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Street Lights that Glow on Detecting Vehicle Movement

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ABSTRACT

Optimizing street lighting to conserve energy and enhance safety is crucial in urban and rural areas. This project proposes a "Street Lights that Glow on Detecting Vehicle Movement" system. The purpose of this project is to develop an intelligent street lighting system that activates lights only when vehicles are detected, thereby saving energy. By integrating LDR sensors, IR sensors, an Arduino micro controller, LCD, relay, and LEDs, the system ensures that street lights are only on when necessary, providing illumination when vehicles are present.

I. INTRODUCTION:-

An automatic street lighting system is designed to automatically switch ON the street light alongside the roads or the light lamp just outside our house on the onset of dark weather or switch them off automatically after sunrise or during the light hours.We need to save or conserve energy because most of the energy sources we depend on, like coal and natural gas can't be replaced. Once we use them up, they're gone forever.Saving power is very important, instead of using the power in unnecessary times it should be switched off. In any city “STREET LIGHT” is one of the major power consuming factors. Most of the time we see street lights are controller has an LDR which is used to detect the ambient light. If the ambient light is below a specific value the lights are turned ON. A light dependent sensors is interfaced to the pic 18f452 microcontroller it is used to track the sun light and when the sensors goes dark the led will be made on and when the sensor founds light the led will be made OFF.It clearly demonstrates the working of transistor in saturation region and cut-off region.

The working of relay is also known Microcontroller and the code is written in c language in MikroC ide, the resulted value can be seen with the help of UART or LCD display. Automatic Street Light Control System is a simple yet powerful concept, which uses transistor as a switch. By using this system manual works are 100% removed. It automatically switches ON lights when the sunlight goes below the visible region of our eyes.This is done by a sensor called Light Dependent Resistor (LDR) which senses the light actually like our eyes. It automatically switches OFF lights whenever the sunlight comes, visible to our eyes.This project exploits the working of a transistor in saturation region and cut-off region to switch ON and switch OFF the lights at appropriate time with the help of an electromagnetically operated switch.A street light, lamppost, street lamp, light standard, or lamp standard is a raised source of light on the edge of a road or walkway, which is turned on or lit at a certain time every night. Modern lamps may also have light-sensitive photocells to turn them on at dusk, off at dawn, or activate automatically in dark weather.

II. LITERATURE REVIEW:

“Arduino based led street light auto intensity control system” Shreesh Mishra, Shivakant Gupta, Santosh Singh, Tripuresh Tiwari.

The main aim of this project is to utilize the application of the Arduino board to control the intensity of street light. As the traffic decreases slowly during late-night hours, the intensity gets reduced progressively till morning to save energy and so, the street lights switch on at the dusk and then switch off at the dawn, automatically. The process repeats every day. White Light Emitting Diodes (LED) replaces conventional HID lamps in street lighting system to include dimming feature. The intensity is not possible to be controlled by the high intensity discharge (HID) lamp which is generally used in urban street lights. LED lights are the future of lighting, because of their low energy consumption and long life. LED lights are fast replacing conventional lights because intensity control is possible by the pulse width modulation. [1] This proposed system uses an Arduino board and a rectified-power supply. String of LED are interfaced to the Arduino board with a MOSFET device. The intensity control of the LED light is possible by varying duty cycle from a DC source. A programmed Arduino board is engaged to provide different intensities at different times of the night using PWM technique. This project is also enhanced by integrating the LDR to follow the switching operation precisely.

“IOT based smart and adaptive lighting in street lighting” S.Guru Priya, B.Abinaya.

The system is mainly used for smart and weather adaptive lighting in street lights. The project is implemented with smart embedded system that controls the street light based on detection of sunlight. During the night time the street light gets automatically ON and during the day time it gets automatically OFF. The ON/OFF can be accessed anywhere anytime through internet. A camera is placed on top of the street light to track the actions performed on the road where the footages are stored in a server. In addition to this, a panic button is placed on the pole, in-case of any emergency or

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danger, the person in danger can press this button which raises an alarm at the nearby police station. Whenever the panic button is pressed, the footage at that time recorded by the camera is sent directly to the cloud account. The access of the account is given to the particular police station by which they can view the incident's spot. Each area's street lights are connected to the particular area's police station and each of them has a cloud accessible account. The manual operation using GSM technology is completely eliminated. Thus the system is mainly designed to ensure safety and to prevent energy wastage.

III. EXISTING Methods

Current street lighting systems often rely on manual operation or fixed timers, which do not adapt to the actual lighting requirements or pedestrian and vehicle movement. These systems can lead to excessive energy consumption or inadequate lighting, impacting both energy efficiency and public safety.

