Smart Street Light System Using IOT

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Abstract - This project aims at designing and executing the advanced development in embedded systems for energy saving of street lights and increasing the security on the streets, data sharing, and surveillance of the respective areas. Nowadays, human has become too busy, and is unable to find time even to switch the lights wherever not necessary. The present system is like, the street lights will be switched on whenever the presence of human is detected on the road. For this, IR sensor will be used in this project. This project gives the best solution for electrical power wastage. Also, the manual operation of the lighting system is completely eliminated. Along with this, to solve the issues regarding woman's safety, a switch will be provided on the pole of the street light. When someone is in danger, that person just need to reach up to that switch and press it once. That switch will be further connected to microcontroller. Thus, project works together for maintaining security of women as well as minimizing energy consumption using solar panels.

Keywords: ESP32 microcontroller, street lights, women safety

1. INTRODUCTION

With the intensification of energy crisis all over the world, all the countries are looking for the way to solve this serious problem. One way is to search the new energy and take advantage of the renewable energy. Solar energy is the most direct, common, and clean energy on our planet we have already found until now. The proposed system uses solar energy for overall operation of Street lighting. In addition, the proposed street lighting system does not require complicated and entrenched wiring systems unlike those presently being utilized today. The project at hand can be easily installed and moved and delivers free renewable energy which is stored in a battery ready to be used when darkness falls. This system has the capability of real time flow control. These sensors are connected to the microcontroller in which data has been processed and adjust the lighting levels. Whenever the passer is identified by sensor, it will communicate to neighboring street lights, which will brighten the surrounding lights. The Street lights will dim to low voltage level when no activity is identified and brightens to high voltage level when movement is detected.

2. MOTIVATION

As crimes like robbery, kidnapping, etc. occur more during the night period when women, children or aged people walks through the street. They must feel secure. For this, we are developing a system which will be microcontroller based Along with this, energy consumption is a need of time. Here, we will be using IR sensors, so street lights will be ON only when presence of anything is detected. This will minimize total energy consumption by street lights at great extent.

3. PROBLEM STATEMENT

Many times, we see that street lights are remain switched ON even during day time, this is total of wastes of electricity while India is facing lack of electricity. In entire world there are more than 300 million of street lights, which emits 100 million tons of carbon dioxide per year. 40% of energy is wasted which costs around 20 billion dollars. Therefore, for economical operation of street lights and reduction of carbon footprints, highly efficient LED with smart control of illumine tion level is the demand and need of time. About India, India consumes 18% of electricity for street lighting and residential lighting in which street lighting takes major part, while India is facing shortage of electricity. If all existing streetlight replaced with LED lights, then India will be benefited by 5,500 core of rupees every year and reduction in CO2 emission.

4. LITERATURE SURVEY

1. In the paper titled "Solar Energy Management as an Internet of Things (IoT) Application", authors proposed the system introduced Photovoltaic (PV) array analytics and control have become necessary for remote solar farms and for intelligent fault detection and power optimization. The management of a PV array requires auxiliary electronics that are attached to each solar panel. A collaborative industry-university-government project was established to create a smart monitoring device (SMD) and establish associated algorithms and software for fault detection and solar array management. First generation smart monitoring devices (SMDs) were built in Japan. At the same time, Arizona State University initiated research in algorithms and software to monitor and control individual solar panels. Second generation SMDs were developed later and included sensors for monitoring voltage,

current, temperature, and irradiance at each individual panel. The latest SMDs include a radio and relays which allow modifying solar array connection topologies. With each panel equipped with such a sophisticated SMD, solar panels in a PV array behave essentially as nodes in an Internet of Things (IoT) type of topology. This solar energy IoT system is currently programmable and can: a) provide mobile analytics, b) enable solar farm control, c) detect and remedy faults, d) optimize power under different shading conditions, and e) reduce inverter transients. A series of federal and industry grants sponsored research on statistical signal analysis, communications, and optimization of this system. A Cyber-Physical project, whose aim is to improve solar array efficiency and robustness using new machine learning and imaging methods, was launched recently.

2. In the paper titled "Wireless Power Transfer: A Survey of EV Battery Charging Technologies", Fariborz Musavi, Murray Edington and Wilson Eberle suggested a comprehensive review of existing technological solutions for wireless power transfer used in electric vehicle battery chargers is given. The concept of each solution is thoroughly reviewed and the feasibility is evaluated considering the present limitations in power electronics technology, cost and consumer acceptance. In addition, the challenges and advantages of each technology are discussed. Finally, a thorough comparison is made and a proposed mixed conductive/wireless charging system solution is suggested to solve the inherent existing problems.

3. In the paper "Deployment of the Electric Vehicle Charging Station Considering Existing Competitors", authors Yiqi Zhao, Ye Guo stated the problem of optimal planning of plug-in electric vehicle (PEV) charging stations is studied. Different from many other works, we assume the station investor to be a new private entrant into the market who intends to maximize its own profit in a competitive environment. A modified Huff gravity-based model is adopted to describe the probabilistic patronizing behaviors of PEV drivers. Accordingly, a bi-level optimization model is formulated to decide not only the optimal site and size of the new charging station, but also the retail charging prices in the future operation stage. Based on the specific characteristics of the problem, the operation level sub-problem is reformulated to a convex programming and an efficient solution algorithm is designed for the overall bi-level optimization. Numerical examples of different scales demonstrate the effectiveness of the proposed modeling and computation methods, as well as the importance of considering the competitive effects when planning the charging station.

