A CENTER FOR INTER-DISCIPLINARY RESEARCH
2020-21

SMART STREET LIGHT SYSTEM

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Advanced Academic Center

(A Center for Inter-Disciplinary Research)

SMART STREET LIGHT SYSTEM

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ACKNOWLEDGEMENTS

We express our deep sense of gratitude to our respected Director, Gokaraju Rangaraju Institute of Engineering and Technology, for the valuable guidance and for permitting us to carry out this project.

With immense pleasure, we extend our appreciation to our respected Principal, for permitting us to carry out this project.

We are thankful to the Associate Dean, Advanced Academic Centre, for providing us an appropriate environment required for the project completion.

We are grateful to our project supervisor who spared valuable time to influence us with their novel insights.

We are indebted to all the above-mentioned people without whom we would not have concluded the project.

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1. INTRODUCTION

Streetlights play a vital role in our environment and also play a critical role in providing light for safety during night-time travel. The street light one of the huge in a city. Currently a manual system is used where the light will be made to switched ON/OFF i.e., the light will made to be switched ON in the evening and switched OFF in the morning. Hence there is a lot of energy wastage between the ON/OFF.

The current street light setup costs the city 50% to 70% more than what smart street lights would potentially cost. In developing countries implementation of smart street lights can bring in a lot of change. The LED lights used in the smart street lights are intensity adjustable. They can also save energy in low traffic environments.

In this scenario, when the streetlights are in a working position over the whole night, which consumes much energy and reduce the lifetime of the electrical appliances such as a light-emitting diode (LED) lamp, incandescent bulb, gas discharge lamp, and high-intensity discharge lamps. Especially in cities' streetlights, it is a severe power consuming factor and also the most significant energy expenses for a city. In this regard, an automation system is required to control the lights according to needs.

The term "internet of things" (IoT) is also important for connecting electrical appliances with internet that made it feasible to remotely control items from anywhere and anytime. After the introduction of IoT, the wireless systems provided a great help for automation systems by using cloud networks and Wi-Fi etc. Similarly, many wireless systems are made by using Bluetooth and smartphones connections.

2. INTERNET OF THINGS (IOT)

The Internet of Things (IoT) describes the network of physical object “things” that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. These devices range from ordinary household objects to sophisticated industrial tools.

By making the devices connected to each other and the internet, we’ve let them collect and communicate data and make precise and informed decisions through Machine Learning and Neural Networks (complex mechanisms). This step has achieved outstanding outcomes.

Figure 1: Internet of Things

2.1 WORKING OF IOT:

Internet of Things is a combination of smart electronic devices, local area networks, the Internet, cloud servers, and the user application. An iot device connects through a local network. Then, it transmits information through the Internet to the cloud servers. Further, the cloud servers provide the data or information of the end-user application to the iot device. This transfer of information is a two-way communication that helps operate the iot system.

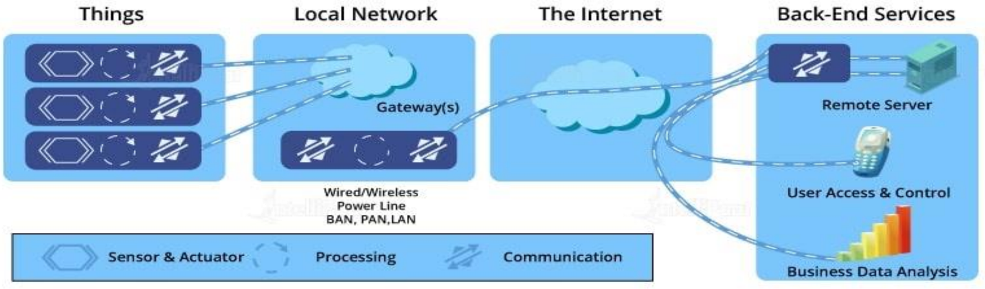


Figure 2: Working of IOT

1. IOT DEVICES - They are smart electronic gadgets that consist of wireless sensors that help in transferring data over the Internet.
2. LOCAL NETWORK - It helps in accessing the data from the devices connected to the Internet.
3. THE INTERNET - It helps the devices connect with the user applications and servers.
4. BACK-END SERVICES - They consist of a remote server, user access and control, and mobile applications. These services constantly help in exchanging streamed data from various IoT devices and end-user applications.

These four components combine together to successfully operate an IoT system.

2.2 HISTORY OF IOT:

The Internet of Things (IoT) has not been around that long. It was only in 1999 that the term ‘internet of things’ was coined by Kevin Ashton. Ashton used the phrase as the title of his presentation for a new sensor project he was working on and it stuck from there.

While the phrase came about in 1999, the concept of connected devices dates back to 1832. When the first electromagnetic telegraph was designed, allowing direct communication between two machines through the transfer of electrical signals.

However, the true Internet of Things history began with the invention of the Internet in the late 1960s.

Figure 3: Kevin Ashton

Kevin Ashton, inventor of the Internet of Things

2.3 WORLD'S FIRST IOT DEVICE:

The world's first IoT device was invented in the early 1980s at the Carnegie Melon University. A group of students from the university created a way to get their campus Coca-Cola vending machine to report on its contents through a network in order to save them the trek if the machine was out of Coke. They installed micro-switches into the machine to report on how many Coke cans were available and if they were cold.

In 1990, John Romkey connected a toaster to the internet for the first time. A year later, a group of students at the University of Cambridge used a web camera to report on coffee. They came up with the idea to use the first web camera prototype to monitor the amount of coffee available in their computer labs coffee pot. They did this by programming the web camera to take photos three times a minute of the coffee pot. The photos were then sent to local computers so everyone could see if there was coffee available.

2.4 PAVING THE WAY FOR THE FUTURE OF IOT:

The Internet of Things was a common topic used by the media at the beginning of the 21st Century with several major developments paving the way for the future of IoT. LG Electronics introduced the world's first refrigerator connected to the internet in 2000. Allowing consumers to do their food shopping online and make video calls. This invention was followed by a small rabbit-shaped robot in 2005 that could report the latest news, weather forecasts and stock market changes. While the first International Conference on Internet of Things was held in 2008 in Switzerland. Today there are more than 27 billion devices connected to the Internet of Things, with experts expecting this number to rise to over 100 billion devices by 2030.

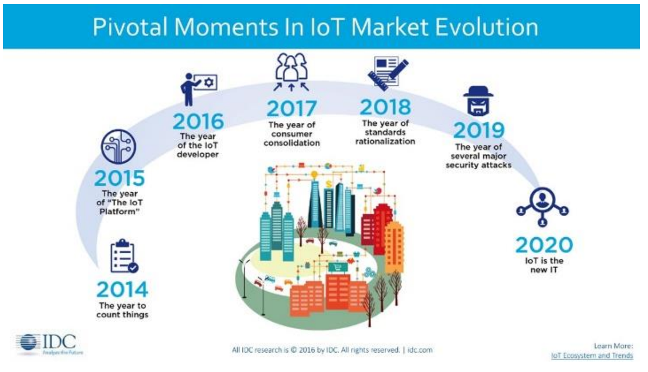


Figure 4: IOT Market Evolution

2.5 FUTURE OF IOT:

The Internet of Things (IoT) has risen to prominence as a global technology. It has grown in popularity in a short period. Moreover, advances in Artificial Intelligence and Machine Learning have made IoT device automation easy. In general, AI and machine learning programs are paired with IoT devices to provide proper automation. As a result, the Internet of Things (IoT) has broadened its field of application across various industries.