IV. PROPOSED SYSTEM:

The proposed system provides an energy-efficient solution by automating the street lighting based on vehicle detection. LDR sensors detect ambient light levels to determine when to activate the system. IR sensors detect the presence of vehicles. The Arduino processes input from these sensors and activates the LEDs via a relay, illuminating the street only when necessary. The LCD displays system status and operational information, while the relay controls the LEDs, ensuring they light up only when vehicles are detected, thereby conserving energy and enhancing safety.

V. BLOCK DIAGRAM:

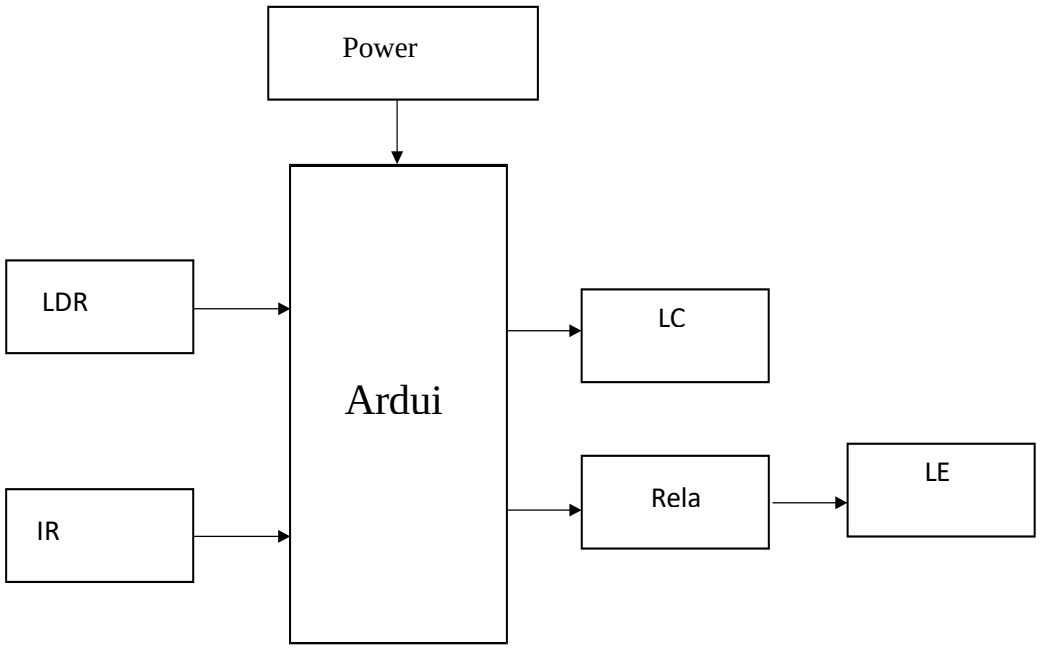

Fig: block diagram of proposed system

VI. ARDUINO

The Arduino is one of the most popular and widely used Arduino boards. It's based on the ATmega328P microcontroller and offers a good balance of features, performance, and affordability, making it suitable for a wide range of projects, from simple to moderately complex.

Most electronic devices involve circuit-making using hardware components. The purpose of introducing Arduino was to make an easy-to-use device that can offer the feature of programming along with circuit making. Therefore, Arduino is a programmable device that is used mostly by artists, designers, engineers, hobbyists, and anyone who wants to explore programming in electronics.

The Arduino uses its components to gather information from the surroundings and generate a precise output accordingly. The information is gathered using some components like sensors, and input pins, and an output is generated depending on the programming done. This output can range from illuminating an LED to turning the motors on.

Arduino are great devices that can be used for creating interactive projects. They can either be

