Real Time Implementation of Automatic Moisture and Light Control Protection for Garden

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Abstract: In this article, we proposed an automatic street light control using Real-Time Clock (RTC) and Light-Dependent Resistor (LDR) and that relies on a real-time clock. The main idea of this paper is predicated on using as little energy as possible. In this work, we use the DS1307 real-time clock module to automatically switch on or off-street lights dependent on the time of day. Programming controls the timing of when the device is active. In a similar vein, LDR is used to detect the amount of light, and the street lights are controlled accordingly. The most significant benefit of street lighting is the reduction of risk associated with potential crashes. Lights on the streets are often switched on at night and left on till morning. Their operation is entirely manual. Because of the increased risk of electrical shock during the rainy season, this proposed design intends to automate the operation of streetlights in order to reduce power consumption, improve public safety, and advance technological progress.

Keywords: *Real Time Clock, Automation Street Light, Real Time Monitoring, Power Consumption and Energy Efficiency.*

1. Introduction

Something embedded in another is related to it. One definition of an embedded system is a computer system in which the software is physically integrated into the hardware. Both standalone and integrated applications may be considered embedded systems. An embedded system is a computer with a built-in microcontroller or microprocessor that is programmed to carry out a limited set of instructions. The system gets its moniker from the application-specific software that is built in into it. An embedded system is a software-based, real-time control system that is microcontroller-based. Microcontroller andmicroprocessor-based systems designed to manage and track the operation of physical devices are known as embedded systems [1]. Embedded systems have the potential to provide exceptional performance and levels of automation.The development of autonomous robots that could be used in everyday life was a major breakthrough made possible by embedded systems, which sent shockwaves through the scientific community. Embedded technologies have already shown their worth in our daily lives via the widespread appeal and unique attractiveness of branded electronic firms' robot companions. Embedded systems are likely to be the dominant technology in the future due to their wide range of possible uses and the possibility that they will allow for the creation of extremely inventive goods [2]. The Embedded market is seeing two big shifts at the moment.

The true impetus behind Embedded programming-based application R&D is the mutually beneficial partnership between Embedded software suppliers and Original Equipment Manufacturers (OEMs) [3].The complexity of Embedded applications necessitating more robust, inexpensive hardware and enhanced connectivity poses problems for the Embedded Operating System (EOS) business and its future development.

Microcontrollers are programmed to carry out certain operations. To be more precise, this refers to use cases where the connection between input and output is explicitly stated. Some kind of processing is required, and output is provided, but this all depends on the input. Input devices such as keyboards, mice, washing machines, digital cameras, pen drives, remote controls, microwave ovens, automobiles, bicycles, telephones, mobile phones, watches, etc. Embedding these applications on a single chip is feasible because of the few resources they need. As a result, both the size and the price are reduced. Microprocessors excel in general-purpose jobs

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like programing, game design, website creation, image editing, document creation, etc [4]. In such circumstances, the connection between the two is unclear. They need a lot of storage space, processing power, input/output interfaces, etc.
The microprocessor has a much faster clock speed than the microcontroller. Microprocessors of today do sophisticated operations at speeds more than 1GHz, whereas microcontrollers only manage speeds of a few megahertz (MHz) up to 30 or 50 MHz.The cost-effectiveness of a microcontroller vs a microprocessor cannot be compared. Compared to a microprocessor, a microcontroller is unquestionably more cost-effective. Nevertheless, a microprocessor should not be utilised in lieu of a microcontroller since doing so greatly increases the cost of the application. The microprocessor is useless in isolation. A system built on a microprocessor is expensive since it requires additional components like RAM, ROM, a buffer, I/O ports, etc.

2. Literature Review

In order to maximise the effectiveness of solar energy conversion, the authors of "Energy Efficient Smart Street Light" [5] evaluated a streetlight with an automatic tracking system. From ceiling fans to washing machines and beyond, these automation systems play a crucial role in making our everyday lives more pleasant and convenient [6]. The conventional lighting system only has two settings, on and off, which is inefficient since it wastes energy by always being at full power. Hence, one of the notable power losses is from street lights, although automation leads to numerous new ways of conserving energy and money. The use of a Light Dependent Resistor (LDR) to regulate the lighting system is one solution [7]. By 2015, the planned traffic-flow-based solar-powered street lighting system will be fully operational. They powered the streets using solar energy, a renewable resource [8]. LEDs (Light Emitting Diodes) are employed because they are more energy efficient and provide more light than traditional light sources such as halogen lamps, mercury lamps, etc. The streetlights' independence from other entities is achieved by their light-sensor-based functioning [9]. The studies detail the two-installation case study conducted in Scotland and Wales and provide an overview of the technology's features and advantages. Around a hundred thousand MINOS devices had been installed and were functioning well, according to the system's installation log[10].