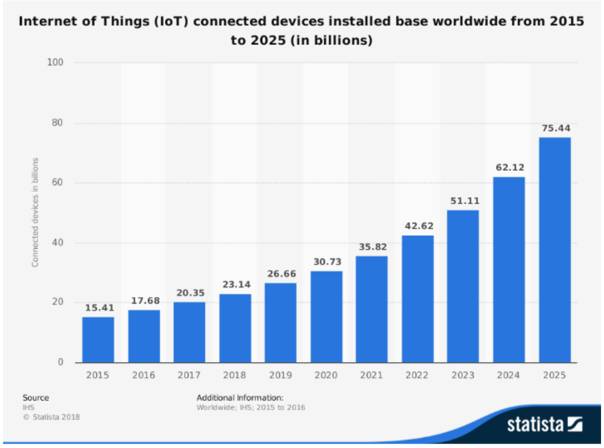


Figure 5:IOT devices graph

2.6 FUTURE PREDICTIONS:

1.By 2025, it is estimated that there will be more than to 21 billion iot devices.

2. Cybercriminals will continue to use iot devices to facilitate dos attacks.

3. More cities will become “smart”.

4. Artificial intelligence will continue to become a bigger thing.

5. Routers will continue to become more secure and smarter.

6. 5G Networks will continue to fuel iot growth.

7. Security and privacy concerns will drive legislation and regulatory activity.

8. 5G’s arrival will also open the door to new privacy and security concerns.

9. Iot-based ddos attacks will take on more dangerous forms.

2.7 APPLICATIONS OF IOT:

1. SMART HOMES

One of the best and the most practical applications of IoT, smart homes really take both, convenience and home security, to the next level. Though there are different levels at which IoT is applied for smart homes, the best is the one that blends intelligent utility systems and entertainment together. As IoT evolves, we can be sure that most of the devices will become smarter, enabling enhanced home security.

Figure 6: Smart Home

2. SMART CITY

Not just internet access to people in a city but to the devices in it as well – that's what smart cities are supposed to be made of. And we can proudly say that we're going towards realizing this dream. Efforts are being made to incorporate connected technology into infrastructural requirements and some vital concerns like Traffic Management, Waste Management, Water Distribution, Electricity Management, and more. All these work towards eliminating some day-to-day challenges faced by people and bring in added convenience.

Figure 7: Smart City

3. **SELF DRIVEN CARS**

We've seen a lot about self-driven cars. Google tried it out, Tesla tested it, and even Uber came up with a version of self-driven cars that it later shelved. Since it's human lives on the roads that we're dealing with, we need to ensure the technology has all that it takes to ensure better safety for the passenger and those on the roads. Though it will take a few more years for the technology to evolve completely and for countries to amend laws and policies, what we're witnessing right now is one of the best applications of IOT

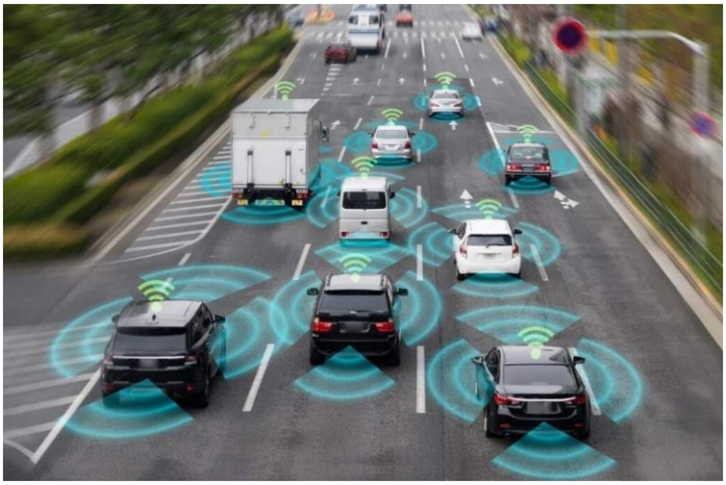


Figure 8: Self Driving cars

4. **FARMING**

Farming is one sector that will benefit the most from the Internet of Things. With so many developments happening on tools farmers can use for agriculture, the future is sure promising. Tools are being developed for Drip Irrigation, understanding crop patterns, Water Distribution, drones for Farm Surveillance, and more. These will allow farmers to come up with a more productive yield and take care of the concerns better.

Figure 9: Smart Farming

5. **WEARABLES**

Wearables remain a hot topic in the market, even today. These devices serve a wide range of purposes ranging from medical, wellness to fitness. Of all the IoT start-ups, Jawbone, a wearables maker, is second to none in terms of funding.

Figure 10:Smart wearables

6. INDUSTRIAL INTERNET

The Industrial Internet of Things consists of interconnected sensors, instruments, and other devices connected with computers' industrial applications like manufacturing, energy management, etc. While still being unpopular in comparison to IoT wearables and other uses, market researches like Gartner, Cisco, etc., believe the industrial internet to have the highest overall potential.

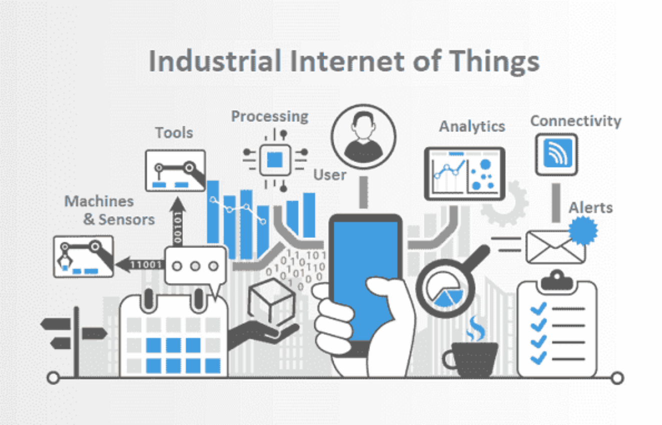


Figure 11:Industrial Internet of Things

7. TELEHEALTH

Telehealth, or Telemedicine, hasn’t completely flourished yet. Nonetheless, it has great future potential. IoT Examples of Telemedicine include the digital communication of Medical Imaging, Remote Medical Diagnosis & Evaluations, Video Consultations with Specialists, etc.

