

SUBSEA COMMUNICATION USING FIBER OPTICS

Submitted in Partial fulfillment of the Requirements for the Award of
Bachelor of Engineering in Electronics and Communication.

By

Aakash.S (38130002)

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

May 2022



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Aakash.S (38130002), Fardeen Essa (38130063) who carried out the project entitled SUBSEA COMMUNICATION USING FIBER OPTICS under my / our supervision from December 2021 to May 2022

Internal Guide

External Guide (if Applicable)

**Head of the Department
(Name in Capital letters with Seal & Signature)**

Submitted for Viva voce Examination held on 02.05.2022

Internal Examiner

External Examiner

DECLARATION

We AAKASH.S (3813002) and FARDEEN ESSA (38130063) hereby declare that the Project Report entitled **SUBSEA COMMUNICATION USING FIBER OPTICS** done by us under the guidance of Dr.S.Karthikeyan is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering in Electronics and Communication.

DATE: 02.05.2022

PLACE: CHENNAI

SIGNATURE OF THE CANDIDATE

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We are pleased to acknowledge our sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

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ABSTRACT

Optical Cable maintenance must be under care at least once in a year. Additional Man-Power will create minor impact to the existing protocol since persons are required to support over all power backup and system maintenance but, when compared to the profit ratio this factor is purely negligible. This technology is developed to overcome and avoid time delay in controlling the subsea equipment. To remove the issue of hydraulic fluid discharge. To avoid subsea accumulation in deep water. To reduce the overall cost of the project as the time of the project is reduced. To avoid long residence time in long umbilical leading to degradation of fluids (flocculation). To develop new technology which will pave a way to wireless communication using optics in future. To avoid issues from fluid contamination. Precise data Log can be Maintained. Hydraulics controlled through optical fiber technology will tremendously decrease the time delay when compared to existing high pressure steam control valves. On Implementing IoT, this system can be securely handled globally from any where in the world. In case of Network crash of Internet Protocol Failure an emergency password protected manual control unit will do the job in next fraction of seconds. Whole system will be under systematic control and the cost of the existing mechanism will be reduced nearly to 200 percent. There is minor chance for error rate of nearly 5% when compared to the present traditional sub sea equipment success rate. This can only be improvised based on the upcoming network technologies. Optical Cable installation cost will be highly complex. 24x7 Power backup must be maintained from sub station. National Firewall should be under surveillance and it must be protected against black hat hackers.

CHAPTER-1

INTRODUCTION

In oil and gas industry, though the technology has developed so much in the 21st century we are using the same old traditional way of communicating underneath the subsea using hydraulics, which takes quite a long time to communicate from topside to the subsea Equipment but produces 100% success rate. Many researchers are working on to develop the subsea communication system using Wi-Fi, but due to several factors, Wi-Fi does not travel underneath the sea. As the first step for wireless Communication, I am using optical fiber (wired) as a medium of communication and developing the speed of Communication and controlling the subsea Equipment. This project focuses on developing the speed of Communication and controlling the subsea Equipment using Fiber optical as a medium, which is already present in the subsea umbilical. I have developed a device which can retrieve the message from optical Fiber and open the valve manually underneath the sea within a maximum time span of 13 seconds

1.1 IMPORTANCE OF SUBMARINE CABLES:

Undersea cables currently carry 99 percent of the data traffic that crosses the seas. Submarine cables have a high level of dependability, especially when numerous pathways are available in the case of a cable break (as mentioned above). Submarine cables have a total carrying capacity of terabits per second, but satellites normally give only 1,000 megabits per second and have a greater latency. A typical multi-terabit transoceanic submarine cable system, on the other hand, costs several hundred million dollars to build.

These cables are highly prized not just by the businesses who create and operate them for profit, but also by national governments, due to their low cost and utility. The Australian government, for example, deems its undersea cable systems "essential to the national economy." As a result, the Australian Communications and Media Authority (ACMA) has established protection zones that limit activities that may cause harm to the cables that connect Australia to the rest of the world. The ACMA also oversees all initiatives including the installation of new underwater cables.

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1.2 WHAT IS A SUBMARINE CABLE?

A submarine cable is a fiber optic cable laid in the ocean, connecting two or more landing points.

Rarely much wider than a garden hose, today cables generally comprise of the optical fibers that carry the information, which are then covered in silicon gel, then sheathed in varying layers of plastic, steel wiring, copper, and nylon in order to provide insulation to protect the signal and protect the cable from damage from wildlife, anchors & fishing, or weather & other natural events.

The cables are laid using ships that are modified specifically for this purpose, transporting and slowly laying the 'wet plant' infrastructure on the seabed. These

special ships can carry thousands of kilometers of optical cable out to sea. A special subsea plow is also used to trough and bury submarine cables along the seabed closer to shorelines where naval activities, such as anchoring and fishing, are most prevalent and could damage submarine cables.

“We've had submarine cables for over 150 years,” explains Gil Santaliz, founder and CEO of New Jersey cable landing station NJFX, “and they've really been a way for communication between countries and continents.”

“The most basic application is communicating what's happening in one part of the world to another, but we've morphed that to allow applications to exist in multiple countries at the same time, to enhance the performance of applications, and to find eco-friendly locations where you can run applications with a zero-carbon footprint yet enjoy the application the country where they don't have that resource.”

1.3 SUBSEA CABLES CONNECTING THE WORLD FOR 170 YEARS :

Work to demonstrate the potential of subsea cables began in the 1840s, when Samuel Morse, the inventor of Morse Code, submerged a wire insulated with tarred hemp and India rubber, in the water of New York Harbor and telegraphed through it in 1842.

The first commercial cable was laid in 1850, when the English Channel Submarine Telegraph Company laid a telegraph cable between England and France. It was cut weeks later by fishermen thinking it was seaweed. A successor company, the Submarine Telegraph Company, laid a second cable the next year and more cables linking the British Isles to mainland Europe followed.

In 1854 and completed in 1858, the Transatlantic telegraph cable – which ran from Valentia in western Ireland to Bay of Bulls, Trinity Bay, Newfoundland and was the first to traverse the Atlantic – was laid by the Atlantic Telegraph Company. It only functioned for only three weeks before breaking beyond repair.

The first official telegram to pass between two continents – at a rate of a single character every two minutes – was a letter of congratulations from Queen Victoria of the United Kingdom to President of the United States James Buchanan on August 16. Following progressive signal deterioration, the cable was destroyed

after excessive voltage was applied to try and boost the transmission strength. While it was only in operation for a short time, it showed intercontinental communication was possible and a second cable was laid in 1865.

The first trans-Pacific cables were completed in 1902 and 1903, linking the US mainland to Hawaii in 1902 and Guam to the Philippines in 1903.

The first subsea telephone cable, TAT-1, was laid between 1955 and 1956. A joint project between the UK Post Office (of which BT was part for a number of years), the American Telephone and Telegraph company (now AT&T), and the Canadian Overseas Telecommunications Corporation, it was able to carry 35 simultaneous telephone calls.

The eighth transatlantic communications cable, TAT-8, was the first fiber optic subsea cable. Constructed in 1988 by a consortium of companies led by AT&T, France Télécom, and British Telecom, the cable was able to carry 280 Mbits per second. It was retired in 2002.

Today there are more than 400 subsea cables in operation. Some connecting nearby islands can be shorter than 50 miles long. Others, traversing the Pacific, can reach more than 10,000 miles in length. Some connect single points across a body of water, others have multiple landing points connecting multiple countries.

Antarctica is the only continent not yet reached by a submarine telecommunications cable, though one is reportedly being considered to improve connectivity for researchers in the region.

1.4 COST VS RESILIENCE OF SUBSEA CABLES :

Cables were traditionally owned by consortium telecoms firms who would band together to spread the costs of manufacturing and deploying a cable in exchange for being able to use some of the cable's bandwidth. Today, cloud and hyperscale companies such as Facebook, Google, Microsoft, and Amazon are increasingly investing in subsea cables, both as part of traditional consortiums and as private projects.

Like any other digital infrastructure, cables can be bought and sold; Hawaiki Submarine Cable was acquired in July by an affiliate of shipping giant BW Group for a reported \$445 million. And like any other digital infrastructure, a cable's main risk is an unexpected outage.

Onland fiber outages are fairly common; cables and equipment can be eaten by rodents – has happened in Australia and New Zealand recently – or cut by construction works. Even cows treading on an above-ground fiber cable once caused intermittent outages.

While subsea cables might not face danger from cows or construction, risks to subsea cables do exist. Subsea cables have a greater tolerance for failure than terrestrial fiber, but issues that do arise can be costly, difficult, and slow to fix to the time and effort required to first reach and then lift cables to the surface.

“The characteristics are very different on the potential for an impact on a subsea cable to terrestrial cable,” explains Santaliz. “A terrestrial cable has 100 times greater chance of having something go wrong with it than the subsea cable, but yet the fix on a terrestrial cable can be days wherein a subsea environment it could be weeks.”

“You could have a problem with your subsea cable on one side – known as a shunt fault – but it's still operational and it would take another event to have that cable actually have an issue where it couldn't operate. You can tolerate one shunt fault, but then you're telling your ships to get ready to deal with this in a planned coordinated fashion.”

“But the cost is in the millions when you start dealing with a fixed or subsea cable, where terrestrials cables systems will be tens of thousands to go fix.”