Although there are many fascinating uses for electricity, none is more important than street lights for ensuring the safety of pedestrians and drivers after dark. Having streetlights on all night long is a major drain on resources and shortens the lifespan of associated electrical components like electric bulbs. Much of a city's energy budget goes towards lighting, and streetlights in particular are notorious power hogs. An intelligent lighting management system may extend the life of street lights and save expenditures by as much as 70 percent [11]. In certain instances, the on/off times of street lights are predetermined, and if the corresponding timer is malfunctioning for any reason, it will take some time to remedy the issue via the right channels. Keeping the light on for an extended period of time has an impact on the environment [12]. Similar research showed that the majority of crimes are committed at night, emphasizing the need for adequate illumination on roadways and thoroughfares [13].

The purpose of this study [14] is to propose employing solar panels to power lighting in order to cut down on energy use. The goal is to reduce energy consumption by automating the on/off switching of streetlights and by switching the streetlight to avoid wasting light when it is not required. The proposed system [15] uses motion detection sensors to ascertain whether the lights should be brightened or turned off entirely. This study [16] examines the use of the Internet of Things (IoT) and wifi/LoRa for monitoring energy-efficient electrical appliances. This system [17] monitors the movement of people through which the intensity varies, saving the excessive use of light and reducing the cost of power. It is free of cost and has a vast range of operation and can replace the wired network infrastructure of greater cost. In [18] Analysis of Solar energy based street light with auto tracking systemwas published by C.Bhuvaneshwari et.al.,. Lasket, Tsering developed Automatic Light Intensity Monitoring using Modern Technology [19]. Magno, et.al., developed A Low-cost, Highly Scalable Wireless Sensor Network Solution to Achieve Smart LED Light Control for Green Buildings. [20].

3. Proposed Model

Safety and the prevention of accidents at night make street lighting a necessity in modern society. One of a city's most crucial — and costly — duties is lighting its streets at night. In average cities throughout the globe, lighting may account for 10–38 percent of the entire energy cost. Because of its crucial role in maintaining economic and social stability, public authorities in developing nations place a premium on adequate street lighting. Indirectly, the installation of street lights has helped the public and the government decrease the crime rate and the number of accidents in the neighborhood. It promotes social cohesion by making individuals feel safe venturing out in the evening. Nonetheless, in today's hectic world, nobody thinks to turn it off or on until absolutely necessary. Poor lighting causes unhealthy environments and wastes thousands of dollars annually. Lighting for streets may be made much more affordable with the use of energy-saving technology and layout. The three factors of automation, power consumption, and cost effectiveness are now at the forefront of technological development. The goal of automating tasks using computers and other smart technologies is to lessen the need for human labor. While electricity generation is becoming more difficult for a variety of reasons, reducing energy consumption must always be a top priority. When the demand increases, it becomes more critical to design a system that minimizes costs. We implemented automated street light control based on an RTC and LDR to address this issue. In this age of automation, humans are restless and unable to regulate the manual operations of any field; a rapid advancement in embedded systems has paved the way for the design and development of a microcontroller-based automatic street light control using a Real-Time Clock (RTC) and a Light-Dependent Resistor (LDR). As daylight fades below the range of human visual perception, the streetlights turn on automatically. In our proposed design, we used a DS1307, a light-sensing diode with four pins (VCC, GND, SCL, SDA) that are connected to a microcontroller; when we tell it the time, it compares it to the time stored in the RTC; if the two times are the same, it proceeds to the next step, in which it determines whether or not there is sufficient light to warrant turning off the streetlights.

3.1. Automatic Light Control Architecture

These strategies were developed to address deficiencies in previously used approaches. Our proposed design's power supply will draw from 230V ac, and after passing through a step-down transformer, 5V and 12V dc will be produced for use in the circuitry. This is shown in the block diagram Figure 1. The LDR and RTC get their power from this 5V source. LED strips, model ULN2003, need a 12V supply. The microcontroller will get the current time from the RTC, which will keep accurate time using a quartz crystal. The light-dependent resistor (LDR) measures and reports light intensity. The microcontroller, a Node MCU v3, receives data on the light intensity and responds by increasing the conduction rate. This is an Arduino microcontroller, and its code is created in the Arduino software development environment. C-language code is embedded. We've set up the IDE and RTC lib for RTC programming and penned the code for calculating LDR intensity. We utilised microcontroller pins A0 for ADC values from the LDR, D1 and D2 for SCL and SDA from the RTC, D3, D4, and D5 for the LED strips, and D6, D7 for the reset button.