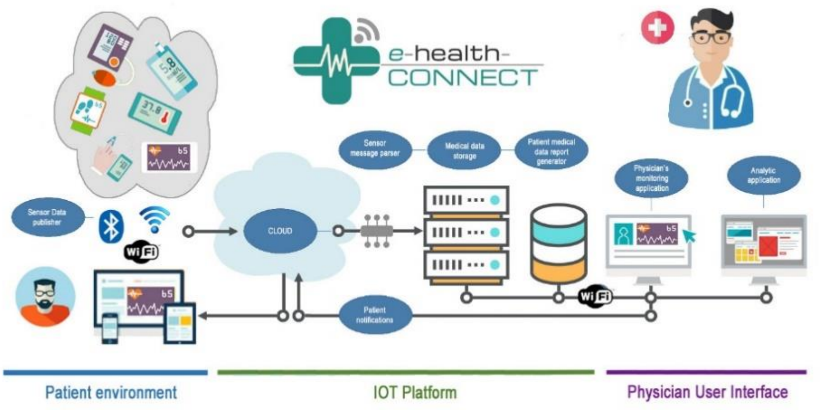


Figure 12:Telehealth

8. SMART SUPPLY-CHAIN MANAGEMENT

Supply-chains have stuck around in the market for a while now. A common example can be Solutions for tracking goods while they are on the road. Backed with IoT technology, they are sure to stay in the market for the long run.

Figure 13:Smart Supply-Chain Management

3. EXISTING PROBLEM

The traditional light system has been limited to two options: ON and OFF only, which are not efficient because these kinds of operations meant power loss due to continuing to work on maximum voltage. With the negligence of the operator or by some other technical problems, streetlights are continuously kept 'ON', even when there is no light required on the streets and this leads to the wastage of electricity. Hence, the wastage of power from street lights is one of the noticeable power losses.

Figure 14: view of Existing Problem

3.1 DISADVANTAGES OF EXISTING SYSTEM:

- Manual switching off/on of street lights
- More energy consumption
- High expense & More manpower

4. PROPOSED SYSTEM

The proposed system comprises of automatic on/off control, fire detection along with an alarm and detection of faulty lamps. The system is programmed by using node-MCU, and provided with remote monitoring system. The location can be fetched by GPS system in case of any faulty lamps.

4.1 ADVANTAGES OF THE PROPOSED SYSTEM:

- Automatic switching of street lights.
- Maintenance cost reduction.
- Wireless communication.
- Energy saving.
- Reduction of manpower.
- Detection of faulty lamps & fire accidents.

5. UNIQUENESS

The proposed system is unique as it provides the information remotely on faulty lamps identification and also it is providing an emergency alert in case of fire accidents with an alarm. The location of faulty lamp is identified by the operators through the message sent to them through GPS system. Hence the faulty lamp is rectified or replaced.

6. LDR – LIGHT DEPENDENT RESISTOR

6.1 INTRODUCTION IF LDR:

A Light Dependent Resistor (LDR) is also called a photo resistor or a cadmium sulphide (CDS) cell. It is also called a photoconductor. It is basically a photocell that works on the principle of photoconductivity. The passive component is basically a resistor whose resistance value decreases when the intensity of light decreases. This optoelectronic device is mostly used in light varying sensor circuit, and light and dark activated switching circuits. Some of its applications include camera light meters, street lights, clock radios, light beam alarms, reflective smoke alarms, and outdoor clocks.

6.2 LDR Structure and Working:

The basic structure of an LDR is shown below.

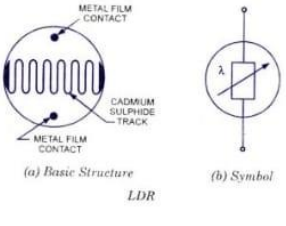


Figure 15: Light Dependent Resistor

The snake like track shown below is the Cadmium Sulphide (CDS) film which also passes through the sides. On the top and bottom are metal films which are connected to the terminal leads. It is designed in such a way as to provide maximum possible contact area with the two metal films. The structure is housed in a clear plastic or resin case, to provide free access to external light. As explained above, the main component for the construction of LDR is cadmium sulphide (CDS), which is used as the photoconductor and contains no or very few electrons when not illuminated. In the absence of light, it is designed to have a high resistance in the range of mega ohms. As soon as light falls on the sensor, the electrons are liberated and the conductivity of the material increases. When the light intensity exceeds a certain frequency, the photons absorbed by the semiconductor give band electrons the energy required to jump into the conduction band. This causes the free electrons or holes to conduct electricity and thus dropping the resistance dramatically (< 1 Kilo ohm). The equation to show the relation between resistance and illumination can be written as:

R = A*(E^a)
Where E- illumination (lux)
R – resistance (ohms)
A, a – constants
The value of ‘a’ usually range between 0.7 and 0.9.

6.3 ADVANTAGES OF LDR SENSOR:

1. LDR’s are cheap and are readily available in many sizes and shapes.
2. Practical Ldrs are available in a variety of sizes the most popular size having a face diameter of roughly 10 mm.
3. They need very small power and voltage for its operation.

6.4 DISADVANTAGES OF LDR SENSOR:

1. Highly inaccurate with a response time of about tens or hundreds of milliseconds.
2. Narrow spectral response.
3. Low temperature stability for the fastest material.

7. RELAY

7.1 INTRODUCTION OF RELAY:

A relay is an electrically operated switch that allows you to turn on or off a circuit using voltage or current much higher than a microcontroller can handle. It aims at closing and opening the circuits electronically and electromechanically. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact form, such as make contacts, break contacts, or combinations thereof.

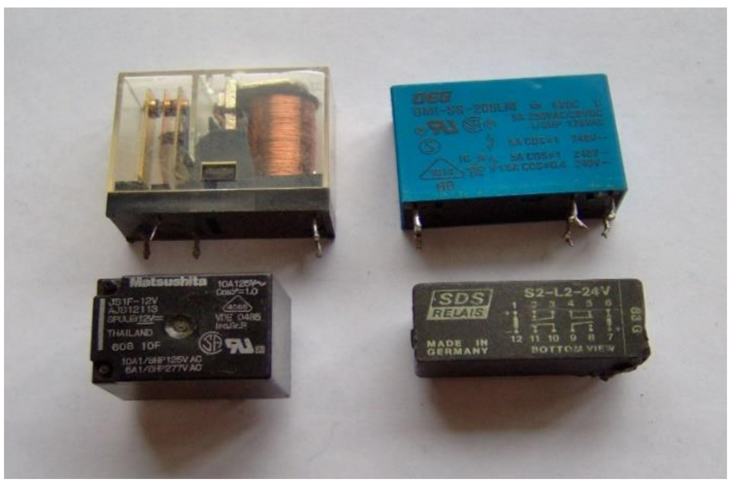


Figure 16: Relay

7.2 TYPES OF RELAYS:

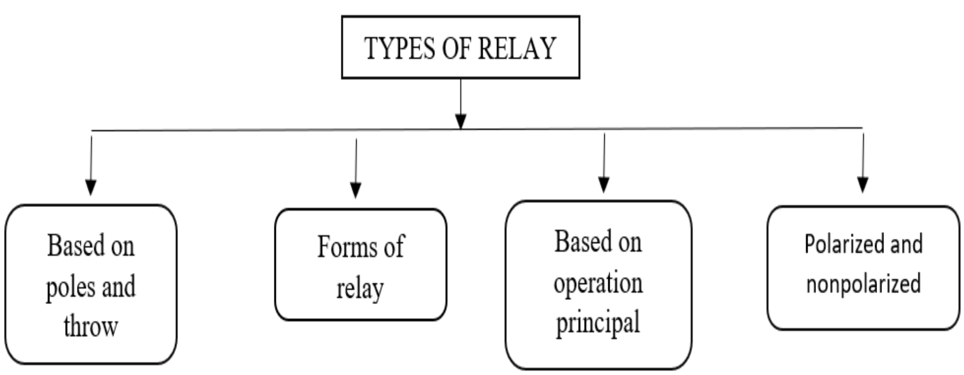
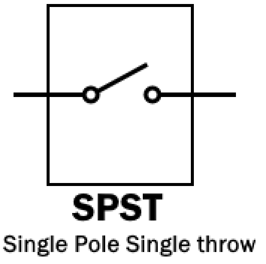


