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INTELLIGENT WIRELESS STREETLIGHTING SYSTEM

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Abstract: Lighting systems, particularly within the public sector, are still designed per the previous standards of reliability and that they don't usually profit of latest technological developments. Use of renewable energy sources instead of typical power sources, therefore taking care of the environment is another advantage of this system. In this paper a wireless street lighting system is developed. It consists of set of sensors todetect the presence of humans and checking for the intensity of light and transmitting the light in wireless.

I. INTRODUCTION

Intelligent Street Lighting System involves the design, installation, operation & maintenance of road lights and associated infrastructure to ensure adequate and uniform lighting levels are provided for all road users.Traditionally streetlights are designed in the old fashion, which means when there is dark, streetlights are turned-on and similarly, when there is a fault in lighting illumination, manual inspection is carried out. But this old system is not effective and efficient to meet future demand & expectations.Now it's time to make our Road Lighting Infrastructure intelligent and smart to control it efficiently, use it on demand, optimise the resources and utilise it to its full potential and with minimum carbon footprint to save our environment.

II. LITERATURE SURVEY

A literature survey on the topic of intelligent wireless street lighting systems can provide valuable insights and information on the state-of-the-art in this field. The following are some key findings that can be gathered from such a survey:

1. Purpose: The primary purpose of an intelligent wireless street lighting system is to provide efficient and effective management of street lighting by using wireless communication technologies. This helps to reduce energy consumption, maintenance costs, and carbon emissions.
2. Components: An intelligent wireless street lighting system typically consists of light-emitting diodes (LEDs), wireless sensors, and a central control unit. The LEDs are used for lighting, while the wireless sensors are used for monitoring and controlling the lighting. The central control unit manages the communication between the LEDs and the sensors.
3. Communication technologies: Wireless communication technologies such as Zigbee, Wi-Fi, and cellular networks are commonly used in intelligent wireless street lighting systems. These technologies provide the ability to monitor and control the lighting remotely, and allow for real-time data collection and analysis.

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4. Energy-saving strategies: An intelligent wireless street lighting system can be used to reduce energy consumption by implementing various energy-saving strategies. For example, the lighting can be controlled based on the level of ambient light or traffic flow, or it can be dimmed when there is notraffic.
5. Maintenance: An intelligent wireless street lighting system can also reduce maintenance costs by providing real-time monitoring and early detection of malfunctions. This helps to prevent extended downtime and reduces the need for frequent maintenance visits.

III. WORKING PRINCIPLE

An intelligent wireless street lighting system is a network of street lights that are controlled and monitored through wireless communication technology. The basic working principle of this system involves the following steps:

1. Installation of sensors and controllers: Each street light is equipped with a sensor and a controller unit. The sensor detects the ambient light level and sends the data to the controller unit. The controller unit, in turn, controls the intensity of the light according to the ambient light level.

2. Wireless communication: The controller units communicate with each other and a central server through wireless communication technology such as Zigbee, LoRaWAN, or Wi-Fi. The central server collects data from all the controller units and provides real-time monitoring and control.

3. Intelligent control algorithms: The central server runs algorithms to determine the optimal lighting levels for each street light based on the ambient light level and other parameters such as weather conditions and traffic volume. The algorithms can also take into account energy-saving goals and reduce the lighting level when it is not needed.

4. Energy management: The intelligent wireless street lighting system can be integrated with energy management systems to optimize energy consumption and reduce energy costs. For example, the system can automatically switch off the lights during off-peak hours when there is less traffic on the roads.

5. Maintenance and monitoring: The central server can also monitor the status of each street light and provide alerts for maintenance or repair when needed.