4. In the paper titled "Intelligent irrigation system- an IOT based approach", Dr. M Newlin Rajkumar, S. Abinaya, Dr. V. Venkatesa Kumar suggested the Internet of Things (IOT) has been denoted as a new wave of information and communication technology (ICT) advancements. The IOT is a multidisciplinary concept that encompasses a wide range of several technologies, application domains, device capabilities, and operational strategies, etc. The ongoing IOT research activities are directed towards the definition and design of standards and open architectures which is still have the issues requiring a global consensus before the final deployment. This paper gives over view about IOT technologies and applications related to agriculture with comparison of other survey papers and proposed a novel irrigation management system. Our main objective of this work is to for Farming where various new technologies to yield higher growth of the crops and their water supply.

5. SYSTEM DESIGN

5.1 SYSTEM ARCHITECTURE:

Solar panels collect energy from the sun and convert it into electricity used to charge the battery, charged battery is used restart the whole system. Through battery, we will provide supply to ESP32 which is controlling the functioning of LDR and IR sensor as per the presence of a vehicle. Then according to the changed occur in IR sensor and LDR the ESP32 controls the power LED circuit. The street lights will dim to low voltage level when no activity is identified and brightens to high voltage level when moment is detected. In this system we are providing the panic switch for emergency condition. When user press the button the output of switch is connected to the microcontroller.

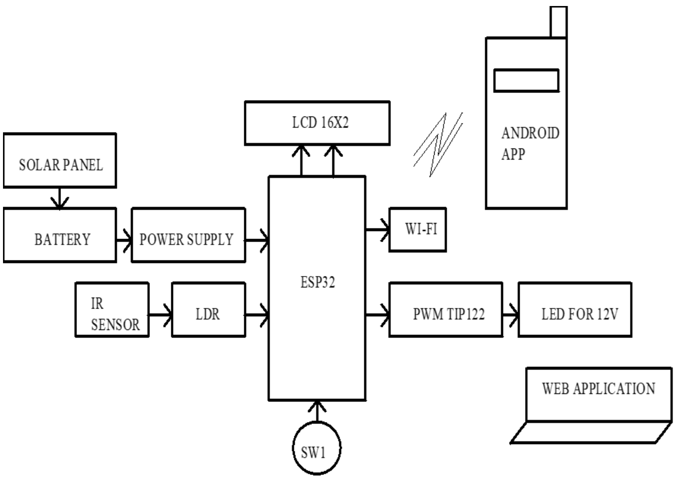

Fig 1: System Architecture (Block Diagram)

5.2 POWER SUPPLY DESIGN

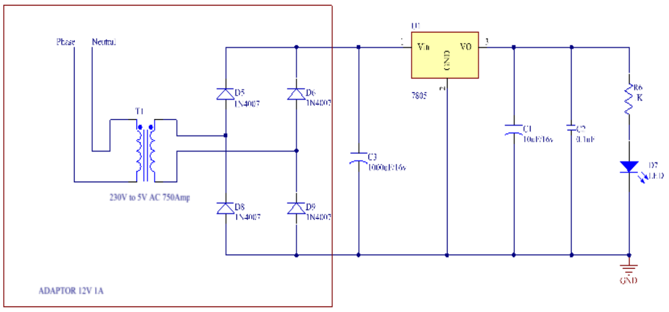

Fig 2: Power supply design

The following information must be available to the designer of the transformer.

1) Power output.
2) Operating voltage.
3) Frequency range.
4) Efficiency and regulation.

Size of core is one of the first consideration in regard of weight and volume of a transformer. This depends on type of core and winding configuration used. Generally following formula is used to find Area or Size of the Core.

$Ai = \sqrt{Wp} / 0.87$ ……. (1)

Where, Ai = Area of cross section in square cm.

Wp = Primary Wattage.

For our project we require +5V output, so transformer secondary winding rating is 9V, 500mA.

b) Wire size: - As stated above the size is depends upon the current to be carried out by winding which depends upon current density. For our transformer one tie can safely use current density of 3.1 Amp / sq.mm.

For less copper loss 1.6Amp/sq.mm or 2.4sq.mm may be used generally even size gauge of wire are used.

R.M.S secondary voltage at secondary to transformer is 9V. So maximum voltage Vm (Vp) across secondary is

$VP = Vrms \times \sqrt{2}$ …..(5)

$Vrms = VP / \sqrt{2}$

$= 9 / 1.141$

$= 7.88$ V

D.C output voltage Vm across secondary is,

$Vdc = 2 * 7.88/pi$ ....(6)

$= 2 * 7.88/3.14$

$= 5.02$ V

6. PROJECT MODEL IMPLEMENTATION

6.1 OVERVIEW OF PROJECT MODULES:

We will interface ESP32 Microcontroller with LCD 16x2, IR sensor, Solar panel, and relay, LDR, Hydrogen Sensor and Buzzer, Exhaust fan. We will interface all components with an ESP32 microcontroller. To provide 5V DC supply. We used transformer and rectifier circuit at the input side of project.