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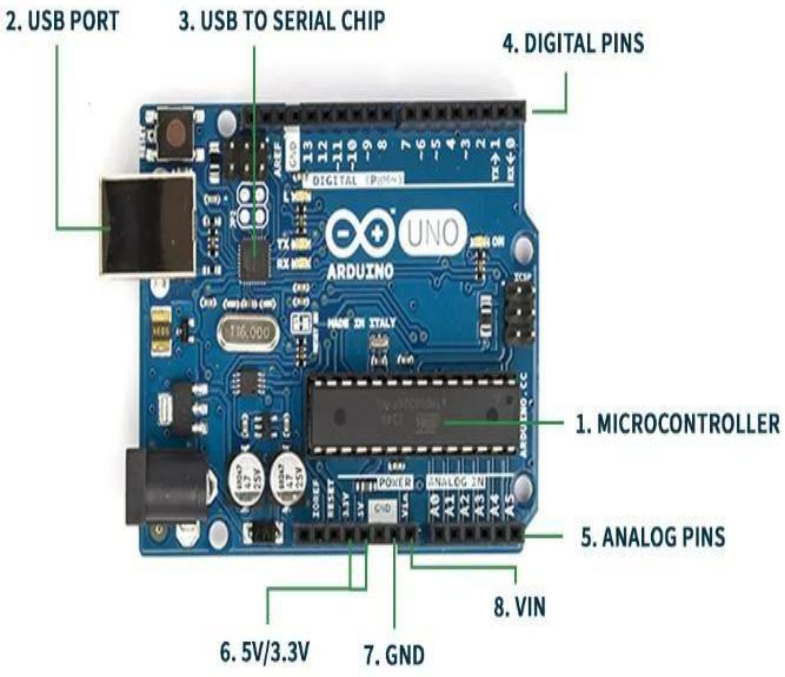
used alone to create basic projects or they can be integrated with Arduino, Raspberry Pi Pico , Node MCU, or nearly anything else using some programming in their software to create some advanced level of projects. It is good to know the specifications of different Arduino so that you can select the right Arduino for your project.

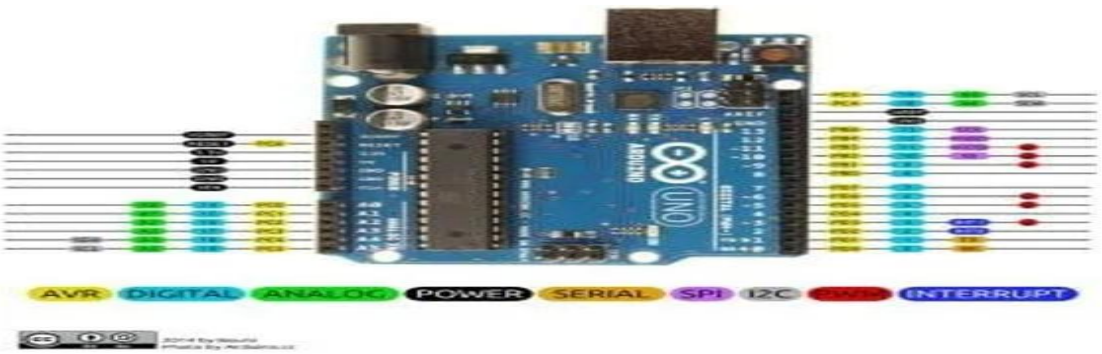
Arduino Hardware



Let us look at the hardware components of Arduino:

- **Microcontroller: The** Microcontroller controls the execution of all the programs and codes uploaded on Arduino. The microcontroller is equipped with components that can perform different functions.
- **USB port:** This port is used to establish a connection between the computer and the Arduino board.
- **USB to Serial chip: The** USB to Serial port is used for adding data from the computer to the microcontroller. This is how the code is uploaded from the computer to the Arduino board.
- **Digital pins**: These pins are used for turning the LEDs on and off by using digital logic ('0' and '1').
- **Analog pins:** These pins are used for taking analog input.
- **5V / 3.3V pins**: These pins are used for supplying power to devices.
- **GND:** This pin is used for setting a reference level.

VII. ARDUINO PINS:



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Types of Arduino Pins:

Let's dive into the details of each type of pin commonly found on Arduino boards:

1. **Digital Pins:**

Definition: Digital pins on an Arduino board can be used for both input and output operations. They are primarily used for working with binary (on/off) signals.

Numbering: Digital pins are typically labelled with numbers (e.g., D2, D7).

Usage: You can use digital pins to read digital signals (HIGH or LOW) from external sensors or devices, control LEDs, toggle relays, and more.

Functions: Digital pins can be configured as INPUT for reading external signals or OUTPUT for controlling external components. They can also be used as INPUT_PULLUP, which activates an internal pull-up resistor.

2. **Analog Pins:**

Definition: Analog pins are used for reading analog signals, such as voltages, from external sensors and devices.

Numbering: Analog pins are labelled with numbers (e.g., A0, A3) and may also have digital equivalents (e.g., A0 is equivalent to D14 on some Arduino boards).

Usage: Analog pins are essential for reading sensor data that produces continuous voltage levels, like temperature sensors, light sensors, and potentiometers.

Resolution: Arduino boards typically have a 10-bit ADC (Analog-to-Digital Converter), allowing for 1024 discrete values (0 to 1023) to represent analog signals.