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BLOCK DIAGRAM

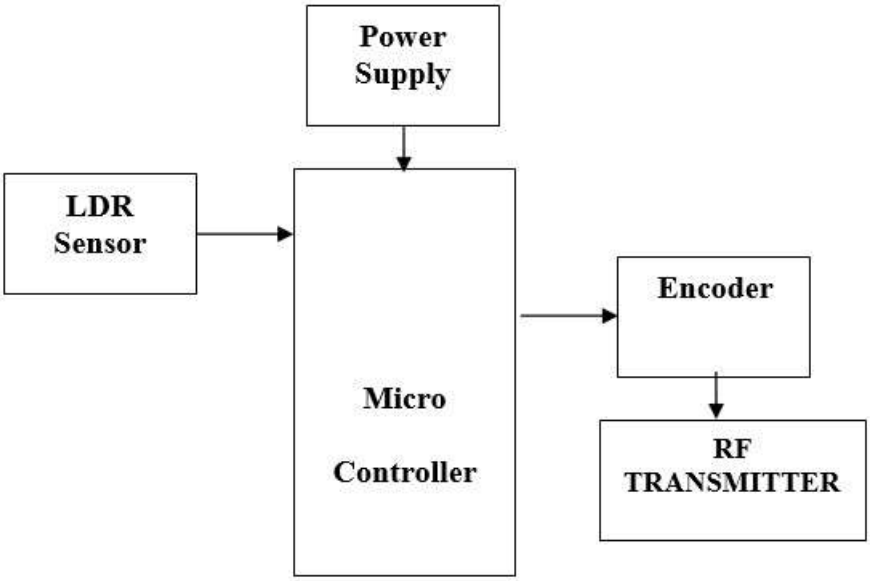

Figure 2.1: Transmitter section

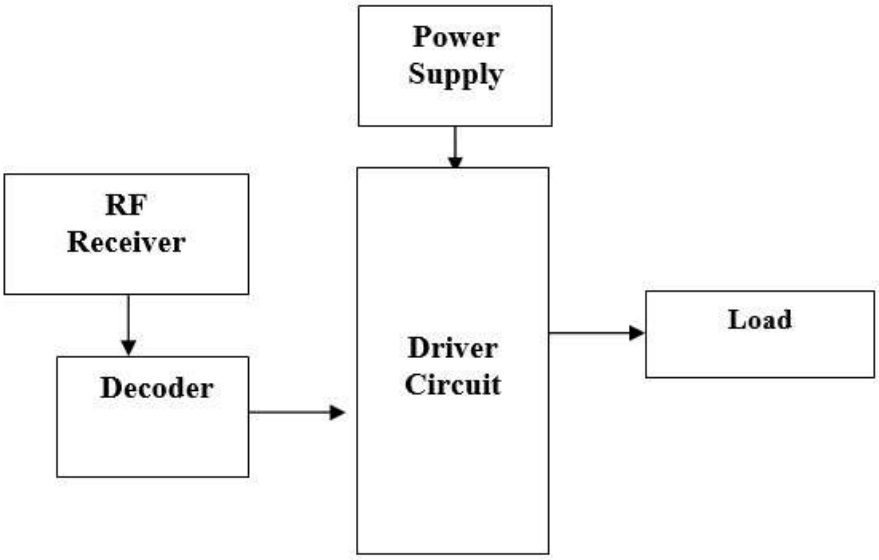

Figure 2.2:Reciver section

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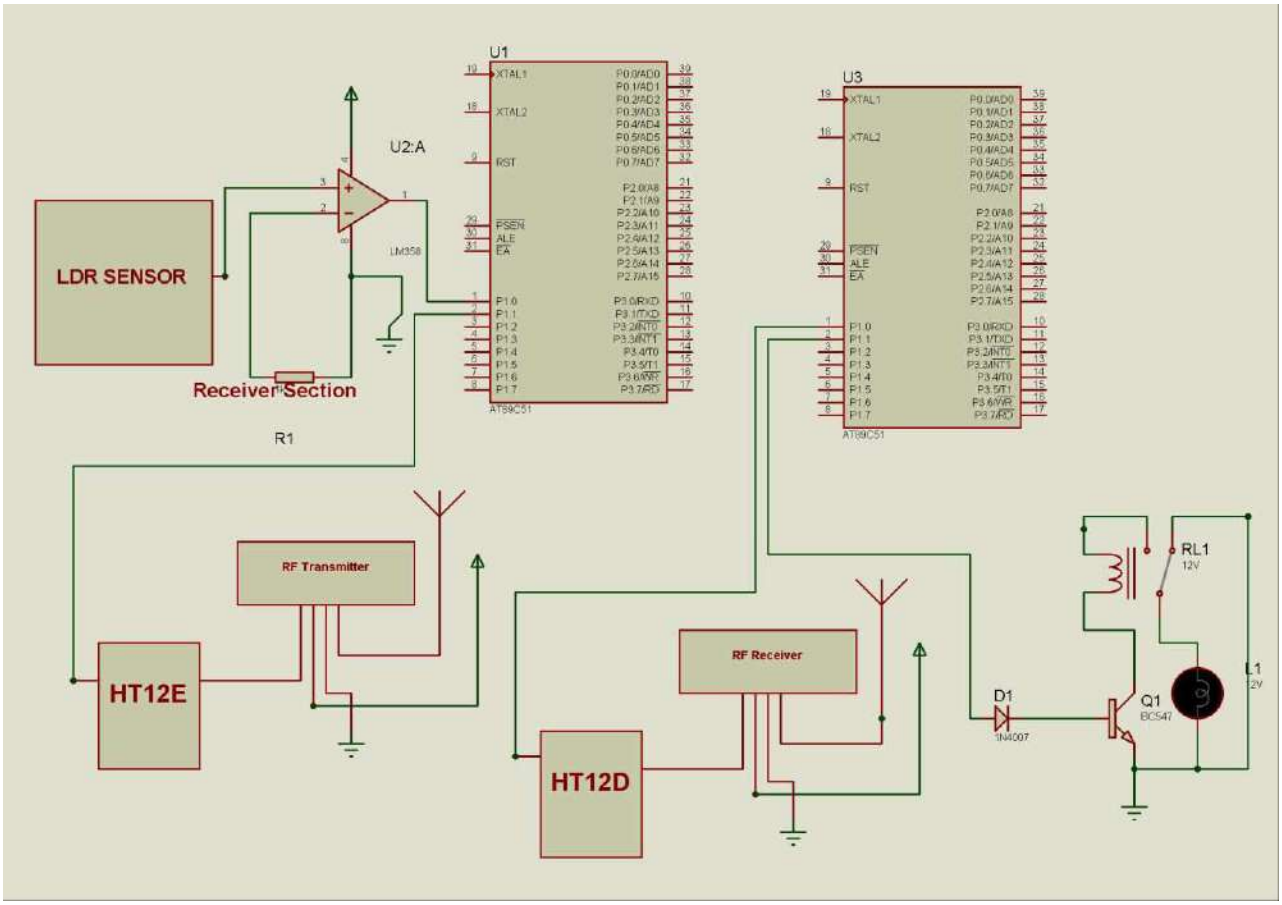
IV. SCHEMATIC DIAGRAM



HARDWARE

LIGHT DEPENDENT RESISTOR (LDR)

Light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity or vice versa. As the name suggests, LDR is a type of resistor whose working depends upon only on the light falling on it. The resistor behaves as per amount of light and its output directly varies with it. In general, LDR resistance is minimum (ideally zero) when it receives maximum amount of light and goes to maximum (ideally infinite) when there is no light falling on it.

SPECIFICATIONS

- Resistance : 400ohm to 400Kohm
- Sensitivity: about 3msec
- Voltage ratings: I used it on 3V,5V and 12V

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V. DESCRIPTION

LDR, an acronym for light dependent resistor is a resistor whose resistance is dependent on light. In this when the light falls on LDR, the resistance of LDR becomes low and the entire voltage drop takes place across the variable resistance (VR) (10K). When no light falls on LDR, the resistance of LDR becomes high so almost entire voltage drop takes place across it. The sensitivity of the circuit can be adjusted by varying the preset (VR).