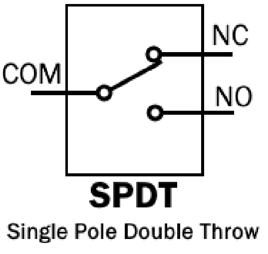
Figure 17: Types of Relay

7.3 BASED ON POLES AND THROW:

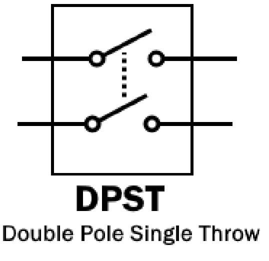
1. SPST- Single pole single throw.



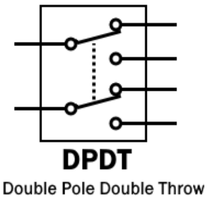
2. SPDT- Single pole double throw .



3. DPST-Double pole single throw .

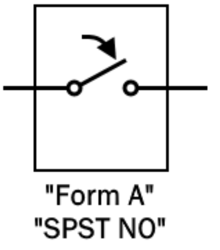


4. DPDT- Double pole double throw.

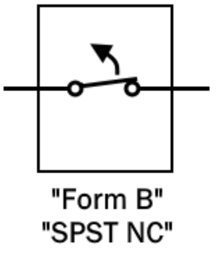


7.4 FORMS OF RELAY:

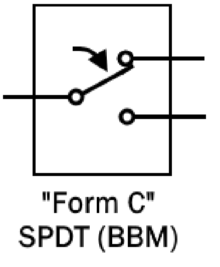
1. FORM A – It is a SPST relay with normally open default state.



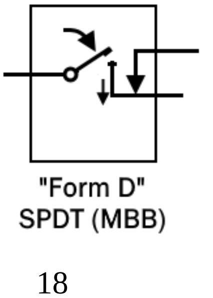
2. FORM B – It is a SPST relay with normally closed default state .



3. FORM C – It is a SPDT relay with double throw contact terminals known as NC & NO.



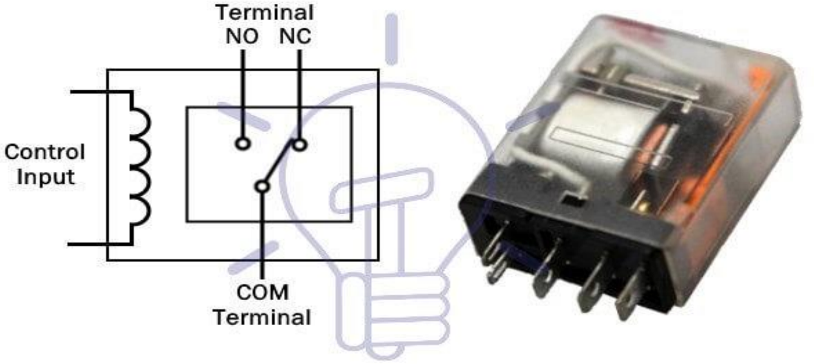
4. FORM D – It is also an SPDT relay and has the same principle as Form C relay but it Is “make-before-break” contact relay.



7.5 BASED ON OPERATION PRINCIPLE:

1. **EMR – ELECTROMECHANICAL RELAY**

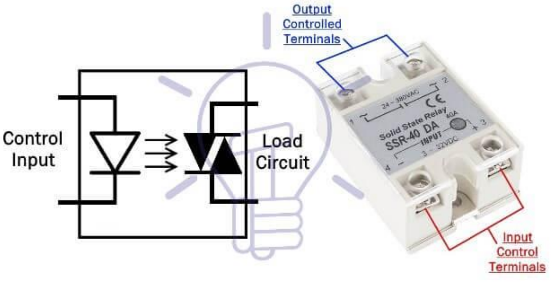
   This type of relay has an electromagnetic coil and a mechanical movable contact.



ElectroMechanical Relay

2. **SSR – SOLID STATE RELAY**

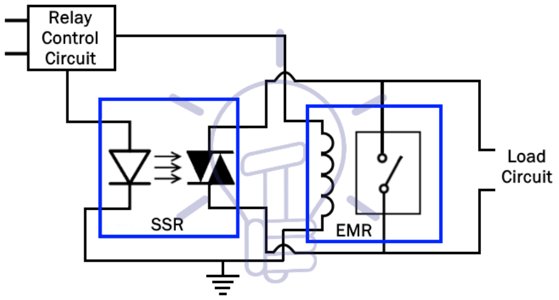
It is made up of semiconductors instead of mechanical parts and it works on isolating the low voltage circuit from high voltage circuit using an optocoupler.



Solid State Relay (SSR)

3. HYBRID RELAY

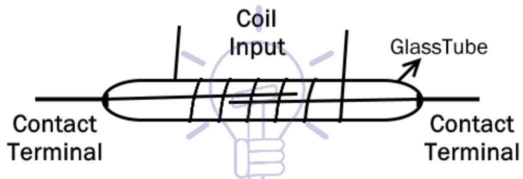
It is made using both SSR and EMR relays .



Hybrid Relay

4. REED RELAY

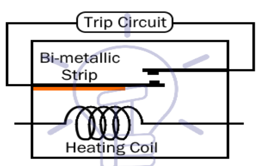
Reed relay is made up of a reed switch & an electromagnetic coil with a diode for back EMF.



Reed Relay

5. ELECTROTHERMAL RELAY

An electrothermal relay is made up of bimetallic strip.



Thermal Relay (Overload Relay)

7.6 POLARIZED AND NON-POLARIZED RELAY:

The polarized relay uses a permanent magnet with an electromagnet. The non-polarized relay does not use permanent magnets & their coil can be energized in both ways without affecting its operation.

7.7 WORKING PRINCIPLE OF RELAY:

It works on the principle of an electromagnetic attraction. When the circuit of the relay senses the fault current, it energises the electromagnetic field which produces the temporary magnetic field. This magnetic field moves the relay armature for opening or closing the connections. The small power relay has only one contacts, and the relay has two contacts for opening the switch.

The inner section of the relay is shown in the figure below. It has an iron core which is wound by a control coil. The power supply is given to the coil through the contacts of the load and the control switch. The current flows through the coil produces the magnetic field around it.