There are, on average, around 100 cable faults a year. While animals and natural events are behind some incidents, the vast majority of cable damage is caused by fishing and shipping activity.

Fixing a damaged cable is incredibly time-consuming; once a fault is located, a ship must sail the area, find and lift the cable – both ends if completely cut – to the

surface often via a rope and grapple or submersible robot. It can take more than a day to lift a cable from the ocean floor at deeper depths. Any damaged length of cable is removed and then the cable is spliced back together, sealed with adhesives and a joint, and lowered back to the ocean floor.

Earlier this year GTT Communications filed an injunction against local fishermen in Ireland to stop them trawling near to two of its submarine cables off the coast of Kilmore Quay in County Wexford.

In August, the Vocus Australia Singapore Cable was broken in 'multiple locations at challenging depths' off the coast of Perth, Australia. Though Vocus never officially declared the cause, the cable was rumored to have been broken by a ship's anchor. The cable was repaired and declared operational 12 days later.

Cables can be broken by natural events too. In January 2020 two subsea cables off West Africa were damaged by undersea mudslides potentially caused by flooding in the Congo river.

CHAPTER-2

LITERATURE SURVEY

2.1 Hydroacoustic Pressure Gradient Recording

The paper presents the results of experimental studies of a portable measuring system based on two inertial fiber-optic accelerometers with a multiturn optomechanical transducer placed in a Mach—Zehnder fiber-optic interferometer arm used as a sensitive element. Passive phase demodulation using a fiber-optic splitter 3×3 makes it possible to record interferometer output signals in the presence of a thermal drift of the operating point. The possibility of recording using such an acoustic and hydroacoustic pressure gradient system is shown. Author names are Kamenev, O. T., Yu S. Petrov, A. A. Podlesnykh, V. A. Kolchinskiy, I. N. Zavestovskaya, Yu N. Kulchin, and R. V. Romashko. "Hydroacoustic Pressure Gradient Recording by a System of Two Fiber-Optic Accelerometers." Bulletin of the Lebedev Physics Institute 48, no. 5 (2021): 135-138.

2.2 Recording of Hydroacoustic Signals

A prototype of a mobile fiber-optic accelerometer in which a multiturn optomechanical transducer placed in a fiber-optic Mach—Zehnder interferometer arm is used as a sensitive element is developed and studied. Passive phase demodulation using a fiber-optic splitter 3×3 maintains stable accelerometer operation in the case of a temperature drift of an operating point. The detectability of weak hydroacoustic signals using a fiber-optic interferometric accelerometer. Author names are Kamenev, O. T., Yu S. Petrov, A. A. Podlesnykh, V. A. Kolchinskii, I. N. Zavestovskaya, Yu N. Kulchin, and R. V. Romashko. "Recording of hydroacoustic signals using a fiber-optic accelerometer." Bulletin of the Lebedev Physics Institute 47, no. 5 (2020): 146-148.

2.3 Progress of Active Thermometry Method in Submarine Pipeline Scour Monitoring

Scour is one of the most important problems lead to submarine pipeline failure. In this paper, several scour monitoring techniques based on active thermometry

method was introduced. Firstly, DS18B20 digital temperature sensor was used to monitor the surface heat change pattern in the heating process in different media like sand and water. The test results validated the feasibility of the active thermometry method. Then, the submarine pipeline scour monitoring system based on Brillouin distributed optical fiber sensing technique was developed. Due to the high cost of monitoring system of distributed Brillouin fiber optical sensing technology. In order to reduce costs, common armed fiber optic cable was used as both heating and sensing unit, and Raman sensing with relatively lower cost was utilized for distributed temperature sensing for scour monitoring. Laboratory test results shown there is good potential of active thermometry method for scour monitoring in practical field. Author name Zhao, Xuefeng, Xu Yan, Xinwang Zhang, Weijie Li, Qin Ba, and Le Li. "Progress of Active Thermometry Method in Submarine Pipeline Scour Monitoring." In Smart Materials, Adaptive Structures and Intelligent Systems, vol. 51951, p. V002T05A014. American Society of Mechanical Engineers, 2018.

2.4 Mobile adaptive holographic laser Seismometer

A prototype of a mobile laser seismometer based on a multiturn fiber-optic sensitive element and an adaptive holographic interferometer is developed. The possibility of recording weak seismic waves propagating in the "land-sea" interface region by the laser seismometer is shown. The original multiturn design of the sensitive element of the seismometer provides a threshold sensitivity of $1.6 \cdot 10^{-7} \text{ m/s}^2$ to seismic acceleration. The long-term operation stability of the laser seismometer is provided due to adaptive properties of the interferometer constructed using a dynamic hologram formed in the photorefractive bismuth titanate crystal. Author name Kamenev, O. T., Yu S. Petrov, R. V. Hizhnyak, I. N. Zavestovskaya, Yu N. Kulchin, and R. V. Romashko. "Mobile adaptive holographic laser seismometer." Bulletin of the Lebedev Physics Institute 44, no. 7 (2017): 202-204

2.5 Fiber-optic Seismometer on the basis of Mach-Zehnder interferometer

The seismometer based on fiber-optic Mach-Zehnder interferometer is proposed and tested. The sensing element of the seismometer is implemented as a multiturn optical fiber coil which allowed to obtain high responsivity to

acceleration 6.1×10^3 V/g in the frequency range 1–20 Hz. Stability of the seismometer operation is provided by feed-back control of the interferometer working point. It is experimentally demonstrated that seismometer is able to reliably detect seismic vibration with acceleration amplitude at the level of 10–8g. Possibility of further increase of seismometer sensitivity is discussed. Author name Kamenev, Oleg T., Yuri N. Kulchin, Yuri S. Petrov, Ruslan V. Khiznyak, and Roman V. Romashko. "Fiber-optic seismometer on the basis of Mach-Zehnder interferometer." *Sensors and Actuators A: Physical* 244 (2016): 133-137.

2.6 External Pipeline Leak Detection Based on Fiber Optic Sensing

The pipeline industry's and the general public's concern for a safe and environmentally friendly environment is at an all-time high. This emphasizes the need of effective leak detection to avoid environmental disasters and operational interruption. As a result, precise approaches for detecting and locating extremely tiny leaks that might lead to bigger breaches are a crucial tool in the building of critical pipelines. External pipeline leak detection systems based on distributed fiber optic sensing appear to be the best option for detecting and localizing extremely tiny breaches. Two 11-kilometer electrically heat traced pipe-in-pipe (EHTPIP) pipelines have been installed between the Nexen Long Lake upgrader and the Nexen Kinosis SAGD facilities for the Kinosis pipeline system. The EHTPIP exterior surface is directly in touch with the fiber optic sensor wire. At temperatures of up to 120 °C and 150 °C, these pipes convey produced emulsion and boiler feed water, respectively. Not only in operation and in the event of a leak, but also when the electrical heat trace system is turned on, the fiber optic distributed sensing system provides temperature feedback information to the operator; in this case, the monitoring system can detect and locate overheating problems and/or signs of heating failures. When a leak occurs, the pipeline's outside temperature rises; this is immediately recognized and monitored by the DITEST temperature monitoring system, which sends an alarm to the Nexen LONG LAKE upgrader SCADA system for that exact spot. Furthermore, by combining fiber optic distributed monitoring with PIP technology, we can detect and locate a leak in the inner pipeline at an early stage, avoiding any environmental damage (the leak is still

contained by the outer PIP tube) and giving the pipeline operator time to plan a sectional replacement. Author name Borda, Carlos, Dana DuToit, Harry Duncan, and Marc Niklès. "External Pipeline Leak Detection Based on Fiber Optic Sensing for the Kinosis 12 "–16 "and 16 "–20 "Pipe-in-Pipe System." In International Pipeline Conference, vol. 46100, p. V001T09A016. American Society of Mechanical Engineers, 2014.

2.7 Distributed Fiber-Optic Vibration Sensor for Gas Pipeline Leak Detection Using Hybrid Interferometer

In this paper, distributed optical fiber sensing system based on hybrid interferometer to measure and locate leaks for gas-filled pipelines. The phase signal induced by the gas leaky acoustic wave can be detected, and then the leakage position can also be calculated from null frequency of the output spectrum. The measuring principle and the leaky source location method for the hybrid interferometer was analyzed. Localization performance was evaluated. The experiment was designed to evaluate leaks positions detection and location performance. The results show that the fiber optical sensor has good accuracy of the leaky position, the fiber optic max inspection length is 10 kilometers, leaky hole is 2.5 mm, gas pressure range 0.5-1.5 MPa, the fiber optic sensor system location error is less than 1.68%. Author name WANG, Q., Q. YANG, and C. YUAN. "Distributed Fiber-Optic Vibration Sensor for Gas Pipeline Leak Detection Using Hybrid Interferometer." Structural Health Monitoring 2013 (2013).