3. **PWM (Pulse-Width Modulation) Pins:**

Definition: PWM pins are a subset of digital pins capable of simulating analog output by rapidly switching between HIGH and LOW states to control the average voltage.

Numbering: PWM pins are often marked with a tilde symbol (~) next to their digital pin numbers (e.g., ~D3,
~D9).

Usage: PWM pins are commonly used to control the brightness of LEDs, the speed of DC motors, and to generate audio tones.

Resolution: Arduino boards typically have an 8-bit PWM resolution, which means they can produce 256 discrete levels of analog-like output.

4. **Special Pins:**

Definition: Special pins serve unique purposes beyond digital and analog I/O. These include pins for serial communication (TX and RX), power supply (5V, 3.3V, GND), and a reset pin (RESET).

Numbering: Special pins may have specific labels, such as "TX" and "RX" for transmitting and receiving serial data.

Usage: RX and TX pins are used for serial communication with other devices, such as computers. Power and ground pins provide voltage and ground connections to external components, while the reset pin resets the microcontroller.

Considerations: Be cautious when using the RX and TX pins, as they are often used for programming and debugging, and connecting them incorrectly can disrupt communication.

5. **Power Pins:**

5V Pin:

Definition: The 5V pin provides a regulated 5-volt power supply. It can be used to power external components that require 5V.

Usage: You can use the 5V pin to supply power to sensors, displays, or other components that require a 5V input.

Voltage: The voltage on this pin is stable and regulated to 5V.

3.3V Pin:

Definition: The 3.3V pin provides a regulated 3.3-volt power supply. It is suitable for components that operate at 3.3V.

Usage: Some sensors and modules, especially those designed for lower power consumption, may require a
3.3V supply. Use the 3.3V pin to provide power to such components. **Voltage:** The voltage on this pin is stable and regulated to 3.3V. **VIN (Voltage In) Pin:**
Definition: The VIN pin is used to supply an external voltage to the Arduino board, typically

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when the board is not powered via USB or an external power jack.

Usage: When powering the Arduino from an external source, like a battery or an external power supply, you can connect it to the VIN pin to provide power to the board.

Voltage: Ensure that the external voltage supplied to the VIN pin falls within the acceptable voltage range for your specific Arduino board.

6. IOREF (Input/output Reference) Pin:

Definition: The IOREF pin provides a reference voltage that indicates the voltage level at which the microcontroller operates.

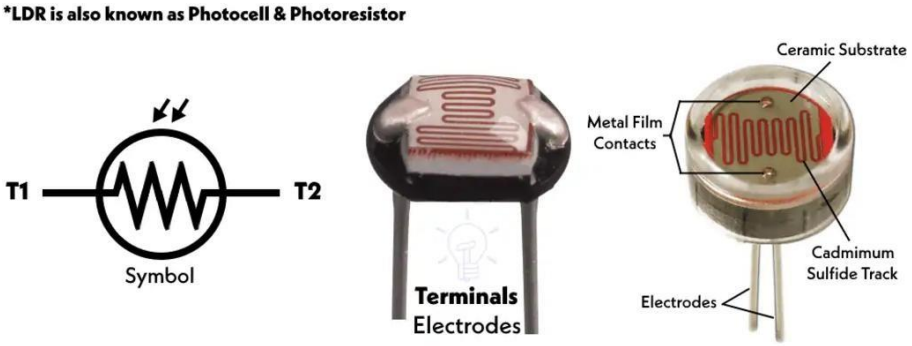
Usage: It's used as a reference for components that need to interface with the microcontroller, particularly in situations where voltage compatibility is important.
Voltage: The voltage level on the IOREF pin depends on the operating voltage of the microcontroller (e.g., 5V for most Arduino boards). It helps external components adapt to the board's voltage level.

Understanding these different types of pins and their capabilities is crucial for effectively using Arduino boards in your projects. Each type of pin has specific functions and applications, and mastering their use will enable you to create a wide range of electronic projects.

LDR Sensor

LDR (**Light dependent resistor**) also known as **photocell**, **photoresistor** or **Photo Conductive Cell** is a light- sensitive resistor whose resistance varies with the intensity of light. It is a type of variable resistor whose resistance varies with the light. Its resistance varies inversely with the change in light intensity i.e. its resistance increases with a decrease in light intensity and decreases with an increase in light intensity.

It is a type of photo sensor that works on the principle of photoconductivity. Its electrical conductivity changes with the intensity of the falling light. Its resistance also depends on the frequency and wavelength of the incident light. Although its sensitivity depends on the design and Semiconductor material of the device.