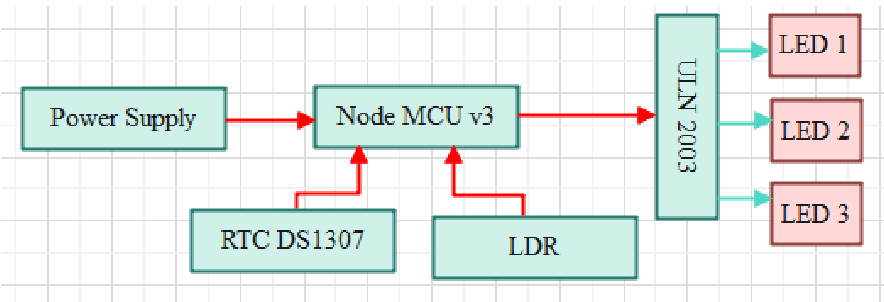

Fig. 1. Automatic Light Control Architecture

We came up with a novel approach and employed LDRs and RTCs in this proposed design, while before they had just used LDRs or RTCs, to account for the volatility of the Indian environment and seasonal variations. If the time on the RTC coincides with the time we've specified for the lights to come on, then just the lights will activate; otherwise, they will stay off. When the RTC checks to see whether it's time to turn on the lights, it compares the current time to the time set by the user; if the difference is less than or equal to 5, the lights turn on.

3.1.1. Microcontroller NODE MCU Description

The microcontroller is a programmable electronic device. A microcontroller is a single-chip device that has a central processing unit (CPU), memory (RAM), input/output (I/O) ports, and a timer. Microcontrollers are great for various uses because of the set quantity of on-chip Memory, ROM, and I/O ports. Prototyping your Internet of Things (IoT) device is as easy as writing a few lines of Lua code with the aid of the Node MCU, an open-source firmware and development kit. Expressive Systems created a micro controller known as the ESP8266.

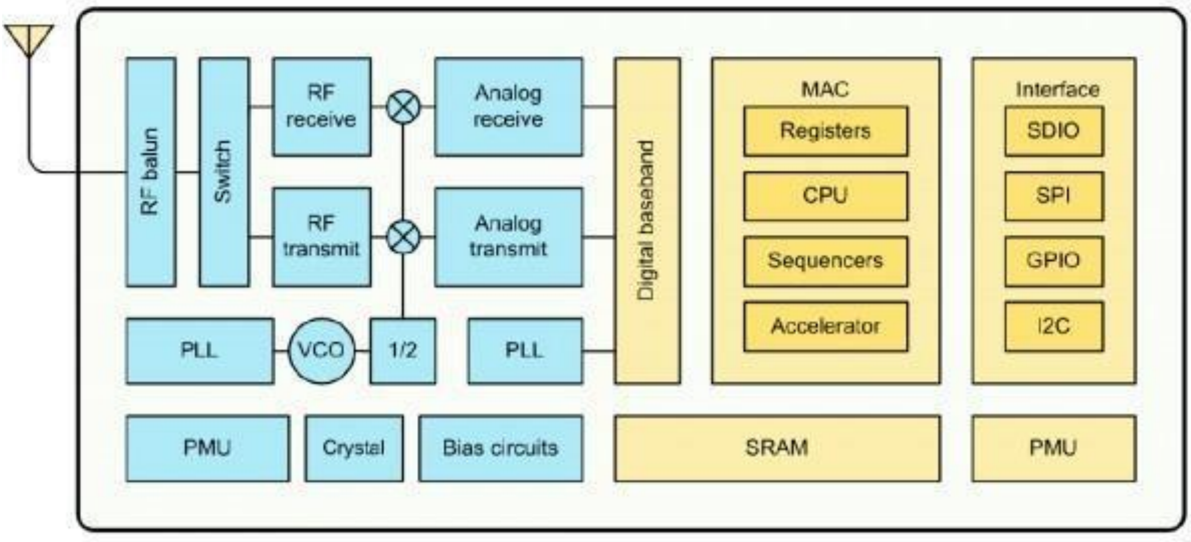

Fig. 2. Basic block diagram of Node MCU v3

In Figure 2, this module has a wide variety of pin-outs and an integrated USB port. Like Arduino, Node MCU devices may be easily flashed by connecting them to a laptop via micro-USB cable. There are a total of 30 pins on the node MCU v3, but we only make use of a subset of them. A zero, GND, VCC, D1, D2, D3, D4, and D5 are the standard digital outputs.
Gnd means "ground" or "grounding."
Power is supplied via the VCC pin.
The microcontroller's analogue input is connected to pin A0.
The SCL input is connected to D1.
SDA data is entered via D2.
The LED strips should be connected using pins D3, D4, and D5.

3.1.2. Features of Node MCU

1. The Tensilica 32-bit RISC Processor Xtensa LX106 serves as the microcontroller.
2. 3.3V is the working voltage.
3. Powered by a 7-12V input voltage
4. Digital Input/Output (DIO) Pin Count: 16
5. ADC Input Ports (Analog Input): 5
6. UARTs: 1
7. SPIs: 1
8. I2Cs: 1
9. 4 MB of internal flash memory
10. ROM: 64 KB SRAM: 10
11. 80 MHz Clock Frequency
12. USB-TTL based on CP2102 is onboard, allowing for Plug n Play operation.
13. Radio Antenna PCB
14. Compact form factor allows for easy integration into existing IoT applications.