Light Dependent Resistor

The circuit symbol used for the light dependent resistor or photo-resistor combines its resistor action while indicating that it is sensitive to light. The basic light dependent resistor symbol has the rectangle used to indicate its resistor action, and then has two incoming arrows - the same as those used for photodiodes and phototransistors to indicate its light sensitivity.

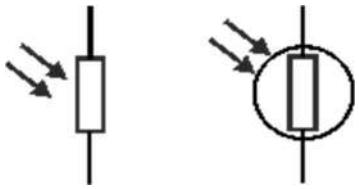

Figure 4.1:Light Dependent Resistor Symbol

APPLICATION

The photo-resistor or light dependent resistor is attractive in many electronic circuit designs because of its low cost, simple structure and rugged features. While it may not have some of the features of the photo-diode and photo-transistor, it is ideal for many applications.

RF MODULE (RADIO FREQUENCY)

Radio Frequency , any frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is created that then is able to propagate through space. Many wireless technologies are based on RF field propagation .

Figure 4.2: Receiver Module

Radio Frequency. The 10 k Hz to 300 GHz frequency range that can be used for wireless communication

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Radio Frequency. Also used generally to refer to the radio signal generated by the system transmitter, or to energy present from other sources that may be picked up by a wireless receiver.

- Wireless mouse, keyboard
- Wireless data communication
- Alarm and security systems
- Home Automation, Remote control
- Automotive Telemetry
- Intelligent sports equipment
- Handheld terminals, Data loggers
- Industrial telemetry and tele-communications
- In-building environmental monitoring and control
- High-end security and fire alarms

Transmitter

The TWS-434 extremely small, and are excellent for applications requiring short-range RF remote controls. The transmitter module is only 1/3 the size of a standard postage stamp, and can easily be placed inside a small plastic enclosure.

TWS-434: The transmitter output is up to 8mW at 433.92MHz with a range of approximately 400 foot (open area) outdoors. Indoors, the range is approximately 200 foot, and will go through most walls.

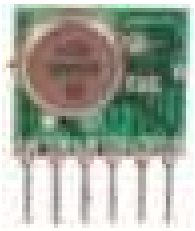

Figure 4.3:Transmitter Module

The TWS-434 transmitter accepts both linear and digital inputs, can operate from 1.5 to 12 Volts- DC, and makes building a miniature hand-held RF transmitter very easy. The TWS-434 is approximately 1/3 the size of a standard postage stamp

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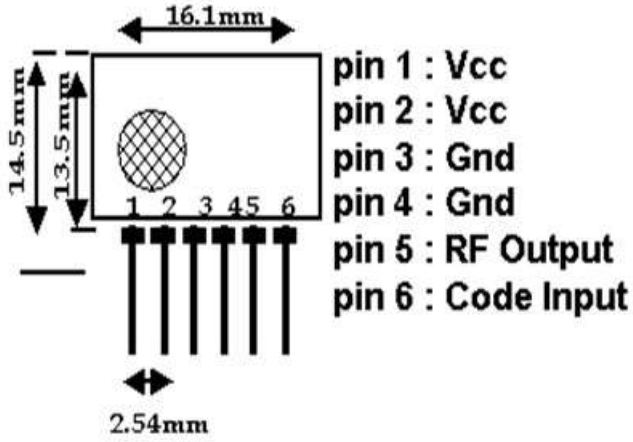