2.8 Introduction to Wireless Communications and Networks

Physical layer --- involves the actual signal transmission and reception over the propagation channel. Datalink Link layer --- deals with signal at the output of the base station receiver, performs radio resource management, power control, rate allocation, call admission, error control etc. Networks layer: a protocol stack that includes handoff management, location management, traffic management and traffic control. Application layer: communicating, distributed processes running in end systems (hosts), e.g., e-mail, Web, P2P file sharing, instant messaging. In this Survey they explained about 1. Fundamentals of cellular communications 2. Characterization of the wireless channel 3. Transmitter

techniques for mobile radio 4. Receiving techniques for fading dispersive channels 5. Multiple access techniques 6. Mobile management in wireless networks 7. Wireless and wireline interworking. Author name Li, Tongtong. "Introduction to Wireless Communications and Networks." Dept. Electrical and Computer Engineering, Michigan State University

2.9 Research toward optical-fiber Transmission systems

The foundations of optical fiber transmission systems are discussed, including the fiber transmission medium, sources that can be used as carriers, modulation and detection techniques, and some system design concerns. Low-loss optical fibers have opened up new possibilities for optical communication. Fibers may soon be employed in communication networks in the same way as wire pairs of coaxial cable are currently. It has been possible to obtain transmission losses as low as 2 dB/km. Experimental fiber repeaters with a 10⁻⁹ error rate and a pulse rate of roughly 300 Mb/s have been reported. Fiber cabling and splicing are two issues that require novel solutions in order to make a functional system a reality. Author name Miller, Steward E., Enrique AJ Marcatili, and Tingye Li. "Research toward optical-fiber transmission systems." Proceedings of the IEEE 61, no. 12 (1973): 1703-1704.

10. The current state of fiber optics components is discussed, as well as future applications of fiber optic technology. A brief review of the principles of light guiding and the elements that influence light guide performance is offered. The current capabilities of fiber optics are described in terms of attenuation, information capacity, fiber strength, and manufacturing. The current state of optical cables, sources, detectors, and couplers is discussed, as well as suggested and demonstrated solutions. Fiber optics development trends are discussed, as well as comparisons and contrasts with other technologies that show fiber optics' economic and technological feasibility. Finally, concluding remarks review the current state of technology and highlight where it is projected to be applied. Author name Giallorenzi, Thomas G. "Optical communications research and technology: Fiber optics." Proceedings of the IEEE 66, no. 7 (1978): 744-780.

2.11 Resistors, elementary resistor circuits and the resistor paradox

Resistance may be found in a variety of places, including society, politics, and even friendship. Almost every piece of circuitry has some of this unique property. Resistors are the ones that perform a great job of displaying their resistance, and are very useful for practical applications when used in measured and specified proportions. But what exactly is this property's "resistance" all about? We're talking about processes that block the passage of electrical current, at least in our situation. The lower the current, the higher the resistance. It appears to be simple, and it typically is, which is why most sources (textbooks, for example) leave it at that. However, this is merely the most obvious start.

$$I=V/R$$

I... current, which is measured in amperes or amps (A).

voltage, measured in volts (V).

R. .. resistance, measured in ohms (Ω), where Ω represents the Greek letter omega.

In the first part of this series, we saw Ohm's law in action: voltage (V) and resistance (R) are calculated as two independent factors, with current (I) as the dependent variable. Here's another explanation, this time from a different perspective: The voltage-to-current ratio is denoted by R.

$$R=V/I$$

The use of a multimeter to determine V and I in any given circuit is simple. Let's assume we want to change the voltage by going from zero to higher and higher numbers (but at any instance, clearly on the safe side of potentially hazardous levels, frying our breadboard or, even slightly more unfortunately, throwing you into the abominable abyss of cardiac arrest). Create a graph with the x-axis representing voltage and the y-axis representing current. aggressive, but IV-curve (or IV-characteristic, which sounds more aggressive, but has nothing to do with anything administered by an intravenous (IV) channel, save for your resuscitation) will be its name. Author name Thomas Gamsjager, Lanttberg, August 2017, "Resistors, elementary resistor circuits and the resistor paradox", pp.2-7.

12.Li-Fi is a novel type of wireless communication that employs LED lights to send data wirelessly in an era of overloaded data communication networks. In

today's fast-paced society, data transmission is one of the most vital day-to-day tasks. When several devices are connected to the Internet, the existing wireless networks are extremely sluggish. Furthermore, as the number of devices connecting to the Internet grows, restricted bandwidth availability makes it much more difficult to enjoy fast data transfer speeds and connect to a secure network. Radio waves are only a small section of the electromagnetic spectrum that may be used to transmit data. Li-Fi is a light-based variation of Wi-Fi that uses light instead of radio waves to communicate data. Li-Fi would replace Wi-Fi modems with transceivers equipped with LED lamps that could illuminate a room while both transmitting and receiving data. Li-Fi can help relieve the excessive loads that the present wireless system is experiencing by combining the new and underutilized capacity of visible light with the currently available radio frequencies for data transport. Li-Fi is a light-based variation of Wi-Fi that uses light instead of radio waves to communicate data. Li-Fi would replace Wi-Fi modems with transceivers equipped with LED lamps that could illuminate a room while both transmitting and receiving data. Life can help relieve the excessive loads that the present wireless system is experiencing by combining the new and underutilized capacity of visible light with the currently available radio frequencies for data transport. FN Division, Tec, "Study on Li-Fi & its applications," vol. 5, pp 1-19

CHAPTER-3

PROJECT DESCRIPTION

3.1 EXISTING SYSTEM:

Existing ONGC stations involved on hydraulics and Steam generation process which would nearly take couple of twenty mins cycle for gate valve control operation. Which is nearly forty mins of durations to control the valve on open and close state. Huge amount of hot air vaporization is required on every single operation of hydraulics. This method produces 100% success rate but, resource management failure rate is very high. When compared to the recent innovations and existing technologies this traditional method of existence could be improvised through optical fiber communication on the existing sea umbilical. Since resource management is the key for next generation this old traditional methodology must be replaced with latest innovations.

3.2 PROPOSED SYSTEM:

Instead of using traditional gate-valve control mechanism on compressed steam pumping, in this project as proposed solenoid valves can be replaced which will be unique choice for communicating under sea against under water pressure. These kind of solenoidal valves can be controlled via microcontrollers based on logical triggering voltage. In this proposal we put forward in two divisions as phase – I automatic Mode and phase – II on Manual Mode. Both the modes are secured via digital passwords to ensure Firewall safety system of the nation. Through google assistant voice engine, trigger phrase are created to control the gate mechanism of valves from any part of the world. On the other-hand this system can be manually operated through the resource person from the sub-station against emergency activation and de-activation of the entire system.

3.3 BLOCK DIAGRAM:

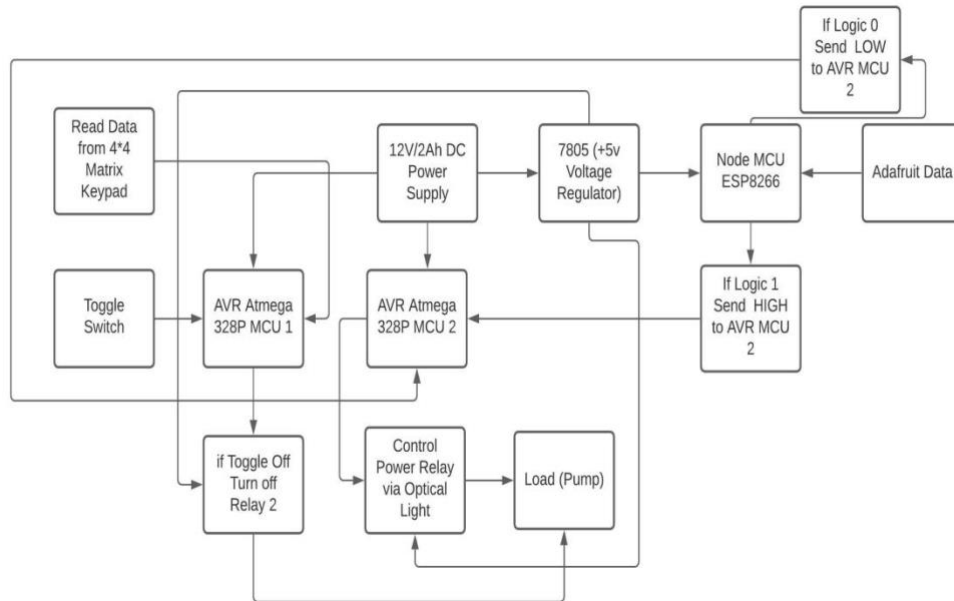


Fig:3.1: Block diagram

3.4 HARDWARE REQUIREMENTS:

- AVR ATMEGA 328P MICROCONTROLLER
- NODEMCU ESP8266 WIFI BASED MICROCONTROLLER
- LIGHT DEPENDENT RESISTOR
- 16X2 LCD
- I2C DRIVER PCF5478
- 4X4 KEYPAD MODULE
- LIGHT EMITTING DIODE
- SPDT BUTTONS
- 5V RELAY SWITCH
- DC VOLTAGE REGULATORS
- DIODE
- ACTIVE PASSIVE BUZZER
- TRANSISTOR
- FEW JUMPER WIRE
- SUBMERSIBLE PUMP

3.5 STEPS INVOLVED:

Automatic phase:

- Communicating through IFTTT on ADAFRUIT and Google Assistance, Voice Recognition Engine using keywords or Phrases.

- Based on the encrypted trigger the valve is controlled via optical network

Manual phase:

- Password Synchronization
- Toggle Switch Activation from Automatic to Manual phase
- Button B1 to deactivate open state of valve and B2 – to reactivate valve.