Due to this magnetic field, the upper arm of the magnet attracts the lower arm. Hence close the circuit, which makes the current flow through the load. If the contact is already closed, then it moves oppositely and hence open the contacts

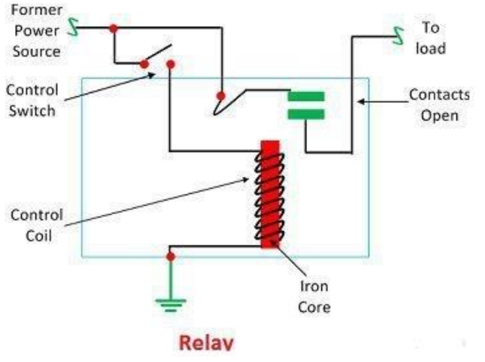


Figure 18: Working of Relay

7.8 RELAY MODULE:

The relay module is a separate hardware device used for remote device switching. With it you can remotely control devices over a network or the Internet. Devices can be remotely powered on or off with commands coming from the operator delivered over a local or wide area network. You can control computers, peripherals or other powered devices from across the office or across the world.

The Relay module can be used to sense external on /Off conditions and to control a variety of external devices. The PC interface connection is made through the serial port.

The Relay module houses two SPDT relays and one wide voltage range, optically isolated input. These are brought out to screw-type terminal blocks for easy field wiring. Individual LEDs on the front panel monitor the input and two relay lines. The module is powered with an AC adapter.

Figure 19:Relay Module

7.9 PINS OF RELAY MODULE:

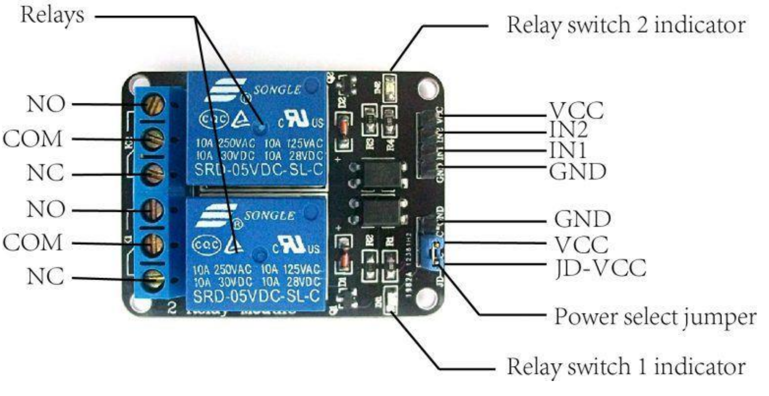


Figure 20 : Pins of Relay Module

The left side of the module is high voltage side. It has 2 connectors each with three sockets: common (COM), normally open (NO) and normally closed (NC)
COM – common pin.

NC – Normally closed, this configuration is used when you want the relay to be closed by default, meaning the current is flowing unless you send a signal from the Arduino to the relay module to open the circuit and stop the current.

NO – Normally open, this configuration works the other way around: the relay is always open, so the circuit is broken unless you send a signal from the Arduino to close the circuit.

The right side of the module is low voltage side. It has a set of four pins and set of three pins

The set of 4 consists of VCC and GND to power the module, input1(IN1) and input2(IN2) to control the relays

The set of 3 consists of GND, VCC and JD-VCC pins. The JD-VCC pin powers the electromagnet of the relay

GND – Goes to ground

IN1 – Controls the first relay

IN2 – Controls the second relay

VCC – Goes to 5v.

7.10 APPLICATIONS OF RELAY:

Relays have a wide range of applications starting from washing machines at homes to the telecommunication systems at the international space station, they can be found everywhere.

1. They are used in electronic circuit and home appliances for isolating low voltage or DC circuits from high voltage AC circuits.
2. They are the backbone of industrial process automation systems. They are used in combination with PLCs for process control. They are one of the key components in an automation cabinet.
3. Used for signalling and control in railway networks.
4. In motor control circuits for motor switching, protection as well as control.

8. NODE MCU

8.1 INTRODUCTION:

Node Mcu is an open-source LUA based firmware developed for the ESP8266 Wi-Fi chip. By exploring functionality with the ESP8266 chip, Node MCU firmware comes with the ESP8266 Development board/kit i.e., Node Mcu Development board. Since Node Mcu is an open-source platform, its hardware design is open for edit/modify/build. Node Mcu Dev Kit/board consist of ESP8266 Wi-Fi enabled chip. The ESP8266 is a low-cost Wi-Fi chip developed by Express if Systems with TCP/IP protocol. For more information about ESP8266, you can refer to the ESP8266 Wi-Fi module. There is Version2 (V2) available for Node Mcu Dev Kit i.e., Node Mcu Development Board v1.0 (Version2), which usually comes in black coloured PCB. Node Mcu Dev Kit has Arduino like Analog (i.e., A0) and Digital (D0-D8) pins on its board. It supports serial communication protocols i.e., UART, SPI, I2C, etc. Using such serial protocols, we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards, etc.

8.2 Node Mcu Pinout and Functions Explained:

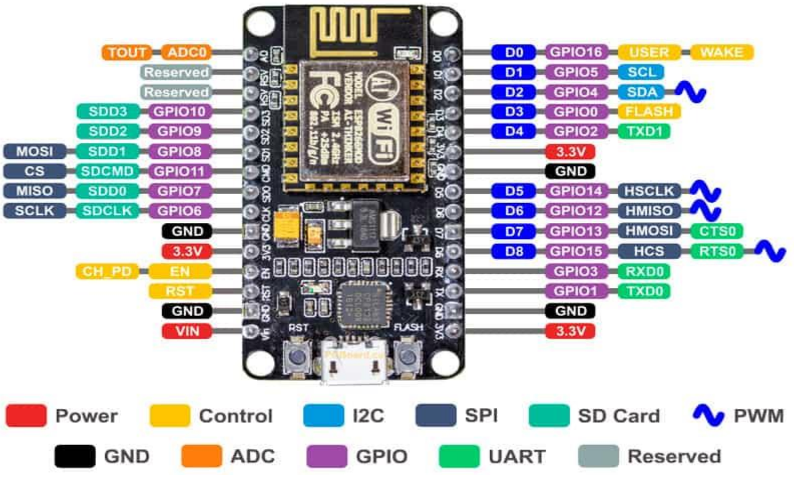


Figure 21:Node Mcu

8.21 POWER PINS:

There are four power pins. VIN pin and three 3.3V pins.

1. VIN can be used to directly supply the Node Mcu/ESP8266 and its peripherals. Power delivered on VIN is regulated through the onboard regulator on the Node Mcu module – you can also supply 5V regulated to the VIN pin
2. 3.3V pins are the output of the onboard voltage regulator and can be used to supply power to external components

8.22 GND:

GND are the ground pins of Node Mcu/ESP8266.

8.23 I2C PINS:

12C Pins are used to connect I2C sensors and peripherals. Both I2C Master and I2C Slave are supported. I2C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum. It should be noted that I2C clock frequency should be higher than the slowest clock frequency of the slave device.