6.2 TOOLS AND TECHNOLOGIES USED:

6.2.1 Hardware requirement:

1. ESP32 Microcontroller: It has a dual-core 32-bit MCU, which integrates Wi-Fi HT40 and Bluetooth/BLE 4.2 technology inside. Compared to the ESP8266 (the previous generation), the ESP- WROOM-32 has a significant performance improvement. It is equipped with a high-performance dual-core Tensilica LX6 MCU. One core handle high speed connection and the other for standalone application development. The dual-core MCU has a 240 MHz frequency and a computing power of 600 DMIPS. In addition, it supports Wi-Fi HT40, Classic Bluetooth/BLE 4.2, and more GPIO resources. ESP32 chip integrates a wealth of hardware peripherals, including capacitive touch sensors, Hall sensors, low noise sensor amplifiers, SD card interfaces, Ethernet interfaces, high-speed SDIO / SPI, UART, I2S and I2C, etc.

2. Solar panel: It can output 10 Watt of power at 12 Volts under ideal light conditions. It is 35 cm x 30 cm x 2.5 cm in size. Can be used in low-cost solar projects. You can connect two such solar panel in parallel to get more current and you can connect them is series for getting more output voltage. Perfect for making solar projects and for use as a general-purpose solar application.

3. Battery: This is original Lithium-ion 18650 Rechargeable Cell from LG. With rated voltage of 3.7volts and a capacity of 2600mAh.

4. IR Sensor: Infrared Obstacle Avoidance IR Sensor Module (Active Low) has a pair of infrared transmitting and receiving tubes. When the transmitted light waves are reflected back, the reflected IR waves will be received by the receiver tube. The onboard comparator circuitry does the processing and the green indicator LED comes to life. The module features a 3 wire interface with Vcc, GND and an OUTPUT pin on its tail. It works fine with 3.3 to 5V levels. Upon hindrance/reflectance, the output pin gives out a digital signal (a low-level signal).

5. LDR: This a 5 mm size light sensor which changes resistance with the change in the ambient light exposed on the surface of the sensor. A Light Dependent resistor (LDR) also called as photo-resist is a sensor whose output varies in proportion to the light falling on it. This is the most common type of LDR where the resistance of the LDR decreases as the light intensity of light falling on it increases i.e.; the resistance is inversely proportional to the light intensity falling on the LDR. LDR (Light Dependent Resistor) is a type of photocell which finds

excellent use in light sensing device application, whether it is automatic outdoor light ON/OFF switch or Indoor automatic light switching. The sensor works best in both Light and dark region.

6. Switch: Little colicky switches are standard input “buttons” on electronic projects. These work best in a PCB but can be used on a solder less breadboard as shown in this tutorial. The pins are normally open (disconnected) and when the button is pressed, they are momentarily closed. Miniature Single Pole Single Throw switches. These are high quality Omron type B3F momentary on switches. Perfect as a tactile reset switch. Rated up to 50mA.

6.2.2 Software requirement:

Sr. No	Parameter	Description
1.	Arduino IDE	For programming in Arduino controller
2.	OrCAD	For Block diagram designing
3.	Altium	For PCB designing

Table 1: Software requirement

7. CONCLUSIONS

In this project we have understand the interfacing of ESP 32 and Wi-Fi module with Android application. Also, we studied the power supply design of 5V required for this project. Along with that we did the interfacing of LCD 20 x 4 with esp32 which will be used to display the operation of the system. We are saving 70% of energy during night time and 100% of energy during day time by using PWM technique. As we developed android application through Blynk software which is useful for many aspects like it will display notification for street maintenance and emergency situation, it can show temperature and humidity present in the atmosphere.

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REFERENCES

1. Dr. A. Senthil Kumar, K. Vignesh, M. Sakthivel, K. Priya, Parenchymal Joseph “A Study on IoT based Smart Street Light Systems”, International Journal of Engineering Research & Technology (IJERT), Volume 8, Issue 07 – 2020.

2. Sanjana Mathew, Sumedh Reddy K and Hemlata Dalmia “Smart Street Lighting System Using Arduino UNO” THINK INDIA JOURNAL, Vol-22-Issue-41- December-2019.

3. Archana. G, Aishwarya N, Anitha J “Intelligent Street Light System” International Journal of Recent Advances in Engineering & Technology, Vol-3, Issue-4, 2015.

4. Tan, Y.K.; Huynh, T.P.; Wang, Z.Z. “Smart personal sensor network control for energy saving in DC grid powered LED lighting system.” Vol-2, Issue-3 IEEE Trans. Smart Grid 2013, 4, 669–676.

5. Park, Y.J.; Lee, M.H. “Cost Effective “Smart Remote Controller Based on Invisible IR-LED Using Image Processing.” Vol-2, Issue-5 In Proceedings of the 2013.