3.6 MANUAL MODE:

- This process is the same old traditional way of commanding from topside and controlling the subsea equipment.
- In this case we have used switches such as B1 and B2 and linked to the Controller unit which converts the analogue message to digital message and the same is travelled through the optical fiber and reaches the receiving end in this subsea.
- To avoid overlapping of Communication automatic mode and manual mode at the same time, we have added a security layer.
- In our device, we have used four by four matrix keypad with the secure password entered correctly it shuts down the automatic mode, and only manual mode can be operated by which overlapping is avoided.

3.7 AUTOMATIC MODE:

- This process is newly introduced according to the latest technology as everything is under our palms. These IoT technologies are developed over recent years.
- However, the equipment inside the subsea are quite old from 18th centuries, and it can be only controlled from the top side using hydraulics as a medium of communication,
- Therefore we have added the automatic phase to make the process little more comfortable to communicate to subsea equipment from any part of the world.
- On using MQTT broker (Message Queuing Telemetry Transport) which is a network protocol that transfers information between devices, the protocol usually runs by receiving all the messages from the client and then routing the message to the appropriate IP address only.
- IFTTT (If this then that) it is an Applet, web-based service which creates chains of a simple conditional statement.

- (Adafruit cloud) It is a cloud service which is primarily used for storing and retrieving appropriate messages and instructions.
- Node MCU is a Wi-Fi module specially targeted for IoT based applications.

3.8 ADVANTAGES OF FIBER OPTICS

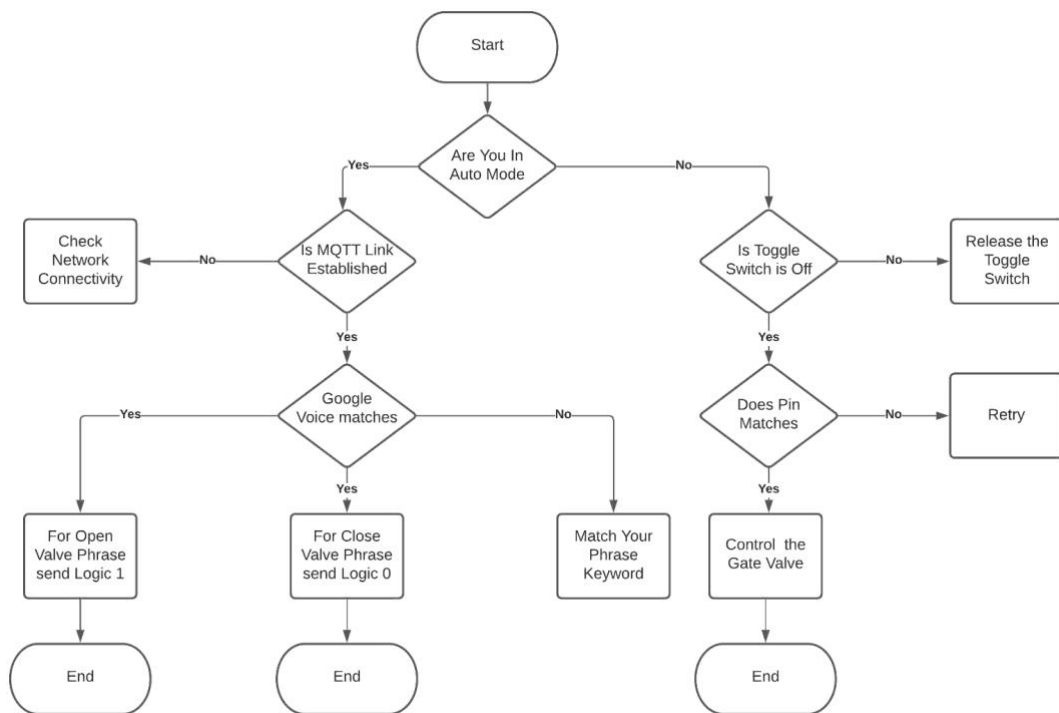
- Efficiency: Using efficiently all existence substance to improve subsea Communication with little alterations in subsea equipment.
- High speed: Subsea equipment is controlled within a microsecond and a maximum of 13 seconds irrespective of the depth.
- Availability: Availability is not an issue as Optical fiber cable is already present in the sea.
- Cheaper: Optical fiber not only requires fewer components for its working, it also reduces the overall cost of the entire project by developing the speed of Communication.
- Security: One main advantage of optical fiber communication is security. Even though IoT is linked with the device, I have used the security layer to avoid overlapping of Commands from automatic phase and manual phase.
- Underwater applications: It can be used for Communication in the sea with astonishing speed.
- Optical fiber communication underneath the sea has a great scope in future.

3.9 LIMITATIONS OF OPTICAL FIBRE

Some of the significant limitations of Optical fiber communication in subsea are:

-
- Information cannot be accessed without an optical fiber cable.
- Only gate valve is used, but this technology is applicable for all types of valves.
- Real-time testing should in large scale is not yet carried out.
- Minor losses while communicating between topside and subsea.
- However, it is yet to be developed for mass-scale adoption.

3.10 WORK FLOW CHART :



CHAPTER-4

HARDWARE REQUIREMENTS

4.1 ATMEGA328:

The ATmega328 is a single-chip microcontroller created by Atmel in the megaAVR family (later Microchip Technology acquired Atmel in 2016). It has a modified Harvard architecture 8-bit RISC processor core.

The high-performance Microchip picoPower® 8-bit AVR® RISC-based microcontroller combines 32 KB ISP Flash memory with read-while-write capabilities, 1024B EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented Two-Wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching one MIPS per MHz, balancing power consumption and processing speed.



Fig:4.1: ATMEGA 328P

SPECIFICATIONS:

The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general-purpose I/O lines, 32 general-purpose working registers, 3 flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8 channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and 5 software-

selectable power-saving modes. The device operates between 1.8 and 5.5 volts. The device achieves throughput approaching 1 MIPS/MHz.

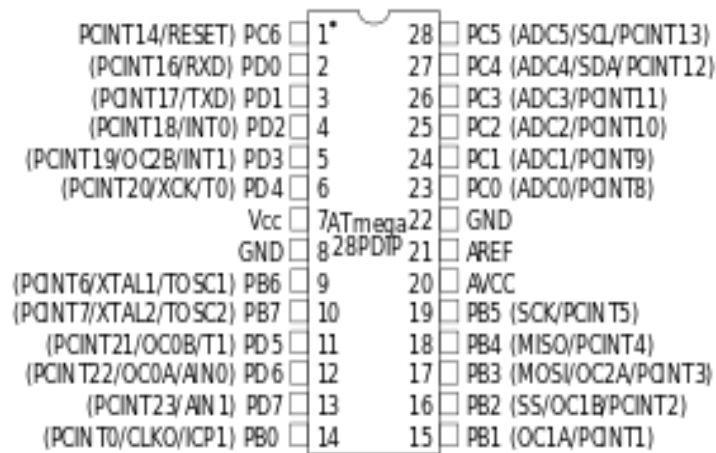


Fig:4.2

FEATURES:

Parameter	Value
CPU type	8-bit AVR
Maximum CPU speed	20 MHz
Performance	20 MIPS at 20 MHz[2]
Flash memory	32 KB
SRAM	2 KB
EEPROM	1 KB
Package pin count	28 or 32
Capacitive touch sensing channels	16
Maximum I/O pins	23
External interrupts	2
USB interface	No

FAMILY:

A common alternative to the ATmega328 is the "picoPower" ATmega328P. A comprehensive list of all other members of the megaAVR series can be found on the Atmel website.

- ATmega328

- ATmega328P and ATmega328P-AUTOMOTIVE
- ATmega328PB and ATmega328PB-AUTOMOTIVE (superset of ATmega328P) - has more UART, I2C, and SPI peripherals than ATmega328P

APPLICATIONS:

ATmega328 is commonly used in many projects and autonomous systems where a simple, low-powered, low-cost micro-controller is needed. Perhaps the most common implementation of this chip is on the popular Arduino development platform, namely the Arduino Uno, Arduino Pro Mini and Arduino Nano models.

4.2 Node MCU

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the e Lua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open-source projects, such as lua-cjson and SPIFFS.

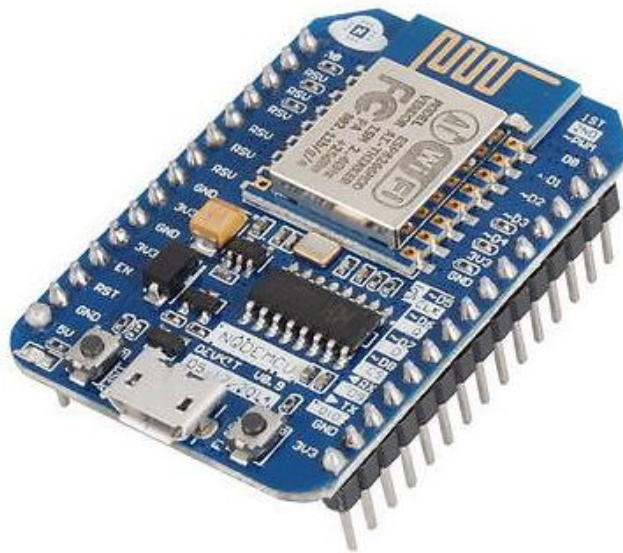


Fig:4.3: Node MCU

The NodeMCU (Node MicroController Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains all crucial elements of the

modern computer: CPU, RAM, networking (wifi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs only \$2 USD a piece. That makes it an excellent choice for IoT projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. You have to solder wires, with the appropriate analog voltage, to its PINs for the simplest tasks such as powering it on or sending a keystroke to the “computer” on the chip. And, you have to program it in low-level machine instructions that can be interpreted by the chip hardware. While this level of integration is not a problem when the ESP8266 is used as an embedded controller chip in mass-produced electronics, it is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

Borrowing a page from the successful playbooks of Arduino or a Raspberry Pi, the NodeMCU project aims to simplify ESP8266 development. It has two key components.