8.24 GPIO PINS:

Node Mcu/ESP8266 has 17 GPIO pins which can be assigned to functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Light and Button programmatically. Each digital enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge-trigger or level-trigger to generate CPU interrupts.

8.25 ADC CHANNEL:

The Node Mcu is embedded with a 10-bit precision SAR ADC. The two functions can be implemented using ADC. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time.

8.26 UART PINS:

Node Mcu/ESP8266 has 2 UART interfaces (UART0 and UART1) which provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0 pins) can be used for communication. However, UART1 (TXD1 pin) features only data transmit signal so, it is usually used for printing log.

8.27 SPI PINS:

Node Mcu/ESP8266 features two SPIs (SPI and HSPI) in slave and master modes. These SPIs also support the following general-purpose SPI features:

1. 4 timing modes of the SPI format transfer
2. Up to 80 MHz and the divided clocks of 80 MHz
3. Up to 64-Byte FIFO

8.28 SDIO PINS:

Node Mcu/ESP8266 features Secure Digital Input/Output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

8.29 PWM PINS:

The board has 4 channels of Pulse Width Modulation (PWM). The PWM output can be implemented programmatically and used for driving digital motors and LEDs. PWM frequency range is adjustable from 1000 up to 10000 us (100 Hz and 1 kHz)

8.30CONTROL PINS:

They are used to control the Node Mcu /ESP8266.
These pins include Chip Enable pin (EN), Reset pin (RST) and WAKE pin.

1. EN: The ESP8266 chip is enabled when EN pin is pulled HIGH. When pulled LOW the chip works at minimum power.
2. RST: RST pin is used to reset the ESP8266 chip.
3. WAKE: Wake pin is used to wake the chip from deep-sleep.

8.3 NODE MCU ESP8266 SPECIFICATIONS & FEATURES:

1. Microcontroller: Ten silica 32-bit RISC CPU Extensa LX106.
2. Operating Voltage: 3.3V.
3. Input Voltage: 7-12V.
4. Digital I/O Pins (DIO): 16.
5. Analog Input Pins (ADC): 1.
6. UARTs: 1.
7. SPIs: 1.
8. I2Cs: 1.
9. Flash Memory: 4 MB.
10. SRAM: 64 KB.
11. Clock Speed: 80 MHz.
12. USB-TTL based on CP2102 is included onboard, Enabling Plug n Play.
13. PCB Antenna.
14. Small Sized module to fit smartly inside your IoT project.

9. INFRARED FLAME DETECTOR SENSOR

9.1 INTRODUCTION OF IR SENSOR:

An infrared flame detector is a device that locates flame by deploying a high-tech infrared sensor to accurately identify their unique spectral pattern emitted by live fire. Infrared detectors are embedded with a pyroelectric sensor that can easily detect thermal radiation and are sensitive to a variation of the light signal it receives.

IR detectors are suitable for areas where combustion sources can produce intense and smoky fires. They can operate within the range of sixty meters from the fire source .IR detectors can be used in both indoor and outdoor environments. IR detectors are immune to radiation produced by sunlight, welding, and other hot objects that might be present in the environment it is installed in.

IR detectors are more reliable and cheaper than other detectors in the market. A flame-sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a fire or flame. The flame detection response can depend on its fitting. It includes an alarm system, a natural gas line, propane & a fire suppression system. Fire Alarm Systems are very common in commercial building and factories, these devices usual contain a cluster of sensors that constantly monitors for any flame, gas or fire in the building and triggers an alarm if it detects any of these.

One of the simplest ways to detect fire is by using an IR Flame sensor, these sensors have an IR photodiode which is sensitive to IR light. Now, in the event of a fire, the fire will not only produce heat but will also emit IR rays, yes, every burning flame will emit some level of IR light, this light is not visible to human eyes but our flame sensor can detect it and alert a microcontroller like Arduino that a fire has been detected. The IR Flame sensor used in this project these sensors are also called Fire sensor module or flame detector sensor.

9.2 WORKING PRINCIPLE:

This sensor/detector can be built with an electronic circuit using a receiver like electromagnetic radiation. This sensor uses the infrared flame flash method, which allows the sensor to work through a coating of oil, dust, water vapor, otherwise ice.

9.3 FLAME SENSOR MODULE:

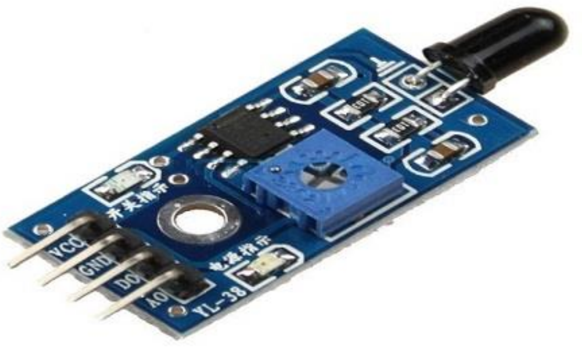


Figure 22: Flame Sensor Module

The pin configuration of this sensor is shown below. It includes four pins which include the following. When this module works with a microcontroller unit then the pins are

- Pin1 (VCC pin): Voltage supply rages from 3.3V to 5.3V.
- Pin2 (GND): This is a ground pin.
- Pin3 (AOUT): This is an analog output pin (MCU.IO).
- Pin4 (DOUT): This is a digital output pin (MCU.IO).

The following image shows all the components of a typical Flame Sensor Module.

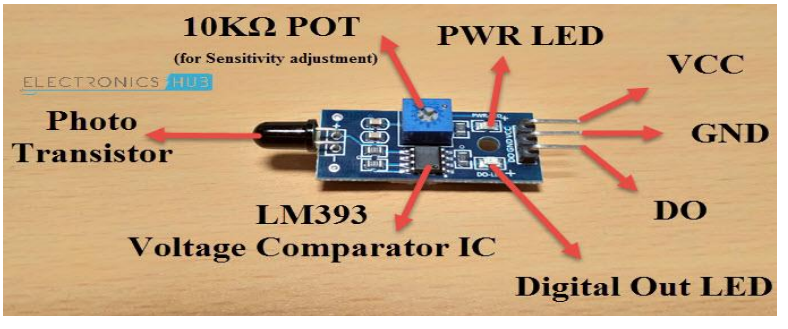


Figure 23: Flame sensor pins

9.4 CIRCUIT DIAGRAM OF FLAME SENSOR MODULE:

If you want to know a little bit more about the Flame Sensor Module, then analysing its circuit will probably help you. The following image shows the circuit diagram of a Flame Sensor.