3.1.3. ESP 8266:

The Node MCU group has built a micro-USB connector for programming and a 3.3v regulator as part of an open-source, comprehensive development board for the ESP8266. After connecting the Node MCU board to your computer and installing the necessary USB drivers, you can immediately begin programming it to communicate with your wifi network. You can get all of that for a mere four dollars (USD) on eBay.As the most widely used and inexpensive wifi system-on-a-chip (SoC) with a TCP/IP stack and a low-power 32-bit microcontroller, ESP8266 is produced by express if, a Chinese company with headquarters in Shanghai. The Internet of Things (IoT) is a newly developing industry at the moment. One of the most common and inexpensive methods for establishing a wireless connection between "Things" and the internet.The Arduino IDE is by far the most popular environment in which to work with ESP modules, while there are many others. The ESP8266 module can only function when supplied with 3.3V; 3.7V or more will damage it. The ESP-01 may be programmed using the 3.3V FTDI board. Every user of ESP-01 eventually runs across issues with turning it on. Power the module via a 3.3V Arduino pin or a potential divider while programming. The module consumes a fair amount of electricity. Thus, a tiny voltage regulator for 3.31v that can produce at least 500mA is essential. A good example of a regulator is the LM317.

3.1.4 ULN 2003:

The ULN2003 is used for current amplification. It has 16 terminals, or pins. The IC has 16 inputs and 14 outputs; the inputs are pins 1, 3, and 5, while the outputs are pins 16, 14, and 12. The inputs are extended from the microcontroller's D3, D4, and D5, and the Vcc is pin 9, a 12V supply; pin 8 is ground. The ULN2003 is an array of Darlington transistors that can handle high voltage and current. For switching inductive loads, it has a common-cathode clamp diode at the high-voltage outputs of its seven NPN Darlington pairs. It is possible to parallel the Darlington pairs to increase their current carrying capacity. Each channel has a 500mA continuous current rating and a 600mA peak current capacity. The inputs are pinned opposite the outputs, and there are built-in suppression diodes for driving inductive loads.
Each of the ULN2001, ULN2002, ULN2003, and ULN2004 is an open collector Darlington array with a common emitter that can handle high voltage and current. Each channel has a 500-mA rating and can handle 600 mA peak currents. Inputs are pinned on the opposite side of the board as the outputs, and suppression diodes are added for driving inductive loads. All of the logic families are supported by the different versions: ULN2001 (all-purpose, DTL, TTL, PMOS, CMOS); ULN2002 (14–25 V PMOS); ULN2003 (5 V TTL, CMOS); and ULN2004 (6 - 15 V CMOS, PMOS). These multipurpose electronics may power anything from a solenoid to a DC motor to a high-power buffer or LED display filament light. In order to minimize thermal resistance, the ULN2001A/2002A/2003A and 2004A are provided in a 16-pin DIP package made of copper. ULN2001D1/2002D1/2003D1/2004D1, they are also offered in a miniature outline format (SO-16). For more condensed code, ULN2003 may be obtained in the TSSOP16 package.

3.1.5. LDR

Two photoconductive cells made of cadmium sulphide (cds) with spectrum responses similar to the human eye. When the brightness of the light increases, the cells' resistance decreases. While being a specialized sort of Resistor, the Light Dependent Resistor (LDR), also known as a Photoresistor, has no polarity and may be connected in any way. These work well with a breadboard and can be adapted to a perf board with little effort. The LDR pinout diagram depicts a symbol similar to that of a Resistor, but with additional, internal arrows. The directional arrows indicate the lights' messages. The concept of photoconductivity lies at the heart of how photoresistors function. The absorption of light by a substance may enhance its conductivity, a process known as "photoconductivity.

A photoresistor, also known as an LDR (Light Dependent Resistor), is a kind of resistor whose resistance varies with the intensity of the light hitting it. Hence, in a completely dark room, the resistor will have a resistance of many megaohms, but when light is progressively shone over the sensor, the resistance will begin to diminish, eventually reaching a few ohms. Electrons in a semiconductor material's valence band are stimulated to the conduction band when light (photons) strikes the device. In order for the electrons to transition from the valence band to the conduction band, the energy of the photons in the incoming light must be larger than the bandgap of the semiconductor material. Because of this quality, the LDR may serve as a light detector. It is sensitive to the quantity of light hitting it and can therefore tell day from night. So, this sensor is the simple and inexpensive answer for us if we need to detect light or tell the difference between day and night.

3.1.6. RTC

A real-time clock (RTC) is an accurate timepiece for computers, often implemented as an integrated circuit. While the word is most often used to describe components of computers, servers, and embedded systems, real-time clocks (RTCs) may be found in almost any electronic equipment that requires precise timekeeping. The clock's precision relies on the crystal's precision and the accuracy with which the oscillator circuit's capacitive load matches the capacitive load for which the crystal was trimmed. Crystal frequency drift due to temperature changes will provide another source of inaccuracy. The clock may be running quickly if the oscillator circuit was subjected to external circuit noise.