1. An open source ESP8266 firmware that is built on top of the chip manufacturer’s proprietary SDK. The firmware provides a simple programming environment based on eLua (embedded Lua), which is a very simple and fast scripting language with an established developer community. For new comers, the Lua scripting language is easy to learn.
2. A DEVKIT board that incorporates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, wifi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board. Figure 1 shows the DEVKIT board, and Figure 2 shows the schema of its pins.
3. The Arduino project creates an open-source hardware design and software SDK for a versatile IoT controller. Similar to NodeMCU, the Arduino hardware is a microcontroller board with a ready USB connector, LED lights, and standard data pins. It also defines standard interfaces to interact with sensors or other boards. But unlike NodeMCU, the Arduino board can have different types of CPU chips (typically an ARM or Intel x86 chip) with memory chips, and a variety of programming environments. In fact, there is an Arduino reference design for the

ESP8266 chip as well. However, the flexibility of Arduino also means significant variations across different vendors. For example, most Arduino boards do not have wifi capabilities and some even have a serial data port instead of a USB port. I feel that NodeMCU provides a more consistent and accessible experience for IoT developers.

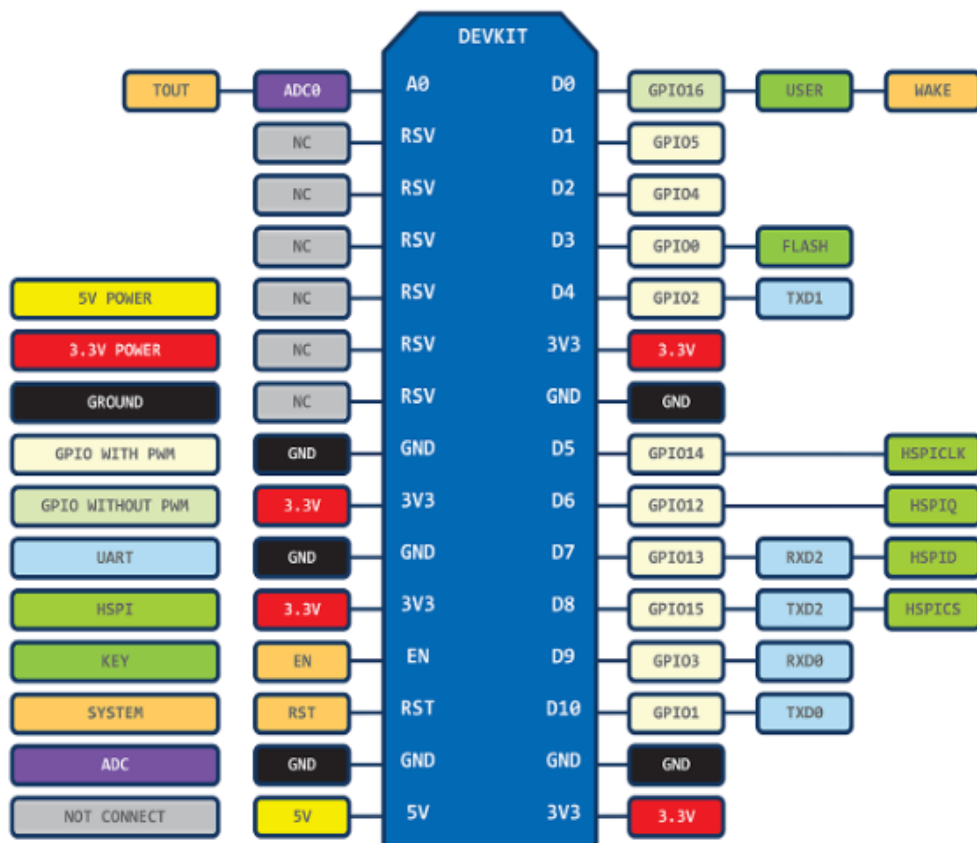


Fig:4.4: ESP8266

ESP8266-01 WIFI Module

ESP8266 comes with capabilities of

- 2.4 GHz Wi-Fi (802.11 b/g/n, supporting WPA/WPA2),
- general-purpose input/output (16 GPIO),
- Inter-Integrated Circuit (I²C) serial communication protocol,
- analog-to-digital conversion (10-bit ADC)
- Serial Peripheral Interface (SPI) serial communication protocol,
- I²S (Inter-IC Sound) interfaces with DMA (Direct Memory Access) (sharing pins with GPIO),

- UART (on dedicated pins, plus a transmit-only UART can be enabled on GPIO2), and
- pulse-width modulation (PWM).

It employs a 32-bit RISC CPU based on the Tensilica Xtensa L106 running at 80 MHz (or overclocked to 160 MHz). It has a 64 KB boot ROM, 64 KB instruction RAM and 96 KB data RAM. External flash memory can be accessed through SPI.

ESP8266 module is low-cost standalone wireless transceiver that can be used for end-point IoT developments.

To communicate with the ESP8266 module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 module using UART having specified Baud rate.

There are many third-party manufacturers that produce different modules based on this chip. So, the module comes with different pin availability options like,

- ESP-01 comes with 8 pins (2 GPIO pins) – PCB trace antenna. (shown in above figure)
- ESP-02 comes with 8 pins, (3 GPIO pins) – U-FL antenna connector.
- ESP-03 comes with 14 pins, (7 GPIO pins) – Ceramic antenna.
- ESP-04 comes with 14 pins, (7 GPIO pins) – No ant.

etc.

For example, below figure shows ESP-01 module pins

ESP8266-01 Module Pin Description

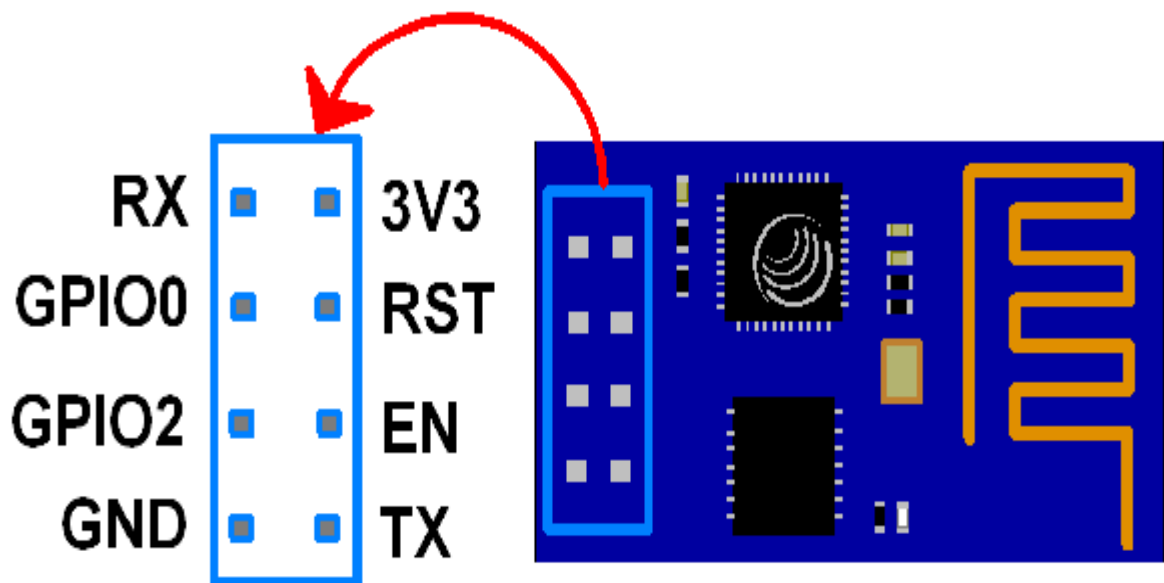


Fig:4.5

ESP8266-01 Module Pins

3V3: - 3.3 V Power Pin.

GND: - Ground Pin.

RST: - Active Low Reset Pin.

EN: - Active High Enable Pin.

TX: - Serial Transmit Pin of UART.

RX: - Serial Receive Pin of UART.

GPIO0 & GPIO2: - General Purpose I/O Pins. These pins decide what mode (boot or normal) the module starts up in. It also decides whether the TX/RX pins are used for Programming the module or for serial I/O purpose.

To program the module using UART, Connect GPIO0 to ground and GPIO2 to VCC or leave it open. To use UART for normal Serial I/O leave both the pins open (neither VCC nor Ground).

4.3 LCD:

A **liquid-crystal display (LCD)** is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock.