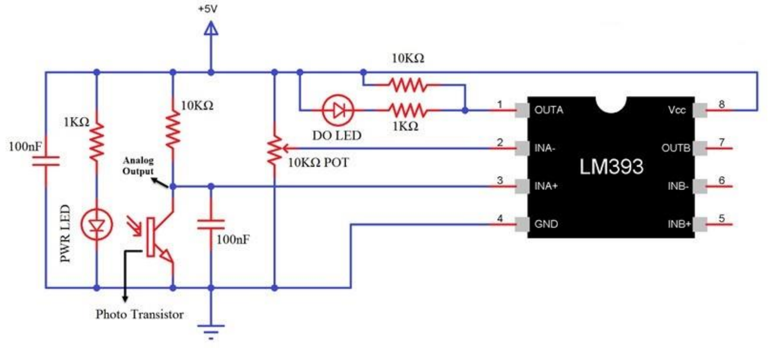


Figure 24: Circuit of Flame Sensor

9.5 DIFFERENT TYPES:

Flame-sensors are classified into four types

- IR single frequency.
- IR multi-spectrum.
- UV flame detectors.
- UV/ IR flame detector.

Fire alarm systems are very common nowadays and commonly installed in Banks, shops, offices, home etc. They detect the fire and trigger a loud alarm to aware everybody. But what if nobody is there to hear that alarm, like in night time or when nobody is at home. So, to inform the authority about any fire incident today we are building a IoT based Fire Alarm system which not only trigger an alarm but also sends an Email alert to concern persons**.** This method can also be used to inform fire department automatically in case of fire. Here we will use Infrared Flame Sensor to detect the fire and ESP8266 Node MCU to trigger the alarm and send email with the help of SMTP server. This project can be further extended to make a phone call or send an SMS with the help of GSM module in case of fire.

9.6 WORKING OF IR SENSOR:

Infrared Flame Sensor consists of a photodiode coated with black epoxy which makes it sensitive to the infrared radiations having wavelength between 700nm to 1mm and can detect fire up to distance of 100cm within 60 degrees of angle of detection. This photodiode is based on a three terminal YG1006 NPN Photo transistor. Every object including the “fire” emits some number of Infrared rays which are detected by the photodiode. An operation amplifier is attached across the photodiode to detect the change in voltage. If the voltage detected is zero it gives digital output “1” and if it detects some voltage in case of fire then it gives digital output as “0”.

9.7 APPLICATIONS OF IR SENSOR:

These sensors are used in several dangerous situations which include the following.

- Hydrogen stations.
- Industrial heating.
- Fire detection.
- Fire alarm.
- Firefighting robot.
- Drying systems.
- Industrial gas turbines.
- Domestic heating systems.
- Gas-powered cooking devices.

10. LIQUID CRYSTAL DISPLAY

10.1 INTRODUCTION OF LCD:

LCD stands for Liquid Crystal Display. It is a flat panel display technology, mainly used in TVs and computer monitors, nowadays it is used for mobile phones also. These LCDs are completely different from that old CRT displays; it uses liquid crystals instead of cathode ray in its primary form of operation.

An LCD display consists of millions of pixels made of crystal and arranged in a rectangular grid. In LCD it has backlights that provide light to each pixel. Each pixel has a red, green, and blue (RGB) sub-pixel that can be turned on or off. When all of the sub-pixels are turned off, then it's black and when all the sub-pixels are turned on 100%, then it's white.

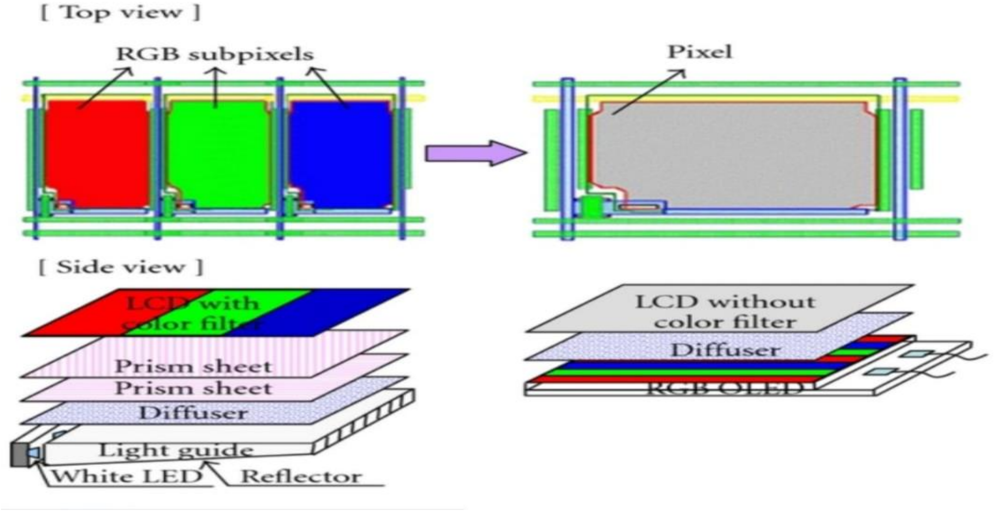


Figure 25 : Liquid Crystal Display

LCD is a combination of two states of matter, the solid and the liquid. The solid part is crystal and this liquid and crystal together make the visible image. LCD consists of two layers which are two polarized panels- filters and electrodes. LCD screen works by blocking the light rather than emitting the light.

10.2 HISTORY OF LCD:

The LCD display was first built in the year 1964 in RCA Laboratories by George Heitmeier who was an electrical engineer in the RCA lab.

At first in the year 1888, liquid crystal was discovered by Friedrich Reinitzer by extracted cholesterol from carrots, who was an Austrian botanist. In that time liquid crystal was used in research and experimental works. Then by the year 1936, liquid crystal was used in a practical application and known as Liquid Crystal Light Valve which is used in wireless telegraphy.

Then in the year 1962, a researcher of RCA Richard Williams generated some patterns in a thin layer of liquid crystal material by applying voltage on it, which is known as electro-optical effects. After all these things finally in 1964 LCD was invented.

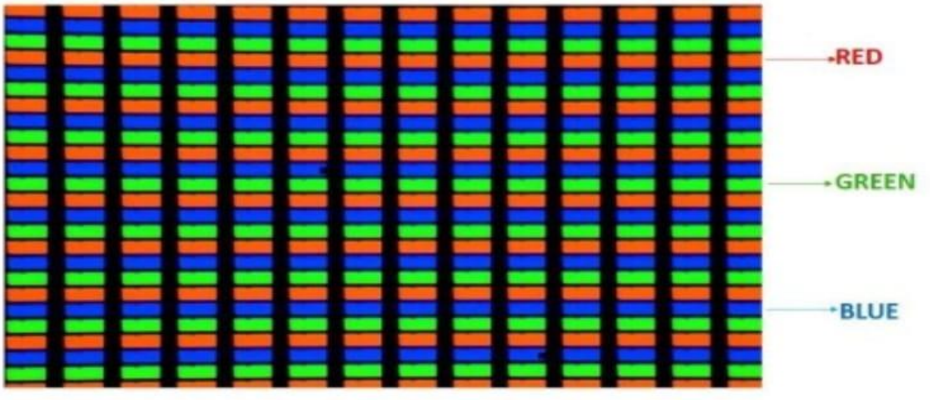


Figure 26: LCD

The first modern LCD was produced in the year 1972, by International Liquid Crystal Company *(*ILIXCO*)* owner James Ferguson. This LCD was made using passive grid technology.

