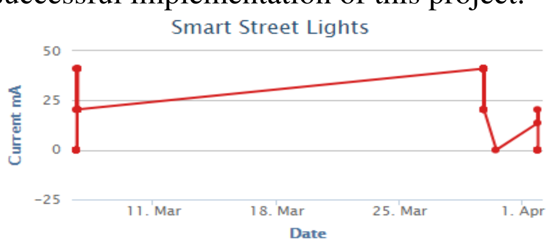

## 12. EXPECTED RESULTS

The following points indicate the series of results that are expected after successful implementation of the project.

1) LEDs glow only in the dark by using LDR and considering its value.
2) LEDs glow at low intensity (20% illumination) initially.
3) LEDs glow at high intensity when an obstacle is detected by IR sensor.
4) Efficient data transfer to ThingSpeak cloud through WiFi module.
5) Accurate fault detection of street lights done and displayed on ThingSpeak.

## 13. RESULTS AND ANALYSIS

Two important results achieved through this project that are displayed in form of graphs on ThingSpeak are Current Consumed and detection of faulty street lights. The below two images illustrate the results achieved by successful implementation of this project.

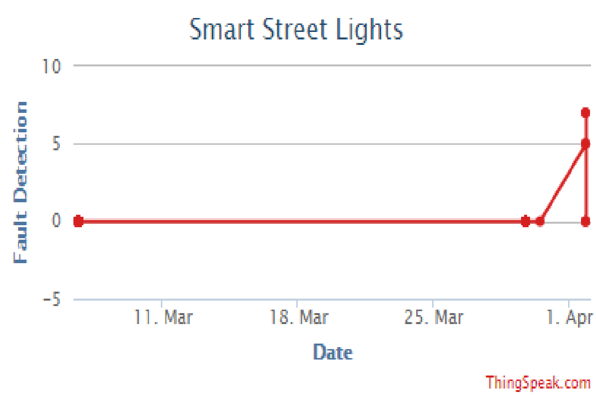



Statistics of current consumed

The fault detection mechanism in this project is implanted in such a way that in the graph:

1) If 0 is displayed in the graph, all the street lights are working well.
2) If 1 is displayed in the graph, the first street light is faulty.
3) If 2 is displayed in the graph, the second street light is faulty.
4) If 3 is displayed in the graph, first and second street lights are faulty.
5) If 4 is displayed in the graph, Third Street light is faulty.
6) If 5 is displayed in the graph, first and third street lights are faulty.
7) If 6 is displayed in the graph, second and third street lights are faulty.
8) If 7 is displayed in the graph, all the street lights are faulty.

If there are more than three street lights, the numbering goes as the powers of 2.




Detection of faulty street light

## 14. REFERENCES

1) Journal by Parkash, Prabu V, Dandu Rajendra in International Journal of Innovative Research in Science, Engineering and Technology.
2) Journal by Y M Jagdeesh, S Akhilesh, S Karthik and Prasanth in Smart Grid Technologies.