LCD DISPLAY:

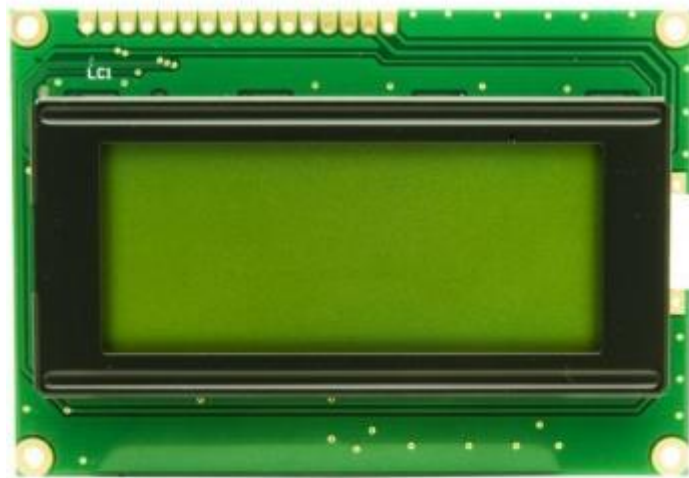


Fig:4.6: LCD Display

They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement. For example, a character positive LCD with a backlight will have black lettering on a background that is the color of the backlight, and a character negative LCD will have a black background with the letters being of the same color as the backlight. Optical filters are added to white on blue LCDs to give them their characteristic appearance.

ILLUMINATION

- CCFL: The LCD panel is lit either by two cold cathode fluorescent lamps placed at opposite edges of the display or an array of parallel CCFLs behind larger displays. A diffuser then spreads the light out evenly across the whole display. For many years, this technology had been used almost exclusively.
- Unlike white LEDs, most CCFLs have an even-white spectral output resulting in better color gamut for the display. However, CCFLs are less energy efficient than LEDs and require a somewhat costly inverter to convert whatever DC voltage the device uses (usually 5 or 12 V) to ≈ 1000 V needed to light a CCFL. The thickness of the inverter transformers also limits how thin the display can be made.
- EL-WLED: The LCD panel is lit by a row of white LEDs placed at one or more edges of the screen.
- A light diffuser is then used to spread the light evenly across the whole display. As of 2012, this design is the most popular one in desktop computer monitors.
- It allows for the thinnest displays. Some LCD monitors using this technology have a feature called dynamic contrast, invented by Philips researchers Douglas Stanton, Martinus Stroomeer and Adrianus de Vaan Using PWM (pulse-width modulation, a technology where the intensity of the LEDs is kept constant, but the brightness adjustment is achieved by varying a time interval of flashing these constant light intensity light sources

The backlight is dimmed to the brightest color that appears on the screen while simultaneously boosting the LCD contrast to the maximum achievable levels, allowing the 1000:1 contrast ratio of the LCD panel to be scaled to different light intensities, resulting in the "30000:1" contrast ratios seen in the advertising on some of these monitors.

Since computer screen images usually have full white somewhere in the image, the backlight will usually be at full intensity, making this "feature" mostly a marketing gimmick for computer monitors, however for TV screens it drastically increases the perceived contrast ratio and dynamic range, improves the

viewing angle dependency and drastically reducing the power consumption of conventional LCD televisions.

WORKING

The principle behind the LCD's is that when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist. This causes the angle of light which is passing through the molecule of the polarized glass and also cause a change in the angle of the top polarizing filter. As a result, a little light is allowed to pass the polarized glass through a particular area of the LCD. Thus, that particular area will become dark compared to other. The LCD works on the principle of blocking light. While constructing the LCD's, a reflected mirror is arranged at the back. An electrode plane is made of indium-tin oxide which is kept on top and a polarized glass with a polarizing film is also added on the bottom of the device. The complete region of the LCD has to be enclosed by a common electrode and above it should be the liquid crystal matter.

LCD LAYER DIAGRAM:

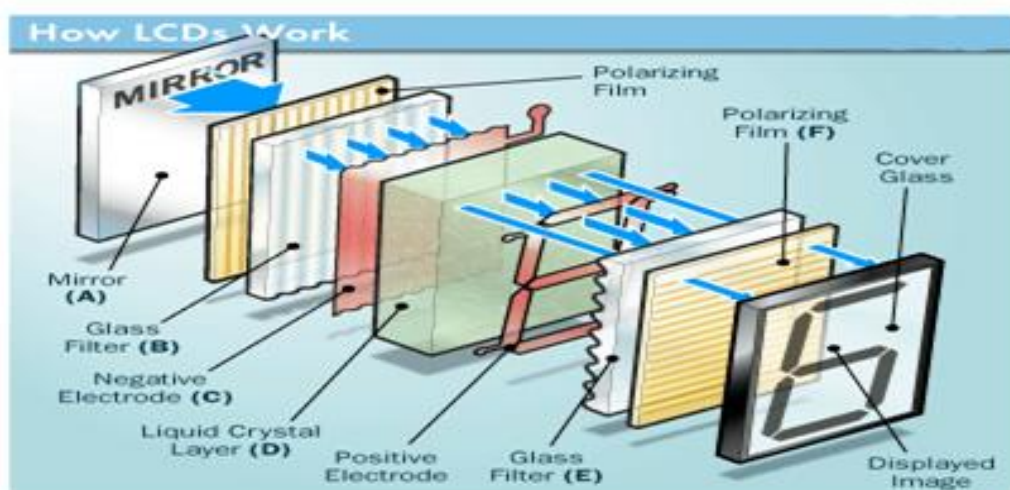


Fig:4.7: LCG layer diagram

Next comes to the second piece of glass with an electrode in the form of the rectangle on the bottom and, on top, another polarizing film. It must be considered that both the pieces are kept at right angles. When there is no current, the light passes through the front of the LCD it will be reflected by the mirror and bounced back. As the electrode is connected to a battery the current from it will cause the liquid crystals between the common-plane electrode and the electrode shaped like a rectangle to untwist. Thus, the light is blocked from passing through. That particular rectangular area appears blank.

Advantages of an LCD's:

- LCD consumes less amount of power compared to CRT and LED
- LCD are consisting of some microwatts for display in comparison to some mill watts for LED's
- LCD are of low cost
- Provides excellent contrast
- LCD are thinner and lighter when compared to cathode ray tube and LED

Applications of Liquid Crystal Display

Liquid crystal technology has major applications in the field of science and engineering as well on electronic devices.

- Liquid crystal thermometer
- Optical imaging
- The liquid crystal display technique is also applicable in visualization of the radio frequency waves in the waveguide
- Used in the medical applications

4.4 SUBMERSIBLE PUMP:

A submersible pump (also known as a sub pump or an ESP) is a device with a hermetically sealed motor that is tightly linked to the pump body. The whole system is immersed in the pumped fluid. The major benefit of this type of pump is that it eliminates pump cavitation, which is a problem caused by a large elevation difference between the pump and the fluid surface. Submersible pumps, as opposed to jet pumps, which produce a vacuum and rely on air pressure, push fluid to the surface. Submersibles are utilized in heavy oil

applications using hot water as the motive fluid, and they employ pressured fluid from the surface to drive a hydraulic engine downhole rather than an electric motor.



Fig:4.8: Submersible pump

WORKING PRINCIPLE:

Electric submersible pumps are multistage centrifugal pumps operating in a vertical position. Liquids, accelerated by the impeller, lose their kinetic energy in the diffuser, where a conversion of kinetic to pressure energy takes place. This is the main operational mechanism of radial and mixed flow pumps. In the HSP, the motor is a hydraulic motor rather than an electrical motor, and may be closed cycle (keeping the power fluid separate from the produced fluid) or open cycle (mingling the power fluid with the produced fluid downhole, with surface separation).

The pump shaft is connected to the gas separator or the protector by a mechanical coupling at the bottom of the pump. Fluids enter the pump through an intake screen and are lifted by the pump stages. Other parts include the radial bearings (bushings) distributed along the length of the shaft, providing radial support to the pump shaft. An optional thrust bearing takes up part of the axial forces arising in the pump, but most of those forces are absorbed by the protector's thrust bearing.

There are also screw-type submersible pumps, there is a steel screw which is used as a working element in them. The screw allows the pump to work in water with a high sand content and other mechanical impurities.

APPLICATION:

Submersible pumps are found in many applications. Single stage pumps are used for drainage, sewage pumping, general industrial pumping and slurry pumping. They are also popular with Pond filters. Multiple stage submersible pumps are typically lowered down a borehole, and most typically used for residential, commercial, municipal and industrial water extraction (abstraction), water wells and in oil wells.

Other uses for submersible pumps include sewage treatment plants, seawater handling, fire fighting (since it is flame retardant cable), water well and deep well drilling, offshore drilling rigs, artificial lifts, mine dewatering, and irrigation systems.

Pumps in electrical hazardous locations used for combustible liquids or for water that may be contaminated with combustible liquids must be designed not to ignite the liquid or vapors.

USE IN OIL WELLS:

Submersible pumps are used in oil production to provide a relatively efficient form of "artificial lift", able to operate across a broad range of flow rates and depths.[3][4] By decreasing the pressure at the bottom of the well (by lowering bottom-hole flowing pressure, or increasing drawdown), significantly more oil can be produced from the well when compared with natural production.[citation needed] The pumps are typically electrically powered, referred to as Electrical Submersible Pumps (ESP) or if hydraulically powered, referred to as Hydraulic Submersible Pumps (HSP).[citation needed]

ESP systems consist of both surface components (housed in the production facility, for example an oil platform), and sub-surface components (found in the well hole). Surface components include the motor controller (often a variable speed controller), surface cables and transformers. The subsurface components are deployed by attaching to the downhole end of a tubing string, while at the surface, and then lowered into the well bore along with the tubing.