In the year 1995 Hitachi and NEC were the first manufacturers of active-matrix LCDs. These LCDs are based on IPS (In-Plane Switching) technology. After all this, by the year 1996 SAMSUNG, TOSHIBA has come to market.

10.3 CHARACTERISTICS OF LCD:

The main characteristics of LCD are:

- Voltage: 3V to 12V
- Operating temperature: Normally it ranges from 0 to +60 C, but for extreme cases, it varies from -40 to +85 C.
- Frequency: 30Hz to 60 Hz
- Average Current Consumption: 1.2micro A to 6micro A
- Opening Time: 100 Ms

Also, LCD has other characteristics in terms of many areas, that is

- Resolution: LCD is made up of liquid crystal, which is neither liquid nor solid, and this thing reflects the light in a well-formed way, lights enter into the crystal and reflect very clearly. So, the image made with this liquid crystal is very accurate. LCD is a Digital display, which addresses each individual pixel using a fixed matrix of horizontal and vertical dots. LCD scales the image according to the resolution the device provided. So, the quality of the image is not degraded.
- Brightness: Brightness means the light provided by the LCD, which is nothing but the intensity of visible light, it is measured using nits. Nits are defined as one candela per square meter. In LCD brightness is very much accurate for the good resolutions and pixels.
- Contrast Ratio: It is the ratio of the brightest color and the darkest color for a particular position of the screen provided by the display. To calculate contrast ratio (CR) see the below formula Typically, the ratios of modern monitors are 1000:1 and TVs are 4000:1.
- Response Rate: Response Rate is high in LCD, which means the time required for changing colours of the pixels is very much less so that the refresh rate is very high in LCD than CRT. There is no lagging between the pixels when the image is changed.

10.4 ADVANTAGES OF LCD:

- The main advantage of LCD is, it has low cost and energy-efficient, and very less power consumption.
- LCD is thinner and lighter and very flexible.
- LCD provides excellent contrast, brightness, and resolution, so the picture quality is very clear as a crystal.
- Radiation of LCD monitors are much less than CRT monitors
- LCDs can be suitable with CMOS integrated circuits so that making of LCD is very easy.
- It gives perfect sharpness at the native resolution
- Zero geometric distortion at the native resolution of the pane
- It provides various conveniences like portability as compared to previous technology-based screens.

10.5 DISADVANTAGES OF LCD:

- LCD requires additional light sources for lighting the pixels, so if the light source is destroyed then the LCD is not providing any image on the display.
- LCD is the less reliable display.
- The image visibility depends on light intensity
- The aspect ratio and resolution are fixed for LCD.
- LCD has an irregular intensity scale and it produces lower than 256 discrete intensity levels.
- In LCD colour saturation is reduced at the low-intensity level due to poor black-level.
- LCD provides a limited viewing angle, which affects the brightness. if we are watching the screen from an angle then the colour of the image is changed in our eyes.

11. CONSTRUCTION OF PROTOTYPE

In this proposed system the main components are LDR Sensor, IR flame sensor, Relay, Wi-Fi module ESP8266, buzzer, Node Mcu etc… The LDR sensor is used to switch ON-OFF the street light based on the ambient intensity level. Relay is used to control the LDR sensor output. The IR sensor senses the fire or heat and alerts by using a buzzer. System is programmed by using a Node Mcu. The Wi-Fi module is used to communicate remotely. Hence the street light system is made smart and automized.

12. BLOCK DIAGRAM

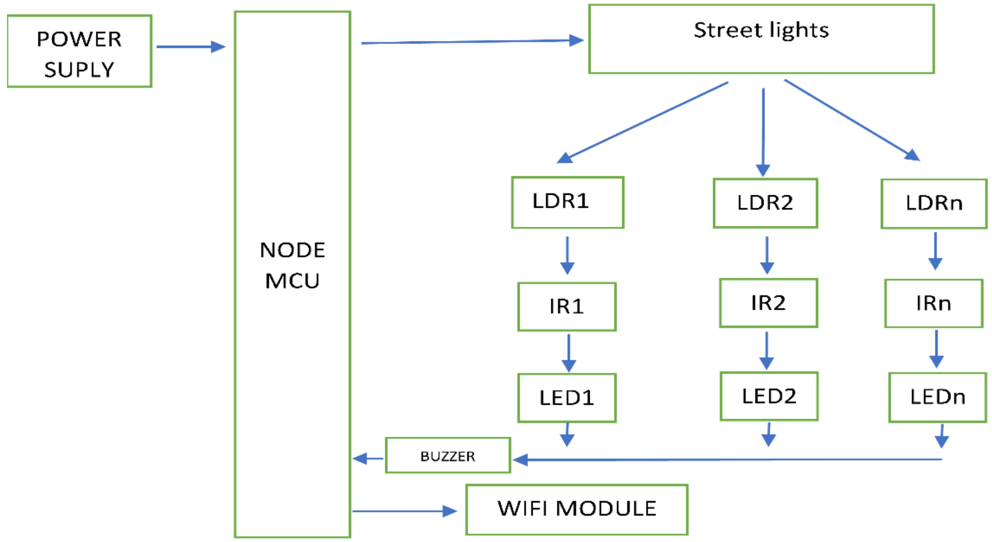


Figure 27 : Block Diagram

13.WORKING

The LDR is used to switch on and off the street lamps. LDR is a light dependent resistor, when light falls on its resistance reduces. The LDR which is used to switch sensor the ambience light and depending on it, led turns on / off automatically. Led on insufficient light and turns off with sufficient light. LDR is operated through relay driver. The relay driver turns on when LDR is uncovered and turn off when LDR is covered.

IR sensor placed at respective lamps is used to identify the spectrum emitted by fire. These sensors are connected to the Node Mcu and the output is connected to alarm and an alert message is sent to the person/operator. Similarly in faulty lamp case also, person can get a message remotely through Wi-Fi module and microcontroller. The operator can detect the location of the faulty lamp by using GPS.

Hence, the smart street system works. By programmed Node Mcu and it activates necessary sensors accordingly.

14. OBJECTIVE

The main objective of this project is to implement an Iot based Smart Street Lightning System. The street lights switch on at the sunset and then switch off at the sunrise, automatically. The process repeats every day. White Light Emitting Diodes (LED) replaces conventional high intensity discharge (HID) lamp in street lighting system. LED lights are the future of lighting because of their low energy consumption and long life. This proposed system uses a Node Mcu board. Strings of LED are interfaced to the Node Mcu board. A programmed Node Mcu board is engaged and enhanced by integrating the LDR to follow the switching operation, Fire detection with alarm and faulty lamp detection using GPS to trace the location.

15.CODE

16. CONCLUSION

Iot Based Smart Intelligent Lighting System project is cost adequate, practical, Eco friendly. The LEDs have long life, emit cool light, donor have any toxic material and can be used for fast switching. Keeping in view the long-term benefits and the initial cost would never be a problem as the investment. The project has scope in various other applications like for providing lighting in industries, campuses and parking lots of huge shopping malls. This can also be used for surveillance in corporate campuses and industries. This project “IoT Based Smart Intelligent Lighting System. “Is a cost effective, practical, eco-friendly and the safest way to save energy.

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