The DS1307 is a serial bus slave device. Implementing a START condition and then giving a device ID number and register address grants access. Unless a STOP condition is carried out, subsequent registers may be accessed in order. The device will abort an active access and reset its address counter when VCC drops below 1.25 x VBAT. So long as the system is operating outside of its tolerance range, inputs to the device will be ignored.

When the voltage drops below the battery backup threshold (VBAT), the device enters a low-current battery backup mode. During startup, if VCC is larger than VBAT + 0.2V, the device will switch from battery to VCC, and if VCC is greater than 1.25 times VBAT, it will detect inputs. The key components of the serial RTC are shown in Figure 3's block diagram.Reading the correct register bytes will provide you with the time and date. Figure 3 depicts the RTC registers. Writing the proper register bytes sets or initializes the time and calendar. The time and date registers are stored using BCD values. The clock halt (CH) bit is located in position 7 of register 0. Setting this bit to a 1 turns off the oscillator. Clearing to a 0 activates the oscillator. Please be aware that the values of all registers upon power-on are not specified. As a result, the oscillator must be turned on (CH bit = 0) when the system is first set up. The DS1307 has a choice of 12-hour or 24-hour operation.

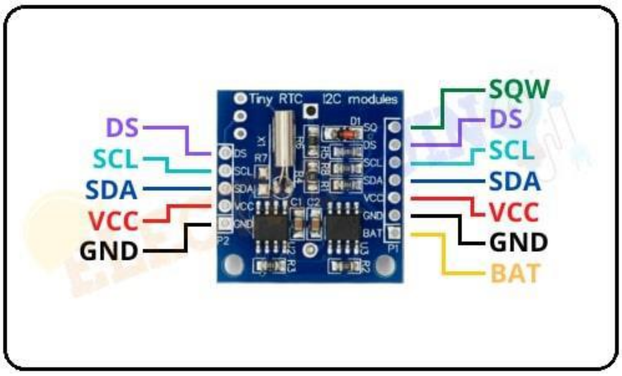

Fig.3. LDR circuital diagram

The 12/24-hour mode choose bit is located in the sixth bit of the hours register. While it's on high, it switches to 12-hour mode. Bit 5 indicates PM if in 12-hour time format, whereas AM indicates logic low. Bit 5 in the 24-hour mode represents the second 10-hour interval (20- 23 hours). The current time is sent to a second group of registers during a 2-wire START. When the clock is still ticking, the time is retrieved from these auxiliary registers. In the event that the main registers are updated during a read, it is not necessary to re-read the registers.

3.2 Working Principle

Because of its crucial role in maintaining economic and social stability, public authorities in developing nations place a premium on adequate street lighting. The primary goal of this proposed design is to create an autonomous streetlight management system that is both affordable and dependable. The current standard switching and timer switching system's biggest flaw is its excessive energy consumption. The primary focus here is on developing a robust automated streetlight controller. The brain of the controlling circuit is the node MCU. The rectifier circuit consists of a step-down transformer, a voltage regulator, and other components to provide the control circuit with the 5V DC it needs to function. The light dependentutilized for this purpose provides analogue signals to the microcontroller based on the amount of light hitting the sensor. The combination of a light-dependent resistor and the timer principle is used. Setting the actual, active, and inactive times of a system.

The proposed model circuit implementation is presented in Figure 4. There are two prerequisites that must be met before the streetlight will turn ON or OFF. The microcontroller's timers and the light-dependent resistor's ability to measure light intensity are two of the prerequisites. When these two criteria are met, the microcontroller sends out signals to activate or deactivate the relay, respectively, causing the streetlight to turn on or off. The NodeMCU Microcontroller's Analog to Digital Converter (ADC) processes the LDR's analogue signals. The lights will turn on when the controller sends the signal.While power wastage issues are being faced in the current street lighting system owing to inappropriate switching operation, the goal of this proposed design is to build a highly dependable automated streetlight system. The microprocessor and Light Dependent Resistor in the planned control circuit are the primary controlling elements. It is determined that the designed system has effective automated switching control. This is the automated street light control circuit that was built. Embedded C programmes are part of the system design and are uploaded to the NodeMCU microcontroller. Analog signals from the RTC and LDR are processed by the microcontroller, together with the ON/OFF time adjustments. Only when both requirements are met will the streetlight switch on or off. When the LDR detects a decrease in light intensity and the specified-ON time coincides, the bulb lights up. This demonstrates how automated street light’s function.