A high-voltage (3 to 5 kV) alternating-current source at the surface drives the subsurface motor. Until recently, ESPs had been costly to install due to the

requirement of an electric cable extending from the source to the motor. This cable had to be wrapped around jointed tubing and connected at each joint. New coiled tubing umbilicals allow for both the piping and electric cable to be deployed with a single conventional coiled tubing unit. Cables for sensor and control data may also be included.

The subsurface components generally include a pump portion and a motor portion, with the motor downhole from the pump. The motor rotates a shaft that, in turn, rotates pump impellers to lift fluid through production tubing to the surface. These components must reliably work at high temperatures of up to 300 °F (149 °C) and high pressures of up to 5,000 psi (34 MPa), from deep wells of up to 12,000 feet (3.7 km) deep with high energy requirements of up to 1000 horsepower (750 kW). The pump itself is a multi-stage unit, with the number of stages being determined by the operating requirements. Each stage includes an impeller and diffuser. Each impeller is coupled to the rotating shaft and accelerates fluid from near the shaft radially outward. The fluid then enters a non-rotating diffuser, which is not coupled to the shaft and contains vanes that direct fluid back toward the shaft. Pumps come in diameters from 90 mm (3.5 inches) to 254 mm (10 inches) and vary between 1 metre (3 ft) and 8.7 metres (29 ft) in length. The motor used to drive the pump is typically a three-phase, squirrel cage induction motor, with a nameplate power rating in the range 7.5 kW to 560 kW (at 60 Hz).[3]

ESP assemblies may also include: seals coupled to the shaft between the motor and pump; screens to reject sand; and fluid separators at the pump intake that separate gas, oil and water.[3] ESPs have dramatically lower efficiencies with significant fractions of gas, greater than about 10% volume at the pump intake, so separating gas from oil prior to the pump can be important. Some ESPs include a water/oil separator which permits water to be re-injected downhole. As some wells produce up to 90% water, and fluid lift is a significant cost, re-injecting water before lifting it to the surface can reduce energy consumption and improve economics. Given ESPs' high rotational speed of up to 4000 rpm (67 Hz) and tight clearances, they are not very tolerant of solids,

such as sand. There are at least 15 brands of oilfield ESPs used throughout the world.

4.5 POWER SUPPLY UNIT:

A power supply (sometimes known as a power supply unit or PSU) is a device or system that supplies electrical or other types of energy to an output load or group of loads. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

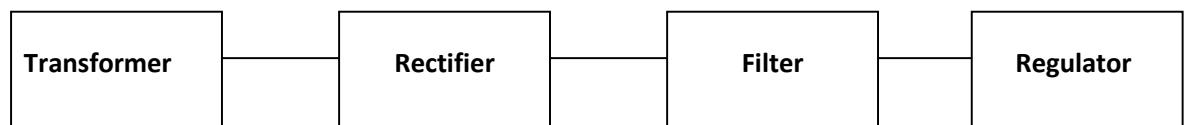


Fig:4.9: Block diagram of power supply

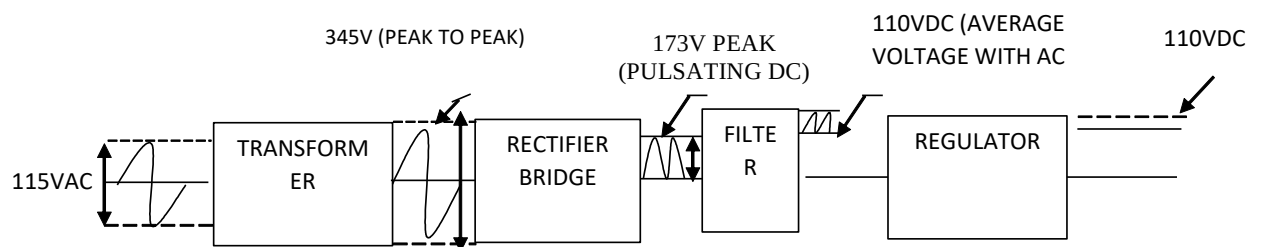


Fig:4.10: Processing of Power supply

The transformer steps up or steps down the input line voltage and isolates the power supply from the power line. The RECTIFIER section converts the alternating current input signal to a pulsating direct current. However, as you proceed in this chapter you will learn that pulsating dc is not desirable. For this reason, a FILTER section is used to convert pulsating dc to a purer, more desirable form of dc voltage.

The final section, the REGULATOR, does just what the name implies. It maintains the output of the power supply at a constant level in spite of large changes in load current or input line voltages. Now that you know what each section does, let's trace an ac signal through the power supply. At this point you need to see how this signal is altered within each section of the power supply.

Later on in the chapter you will see how these changes take place. An input signal of 115 volts ac is applied to the primary of the transformer.

The transformer is a step-up transformer with a turn's ratio of 1:3. You can calculate the output for this transformer by multiplying the input voltage by the ratio of turns in the primary to the ratio of turns in the secondary; therefore, $115 \text{ volts ac} \times 3 = 345 \text{ volts ac}$ (peak-to-peak) at the output. Because each diode in the rectifier section conducts for 180 degrees of the 360-degree input, the output of the rectifier will be one-half, or approximately 173 volts of pulsating dc. The filter section, a network of resistors, capacitors, or inductors, controls the rise and fall time of the varying signal; consequently, the signal remains at a more constant dc level. You will see the filter process more clearly in the discussion of the actual filter circuits. The output of the filter is a signal of 110 volts dc, with ac ripple riding on the dc. The reason for the lower voltage (average voltage) will be explained later in this chapter. The regulator maintains its output at a constant 110-volt dc level, which is used by the electronic equipment (more commonly called the load).

Simple 5V power supply for digital circuits

- Brief description of operation: Gives out well-regulated +5V output, output current capability of 100 mA
- Circuit protection: Built-in overheating protection shuts down output when regulator IC gets too hot
- Circuit complexity: Very simple and easy to build
- Circuit performance: Very stable +5V output voltage, reliable operation
- Availability of components: Easy to get, uses only very common basic components
- Design testing: Based on datasheet example circuit, I have used this circuit successfully as part of many electronics projects
- Applications: Part of electronics devices, small laboratory power supply
- Power supply voltage: Unregulated DC 8-18V power supply
- Power supply current: Needed output current + 5 mA
- Component costs: Few dollars for the electronics components + the input transformer cost

Circuit description

This circuit is a small +5V power supply, which is useful when experimenting with digital electronics. Those transformers are easily available, but usually their voltage regulation is very poor, which makes them not very usable for digital circuit experimenter unless a better regulation can be achieved in some way.

This circuit can give +5V output at about 150 mA current, but it can be increased to 1 A when good cooling is added to 7805 regulator chip. The circuit has over overload and thermal protection.

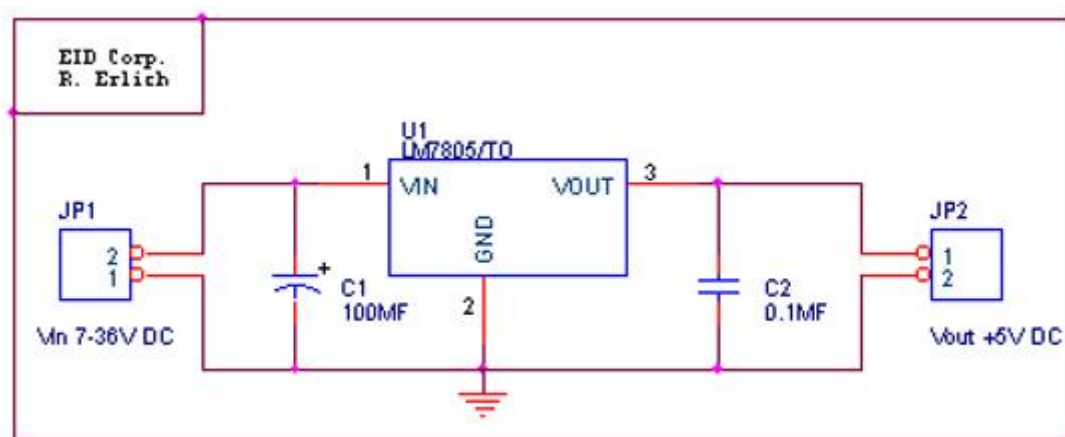


Fig:4.11:Circuit diagram

Circuit diagram of the power supply:

The capacitors must have enough high voltage rating to safely handle the input voltage feed to circuit. The circuit is very easy to build into a piece of Vero board.

Pinout of the 7805 regulator IC.

1. Unregulated voltage in
2. Ground

3. Regulated voltage out

COMPONENT LIST

- 7805 regulator IC.
- 100 μ F electrolytic capacitor, at least 25V voltage rating.
- 10 μ F electrolytic capacitor, at least 6V voltage rating.
- 100 nF ceramic or polyester capacitor.