Figure 4.4: TWS-343 Pin Diagram

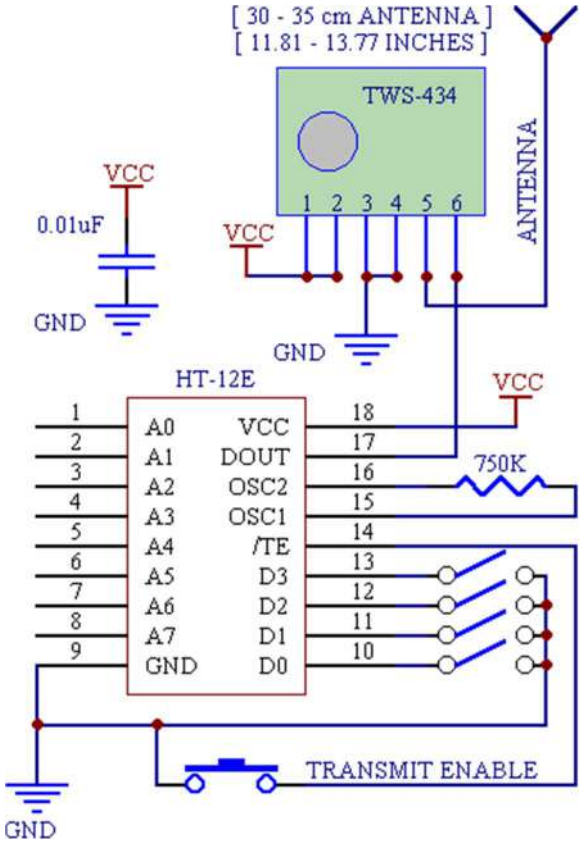

Figure 4.5: - Transmitter Application Circuit

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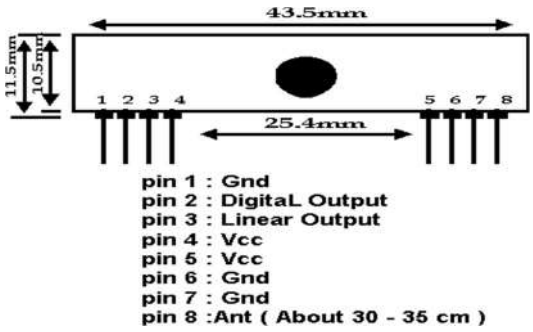
Receiver

RWS-434: The receiver also operates at 433.92MHz, and has a sensitivity of 3uV. The WS-434 receiver operates from 4.5 to 5.5 volts-DC, and has both linear and digital outputs.



TRANSMIT AND RECEIVE DATAGENERATING DATA

The TWS-434 modules do not incorporate internal encoding. If you want to send simple control or status signals such as button presses or switch colsures, consider using an encoder and decoder IC set that takes care of all encoding, error checking, and decoding functions. These chips are made by Motorola and Holtek. They are an excellent way to implement basic wireless transmission control.

RECEIVER DATA OUTPUT

A 0 volt to Vcc data output is available on pins. This output is normally used to drive a digital decoder IC or a microprocessor which is performing the data decoding. The receiver's output will only transition when valid data is present. In instances when no carrier is present the output will remain low.

DECODING DATA

The RWS-434 modules do not incorporate internal decoding. If you want to receive Simple control or status signals such as button presses or switch colsures, you can use the encoder and decoder IC set described above. Decoders with momentary and latched outputs are available.

TRANSMITTING AND RECEIVING

Full duplex or simultaneous two-way operation is not possible with these modules. If a transmit and receive module are in close proximity and data is sent to a remote receive module while attempting to simultaneously receive data from a remote transmit module, the receiver will be overloaded by its close proximity transmitter. This will happen even if encoders and decoders are used with different address settings for each transmitter and receiver pair. If two way communication is required, only half duplex operation is allowed.

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ANTENNAS- WIRE WHIP

The WC418 is made of 26-gauge carbon steel music wire that can be soldered to a PC board. This antenna has a plastic-coated tip for safety and is 6.8 inches long, allowing .1 inch for insertion in a terminal or PC board.