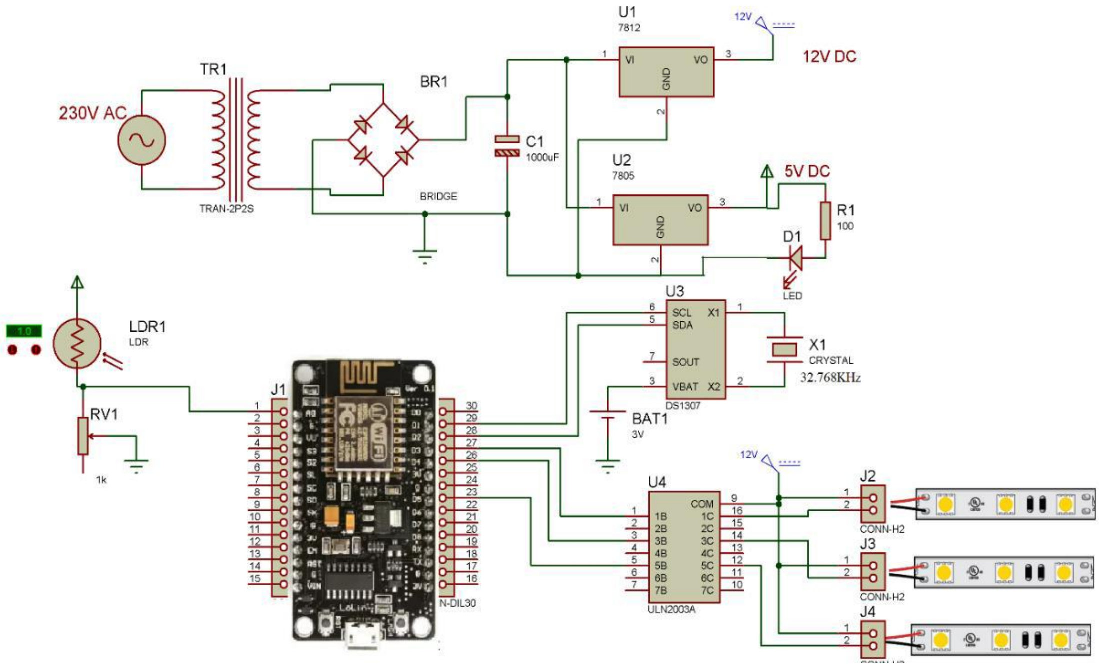

Fig.4. Schematic Diagram

In Figure 5, at all times throughout the day, the LDR sends its analog-to-digital converter (ADC) readings to the controller, which then checks the conditions we've specified in the code to determine whether or not to activate the lights.We have now integrated RTC and LDR since we have specified in the code that the RTC should keep time in accordance with our plans.In order to determine whether or not the lights should come on, the controller first verifies that the time set in the RTC corresponds to the time the user has specified. If this is the case, the controller then checks the light intensity using the ADC value read from the LDR; if the value is below 400, the lights will come on for 5 seconds before turning off automatically.