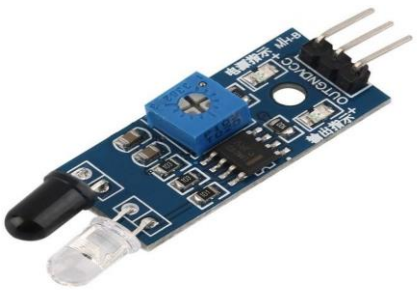


It is used in light sensing circuit that operates based on light and dark conditions such as street lights, solar panels, solar tracker, etc.

IR sensor

IR sensor is an electronic device that emits the light in order to sense some object of the surroundings.

An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations.



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The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode. Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received. There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED's of specific wavelength used as infrared sources. The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibers. Optical components are used to focus the infrared radiation or to limit the spectral response.

IR Sensor Working Principle

There are different types of infrared transmitters depending on their wavelengths, output power and response time. An IR sensor consists of an IR LED and an IR Photodiode, together they are called as Photo Coupler or OptoCoupler.

IR Transmitter or IR LED

Infrared Transmitter is a light emitting diode (LED) which emits infrared radiations called as IR LED's. Even though an IR LED looks like a normal LED, the radiation emitted by it is invisible to the human eye.

The picture of an Infrared LED is shown below.

IR Receiver or Photodiode

Infrared receivers or infrared sensors detect the radiation from an IR transmitter. IR receivers come in the form of photodiodes and phototransistors. Infrared Photodiodes are different from normal photo diodes as they detect only infrared radiation. Below image shows the picture of an IR receiver or a photodiode,

Different types of IR receivers exist based on the wavelength, voltage, package, etc. When used in an infrared transmitter – receiver combination, the wavelength of the receiver should match with that of the transmitter.

The emitter is an IR LED and the detector is an IR photodiode. The IR photodiode is sensitive to the IR light emitted by an IR LED. The photo-diode's resistance and output voltage change in proportion to the IR light received. This is the underlying working principle of the IR sensor

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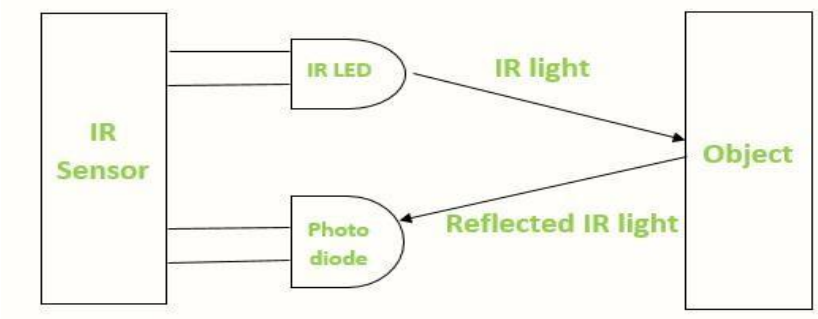

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When the IR transmitter emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor defines.

LCD

LCD is a flat display technology, stands for "Liquid Crystal Display," which is generally used in computer monitors, instrument panels, cell phones, digital cameras, TVs, laptops, tablets, and calculators. It is a thin display device that offers support for large resolutions and better picture quality. The older CRT display technology has replaced by LCDs, and new display technologies like OLEDs have started to replace LCDs. An LCD display is most commonly found with Dell laptop computers and is available as an active-matrix, passive- matrix, or dual-scan display. The picture is an example of an LCD computer monitor.

The Liquid Crystal library allows you to control LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface.

Output of the sketch on a 16x2 LCD

The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. The interface consists of the following pins:

- A **register select (RS) pin** that controls where in the LCD's memory you're writing data to. You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next.
- A **Read/Write (R/W) pin** that selects reading mode or writing mode
- An **Enable pin** that enables writing to the registers
- 8 **data pins (D0 -D7)**. The states of these pins (high or low) are the bits that you're writing to a register when you write, or the values you're reading when you read.

There's also a **display contrast pin (Vo)**, **power supply pins (+5V and GND)** and **LED Backlight (Bklt+ and BKlt-)** pins that you can use to power the LCD, control the display contrast, and turn on and off the LED backlight, respectively.

The process of controlling the display involves putting the data that form the image of what you want to display into the data registers, then putting instructions in the instruction register. The Liquid Crystal Library simplifies this for you so you don't need to know the low-level instructions.