Fig 4.6: Antenna

The following should help in achieving optimum antenna performance:

- Proximity to objects such a users hand or body, or metal objects will cause an antenna to detune. For this reason the antenna shaft and tip should be positioned as far away from suchobjects as possible.
- Optimum performance will be obtained from a 1/4 or 1/2 wave straight whip mounted at a right angle to the ground plane. A 1/4 wave antenna for 418 Mhz is 6.7 inches long.
- In many antenna designs, particularly 1/4 wave whips, the ground plane acts as a counterpoise, forming in essence, a 1/2 wave dipole. Adequate ground plane area will give maximum performance. As a general rule the ground plane to be used as counterpoise should have a surface area => the overall length of the 1/4 wave radiating element (2.6 X2.6 inches for a 6.7 inch long antenna).
- Remove the antenna as far as possible from potential interference sources. Place adequate ground plane under all potential sources of noise.

RELAY

The first relay was invented by Joseph Henry in 1835. The name relay derives from the French noun relays' that indicates the horse exchange place of the postman. Generally a relay is an electrical hardware device having an input and output gate. The output gate consists in one or more electrical contacts that switch when the input gate is electrically excited. It can implement a decoupled, a router or breaker for the electrical power, a negation, and, on the base of the wiring, complicated logical functions containing and, or, and flip-flop. In the past relays had a wide use, for instance the telephone switching or the railway routing and crossing systems. In spite of electronic progresses (as programmable devices), relays are still used in applications where ruggedness, simplicity, long life and high reliability are important factors (for instance in safety applications).

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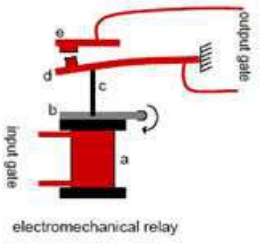
Operation of Relay

When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, the armature is returned by a force approximately half as strong as the magnetic force to its relaxed position. Usually this is a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing.

If the coil is energized with DC, a diode is frequently installed across the coil, to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a spike of voltage and might cause damage to circuit components. If the coil is designed to be energized with AC, a small copper ring can be crimped to the end of the solenoid. This "shading ring" creates a small out-of-phase current, which increases the minimum pull on the armature during the AC cycle.

Electromechanical relay:

It consists in a fixed coil (a) and a moving armature (b) mechanically linked (c) to a moving contact (d). Feeding the coil by means of electrical current a magnetic field rises. Then the moving armature is attracted to the coil and, consequentially, the contact can be moved. The movement of the contact either makes or breaks an electrical connection with a fixed contact (e). When the feeding current of the coil is removed, the armature and the feed contact return to their relaxed position by means of a spring or of the elasticity of the contact. An electromechanical relay has galvanic insulation between the input and output gate and between the terminals of the contacts when they are in break position.



electromechanical relay

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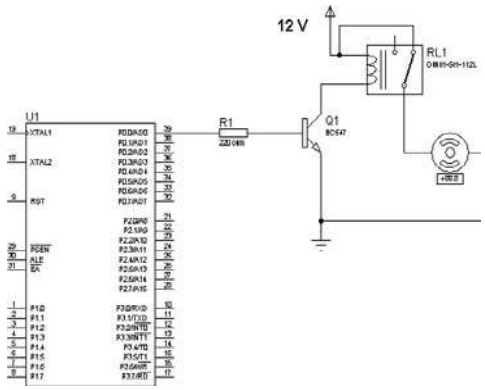

Relays are used:

- To control a high-voltage circuit with a low-voltage signal, as in some types of modems,
- To control a high-current circuit with a low-current signal, as in the starter solenoid of an automobile,
- To detect and isolate faults on transmission and distribution lines by opening and closing circuit breakers (protection relays),
- To isolate the controlling circuit from the controlled circuit when the two are at different potentials, for example when controlling a mains-powered device from a low-voltage switch. The latter is often applied to control office lighting as the low voltage wires are easily installed in partitions, which may be often moved as needs change. They may also be controlled by room occupancy detectors in an effort to conserve energy,
- To perform logic functions. For example, the Boolean AND function is realised by connecting NO relay contacts in series, the OR function by connecting NO contacts in parallel. The change-over or Form C contacts perform the XOR (exclusive or) function. Similar functions for NAND and NOR are accomplished using NC contacts. Due to the failure modes of a relay compared with a semiconductor, they are widely used in safety critical logic, such as the control panels of radioactive waste handling machinery.
- To perform time delay functions. Relays can be modified to delay opening or delay closing a set of contacts. A very short (a fraction of a second) delay would use a copper disk between the armature and moving blade assembly. Current flowing in the disk maintains magnetic field for a short time, lengthening release time. For a slightly longer (up to a minute) delay, a dashpot is used. A dashpot is a piston filled with fluid that is allowed to escape slowly. The time period can be varied by increasing or decreasing the

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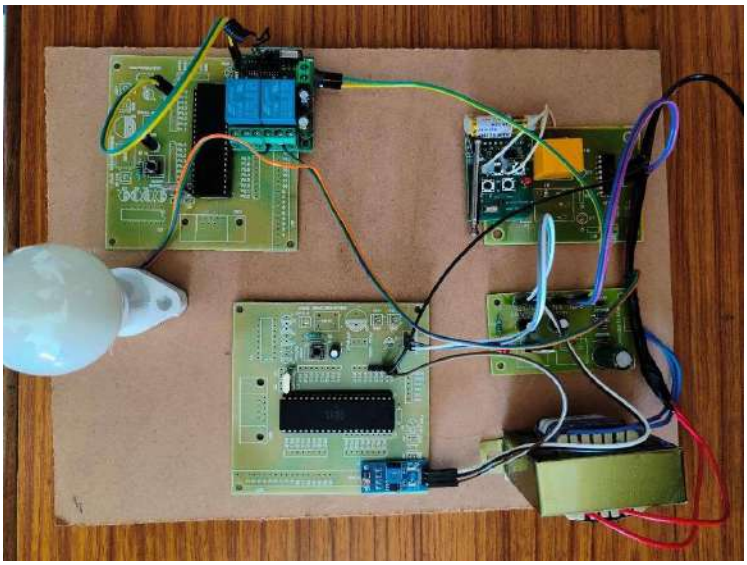
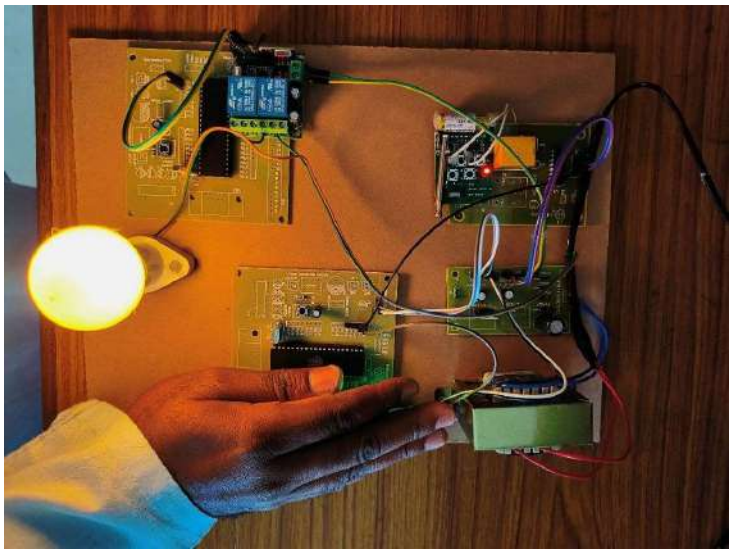
flow rate.

- A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.
- •ULN2803A IC which uses 7 Darlington Transistor Array to amplify the input current coming from the port. This 16-pin IC is capable to take TTL input and the output load may have high voltage up to 50.

VI. RESULT





VII. CONCLUSION

The project "INTELLIGENT WIRELESS STREET LIGHTING SYSTEM" has been successfully designed and tested. It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

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