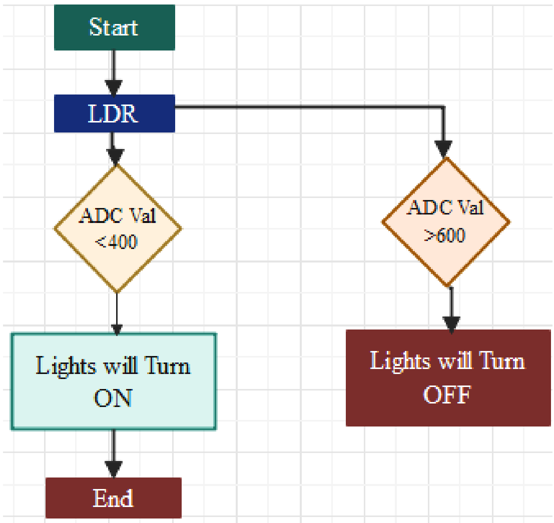

Fig.5. Flow Chart for LDR

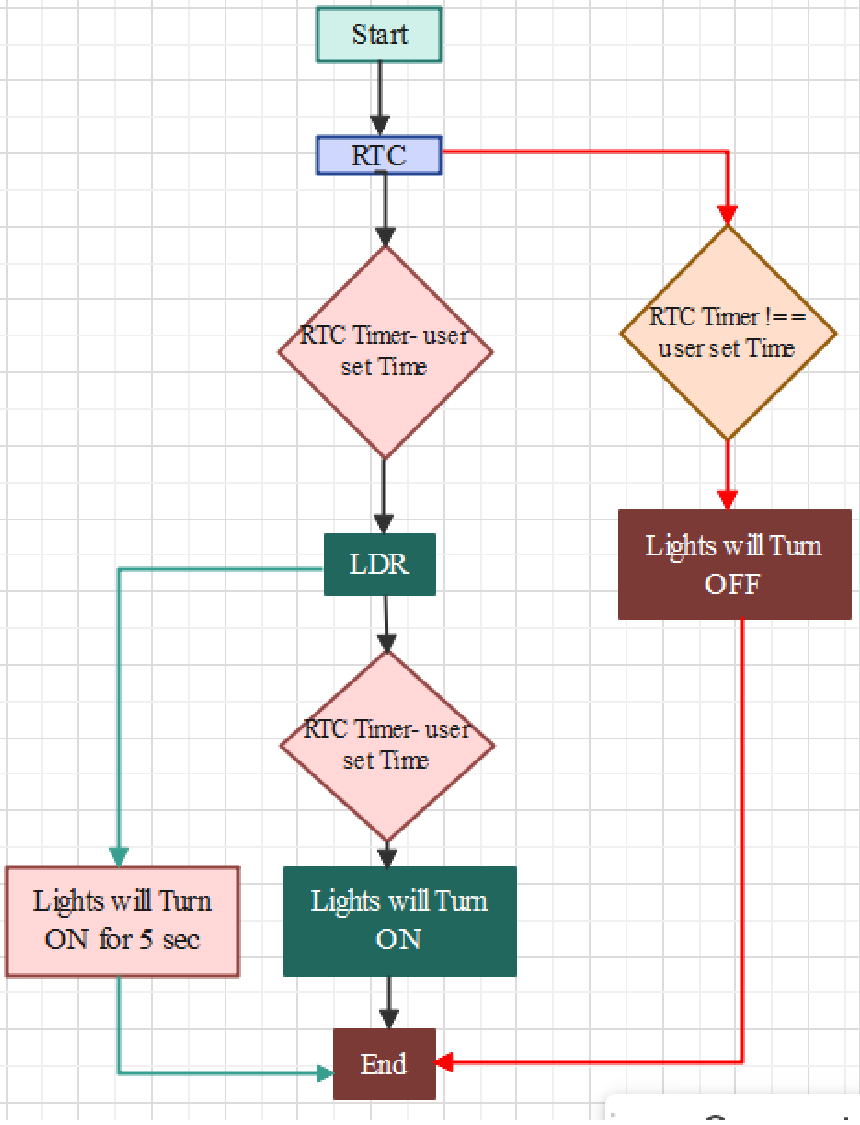

Fig.6. Flow Chart using RTC and LDR

The above design (Figure 6) works well both during the day and at night; the lights turn on and off with the help of an RTC and a light-dependent resistor (LDR).

4. Experimental Analysis

In this case, an LDR and RTC-based Automated Street Light Controlling System has been put into use in the real world. Light intensity is correlated with ADC readings in this system. LDR ADC values may be used to power the system; if the ADC value is below 400, the lights will turn on, and if it's above, they'll stay off.

4.1 Condition-Based Output

As soon as the device is turned on, the LCD screen will display the smart campus (show in Figure 7) so long as a wifi connection is accessible, and then it will display the wifi connection status after it has been established. The next step is to wait for the card to be read while the LCDs the current temperature and humidity. Transfer to the IoT application.