The Hitachi-compatible LCDs can be controlled in two modes: 4-bit or 8-bit. The 4-bit mode requires seven I/O pins from the Arduino, while the 8-bit mode requires 11 pins. For displaying text on the screen, you can do most everything in 4-bit mode, so example shows how to control a 16x2 LCD in 4-bit mode.

LCD Pin Description:

The LCD requires 3 control lines (RS, R/W, and EN) and 8(or 4) data lines. The number of data lines depends on the mode of operation. If operated in 8-bit mode then 8-bit data lines are required. And if the operation is in 4-bit mode then 4-bit data lines are required. The 8-bit mode is faster than the 4-bit mode. In 8-bit mode, LCD uses a total of 14 pins including 8 data lines, 3 control lines, and 3 power supply lines (Vee Vss and Vee)

1. **Power Supply:** The LCD discussed here uses three power supply pins (Vcc, Vss, and Vee) Vcc and Vss pins are used to provide +5V and ground respectively. The pin Vee is used for controlling LCD contrast.
2. **Control Lines:** There are three control lines in the LCD. These three are used to control the LCD operations there are two very important registers inside the LCD: the command register and the data register. The RS (Register select) pin is used to select the register out of these two. If RS = 0 the command register is selected and the user is allowed to send the command to the LCD. If RS = 1, the data register is selected and the data sent by the user is displayed on the LCD.

R / W (Read/ Write) pin allows the user to

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read/write the information (data or code) to/ from the LCD. R /W
= 1 when reading and R/W=0 when the writing operation is performed.
Another control pin EN (Enable) is used to latch the data present on the data pins. A high-low signal is required to latch the data. The LCD interprets and executes the commands at the instant the EN line is brought low.

3. **Data lines:** The 8-bits data pins. D (0)-D (7) are used to send the information to the LCD or read the contents of the LCD's internal register.

LCD Interfacing:

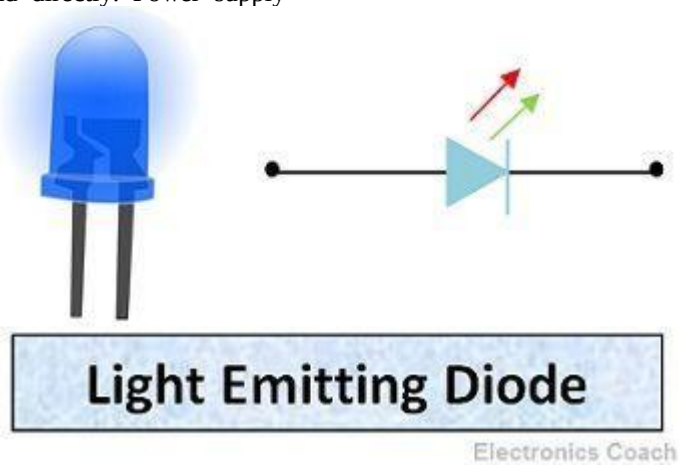
The LCD can be interfaced to the microprocessor 8085 using the programmable peripheral interface (PPI-8255) IC. To display letters and numbers. ASCII code for the letters A to Z, a to 7, and numbers 0 to 9 is sent to the data lines (D0 -D7). These codes may be sent to LCD data lines through one port of 8255 (PPI), port A is used as the output port and send the data to the LCD. The EN pin and RS pin are connected to port B of the 8255. Since it is used as a normal display R/W is made low by connecting to the ground directly. Power supply connections are provided to Vcc and Vss pins. The Vee pin is connected to the EE moving node of the potentiometer which is connected between the Vcc and Vss pins. By moving the potentiometer the contrast of the LCD can be changed.

LED

LED (Light Emitting Diode) is an **optoelectronic device** which works on the principle of electro- luminance. **Electro-luminance** is the property of the material to convert electrical energy into light energy and later it radiates this light energy. In the same way, the semiconductor in LED emits light under the influence of electric field.

The symbol of LED is formed by merging the symbol of P-N Junction diode and outward arrows. These outward arrows symbolise the light radiated by the light emitting diode.

Now, the question arises how the semiconductor material in LED emits light? The answer to this question lies in the construction and working of LED. The symbol of LED is described in the diagram below, the same symbol is used in electronics circuits.



Construction of LED

The semiconductor material used in LED is **Gallium Arsenide (GaAs)**, **Gallium Phosphide (GaP)** or **Gallium Arsenide Phosphide (GaAsP).** Any of the above-mentioned compounds can be used for the construction of LED, but the colour of radiated light changes with the change in material. Below are some of the material and their respective colour of light which they emit.

Working of LED

The electrons are majority carriers in N-type and holes are majority carriers in P-type. The electrons of N-type are in the conduction band and holes of P-type are in the valence band. The energy level of the Conduction band is higher than the energy level of the Valence band. Thus, if electrons tend to recombine with holes they have to lose some part of the energy to fall in lower energy band.

The electrons can lose their energy either in the form of heat or light. The electrons in Silicon and Germanium lose their energy in the form of heat. Thus, they are not used for LEDs as we want semiconductor in which electrons lose their energy in the form of light.

Relay:

A Relay is a simple electromechanical switch. While we use normal switches to close or open a

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circuit manually, a Relay is also a switch that connects or disconnects two circuits. But instead of a manual operation, a relay uses an electrical signal to control an electromagnet, which in turn connects or disconnects another circuit.

Relays can be of different types like electromechanical, solid state. Electromechanical relays are frequently used. Let us see the internal parts of this relay before knowing about working of relay. Although many different types of relay were present, their working is same.

Every electro mechanical relay consists of an consists of an

1. Electromagnet
2. Mechanically movable contact
3. Switching points and
4. Spring

Electromagnet is constructed by wounding a copper coil on a metal core. The two ends of the coil are connected to two pins of the relay as shown. These two are used as DC supply pins.

VIII. ARDUNO IDE: AN INTRODUCTION

Simple, open-source software and hardware form the basis of Arduino, a platform for prototyping that everyone may utilize. The heart of the Arduino system is a microcontroller, and the legs are the software that writes and uploads programs to the board. The Integrated Development Environment (IDE) for Arduino is the name of the program.

FEATURES OF ARDUINO IDE

Arduino boards can receive signals from a variety of sensors and use them to perform stuff like link to the cloud, turn on/off lights or motors, and even digitally generate signals.
By programming the board's microcontroller via the Arduino IDE, you may manage its operations.
An Arduino, or programmable circuit board does not need a separate tool, a programmer, to install new software. All you need is a USB cord.
To make things even simpler to grasp, the Arduino IDE employs a stripped-down version of C++. Arduino makes the microcontroller's features more approachable because to its consistent physical size.
Getting a feel for the Arduino UNO board's fundamentals is necessary before installing the software for the Arduino development environment. These details will allow us to program the Arduino board.