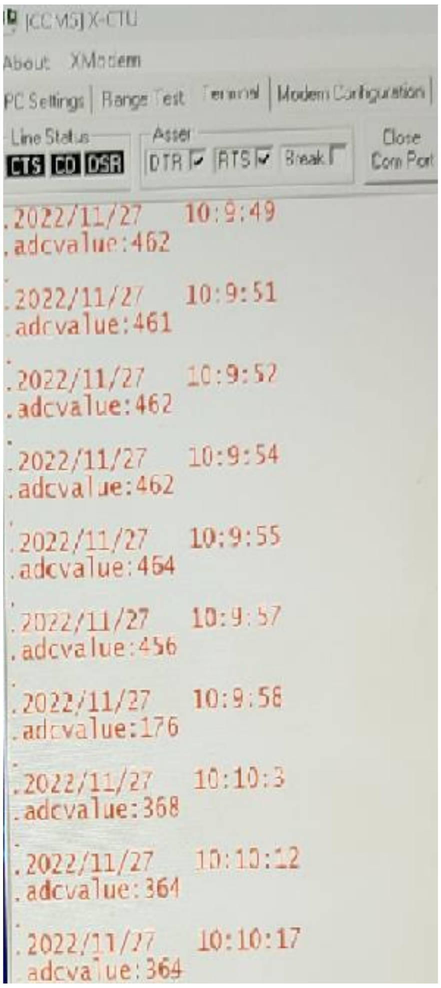

Fig.7. LDR adc_values

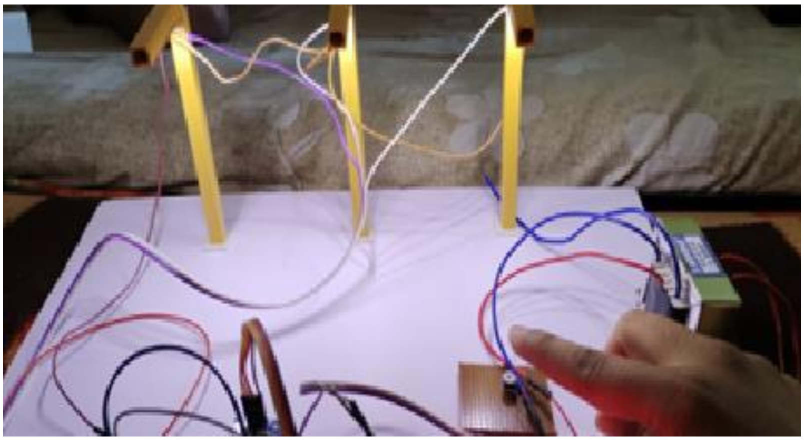

Fig.8. Lights turned ON by covering the LDR

We have now integrated RTC and LDR since we have specified in the code that the RTC should keep time in accordance with our plans. From Figures 8 to 10, the controller will first verify that the time set in the RTC corresponds with the time the user has specified; if it does, the controller will proceed to step two, at which point it will determine whether or not the light intensity registered by the LDR meets the threshold of 400; if it does, the lights will turn on for five seconds before turning off automatically. Numerical Representation of output according to the input is tabulated in Table 1.

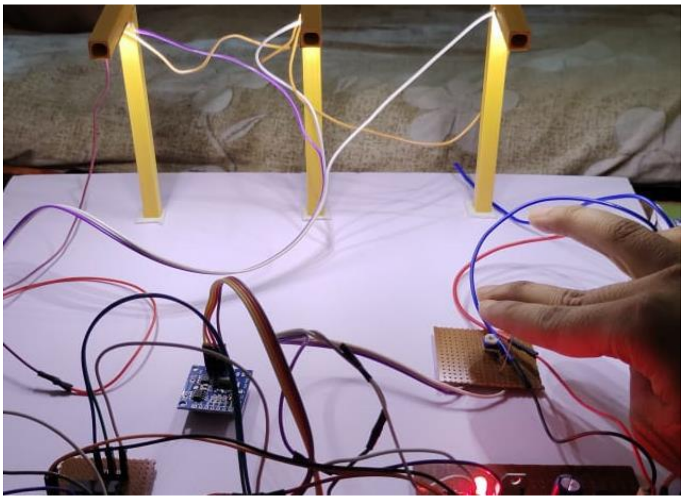

Fig.9. System turned ON the lights

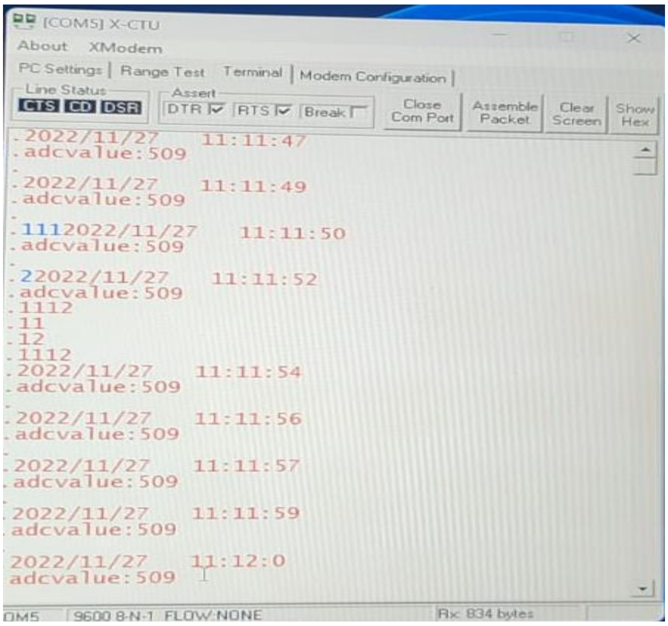

Fig. 10. Time and LDR values

Table 1: Numerical Representation of output according to the input

Component	**INPUT**	**OUTPUT**
LDR	Adc_value<400	Indicators will activate
LDR	Adc_value>600	After the lights are turned ON, they will automatically turn OFF.
RTC and LDR	Rtc time==user set time; adc_value<400	Indicators will activate
RTC and LDR	Rtc time!==user set time;adc_value<400	The lights will remain out until either the time is correct or the adc value is less than 400.
LDR	Adc_value<400	Indicators will activate

5. Conclusion And Future Scope

The design and testing of our proposed paper have proved fruitful. A significant amount of electricity is lost in the typical street lighting system however, this may be prevented with automatic control employing LDR. The constructed control circuit is used to examine the automated switching function, which is proven to be extremely efficient with very low maintenance costs. The streetlight's ON/OFF status is determined by the circuit. The microcontroller has successfully managed the streetlights. When it becomes dark, the controller will send a signal to turn on the lights. In addition, the system relies on both a timer and an LDR sensor, eliminating a previous disadvantage of the street light system. In the long run, we want to expand this effort into an Internet of Things (IoT) initiative to determine how many systems are functioning normally. how much energy is being used, the possibility of determining which streetlight is malfunctioning so that no more complaints are required, and so on.

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