IX. SCHEMATIC DIAGRAM:

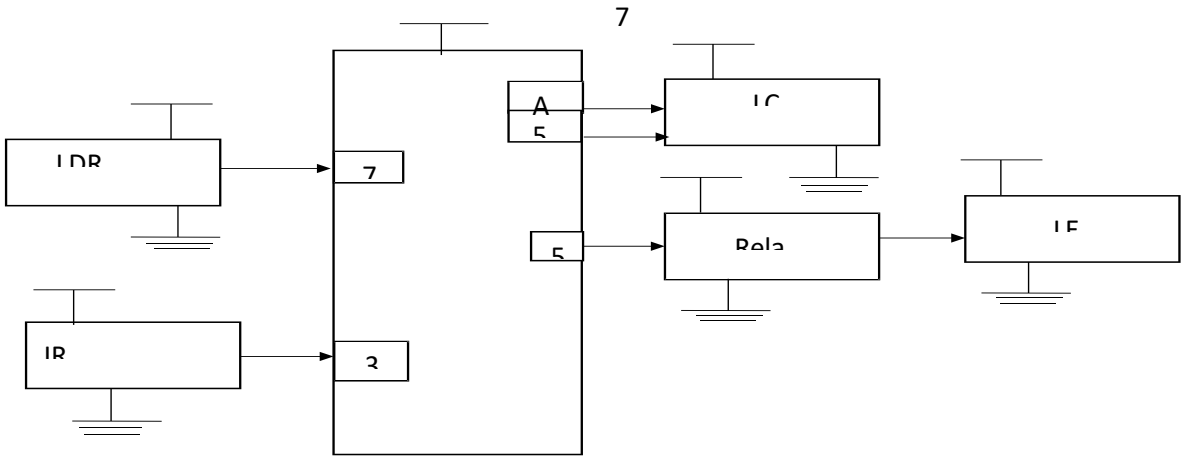

Fig: schematic diagram of proposed system

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X. RESULT

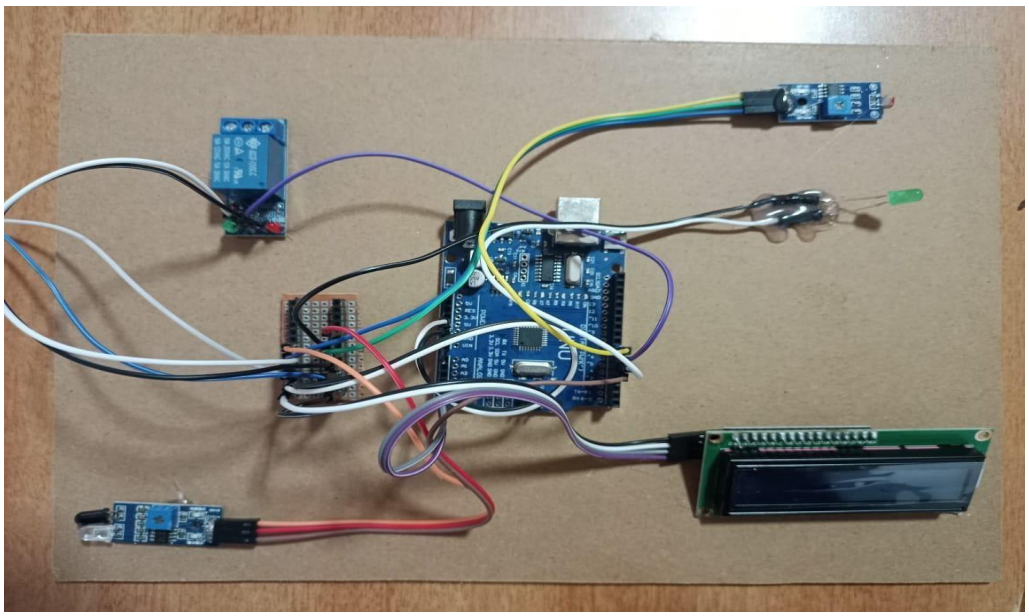

Fig:Model of Street Lights That Glow On Detecting Vehicle Movement

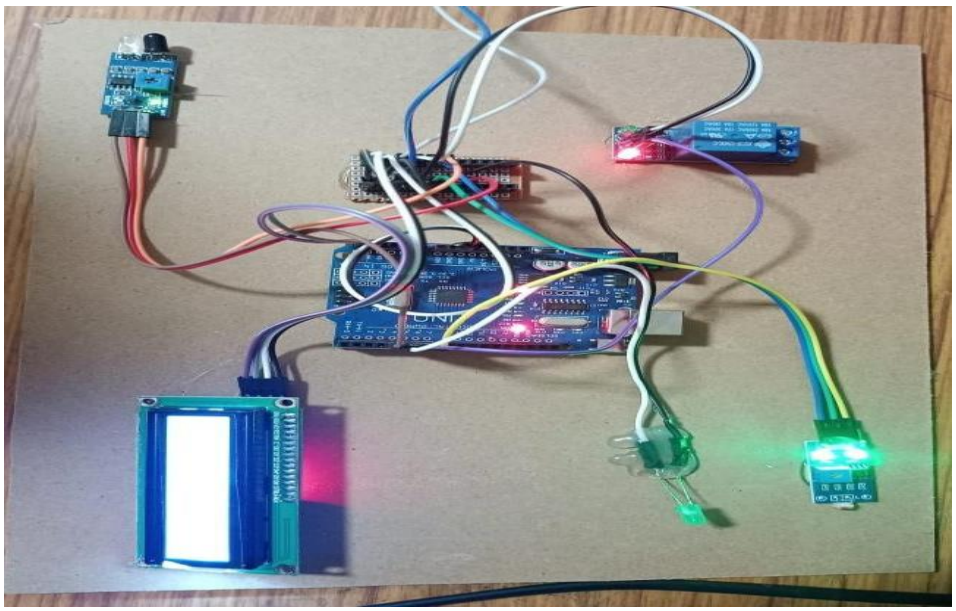

Fig:Working Model of Street Lights That Glow On Detecting Vehicle Movement

The proposed intelligent street light system demonstrates a significant step forward in modernizing street lighting infrastructure. By incorporating LDR and IR sensors, along with an Arduino-driven control system, the project effectively achieves automated brightness adjustment based on ambient light and motion detection. This innovation not only optimizes energy consumption but also enhances public safety by ensuring appropriate lighting conditions in real-time. The addition of an LCD display for system status further improves the system's usability and monitoring.

XI. Future scope :

Overall, this intelligent system addresses the inefficiencies of traditional street lighting by adapting to environmental changes and user needs. With its capability to conserve energy and improve safety, it serves as a sustainable and practical solution, paving the way for smarter urban management. Further developments and scalability could make this system an integral component of future smart city initiatives.

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