MORE OUTPUT CURRENT

If we need more than 150 mA of output current, we can update the output current up to 1A doing the following modifications:

- Change the transformer from where we take the power to the circuit to a model which can give as much current as we need from output
- Put a heat sink to the 7805 regulators (so big that it does not overheat because of the extra losses in the regulator)

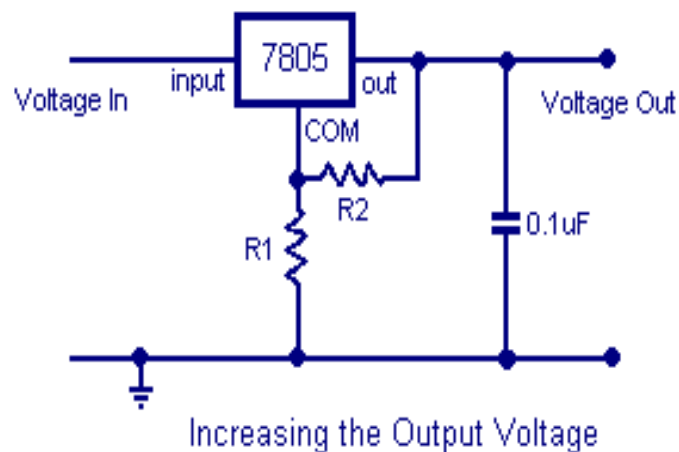


FIG:4.12: MORE OUTPUT CURRENT

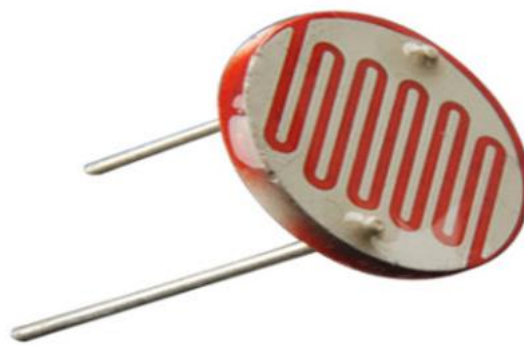
OTHER OUTPUT VOLTAGES

If we need other voltages than +5V, we can modify the circuit by replacing the 7805 chips with another regulator with different output voltage

from regulator 78xx chip family. The last numbers in the chip code tells the output voltage. The input voltage must be at least 3V greater than regulator output voltage to otherwise the regulator does not work well.

4.6 LDR

The controlling of lights and home appliances are generally operated and maintained manually in several occasions. But the process of appliances controlling may cause wastage of power due to carelessness of human beings or unusual circumstances. To overcome this problem, we can use the light dependent resistor circuit for controlling the loads based on the intensity of light. An LDR or a photo resistor is a device which is made up of high resistance semiconductor material. This article gives an overview of what is LDR, light dependent resistor circuit and its working.



Light Dependent Resistor

Fig:4.13: LDR

Construction of a LDR

The construction of a LDR includes a light sensitive material which is placed on an insulating substrate like as ceramic. The material is placed in a zigzag shape in order to get the required power rating and resistance. The area of zigzag separates the metal placed areas into two regions.

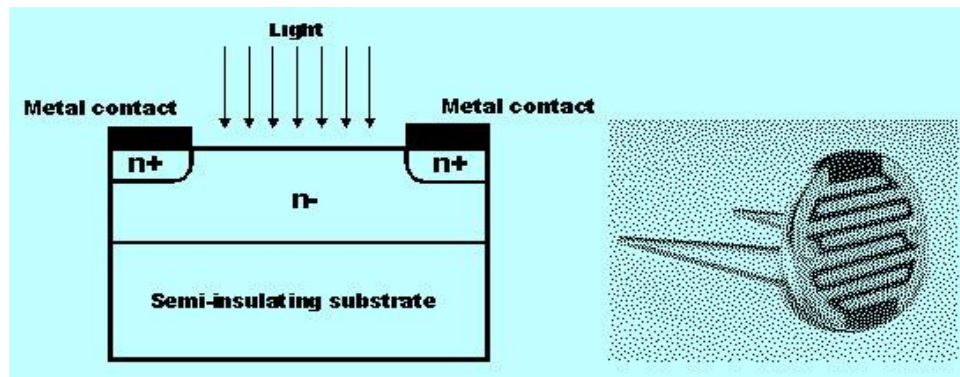


Fig:4.14: LDR

Where the Ohmic contacts are made either on the sides of the area. The resistances of the contacts must be as less as possible to make sure that the resistance, mainly varies due to the light effect only. The use of lead & cadmium materials are avoided as they are injurious to the environment.

Working Principle of Light Dependent Resistor

The working principle of an LDR is photo conductivity, that is nothing but an optical phenomenon. When the light is absorbed by the material then the conductivity of the material reduces. When the light falls on the LDR, then the electrons in the valence band of the material are eager to the conduction band. But, the photons in the incident light must have energy superior than the band gap of the material to make the electrons jump from one band to another band (valance to conduction).

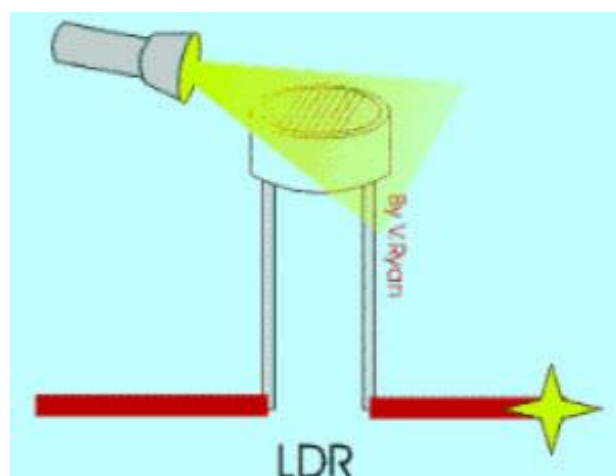


Fig:4.15: Working Principle

Hence, when light having ample energy, more electrons are excited to the conduction band which grades in a large number of charge carriers. When the effect of this process and the flow of current starts flowing more, the resistance of the device decreases.

Light Dependent Resistor Circuit

The circuit of LDR is an electronic circuit built with LDR, relay, Darlington pair, diode, & resistors shown in the below circuit diagram. A voltage supply is given to the load

The required DC voltage of the LDR circuit is supplied from a bridge rectifier circuit or a battery. This circuit changes the AC supply into a DC. The bridge rectifier circuit uses a step-down transformer to step-down the voltage from 230v into 12v. The diodes are connected in the form of a bridge used to alter the AC voltage into DC. The voltage regulator is used to change the 12v DC- 6v DC, and then, this DC voltage is supplied to the entire circuit. A 230v AC supply for both the bridge rectifier and the load is to be kept continuously for continuous operation of the light sensor circuit.

Light Dependent Resistor Circuit Diagram

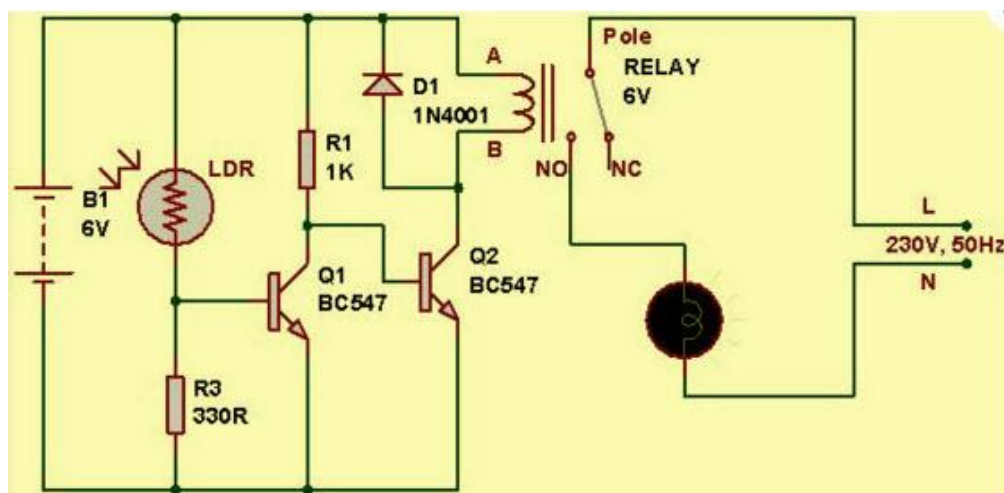


Fig:4.16: LDR Circuit Diagram

In the morning time, this sensor has a low resistance around 100Ω. Thus, the power supply flows through the LDR & ground through the variable resistor and resistor as shown in the above light sensor circuit. This is due to the resistance

offered by the light dependent resistor in the daytime or when the light falls on the LDR, then it is less compared to the resistance of the remaining part of the sensor circuit. We are alert of the principle of current, that the flow of current always flow in the path of low resistance.

Therefore, the relay coil does not get sufficient supplies to get strengthened. Hence, the light is switched off in the daylight. In the same way, during the night time, the resistance of the LDR increases to a high value ($20\text{M}\Omega$). Thus, due to the high resistance of the resistor, the flow of current is low or almost zero. Now, the flow of current through the low-resistance lane such that it increases the base voltage of Darlington pair to reach more than 1.4v . As the Darlington pair transistor is triggered, the relay coil acquires enough supply to get energized, and hence, the light switches in the night time.

Applications of LDR

Light dependent resistors are simple and low-cost devices. These devices are used where there is a need to sense the presence and absence of light is necessary. These resistors are used as light sensors and the applications of LDR mainly include alarm locks, street lights, light intensity meters, burglar alarm circuits. For better understanding of this concept, here we have explained one project namely; power conserving of intensity-controlled street lights using LDR.

4.7 LED

A **light-emitting diode (LED)** is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. This effect is called electroluminescence. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared light. Infrared LEDs are used in remote-control circuits, such as those used with a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet, and infrared wavelengths, with high light output.

Early LEDs were often used as indicator lamps, replacing small incandescent bulbs, and in seven-segment displays. Recent developments have produced white-light LEDs suitable for room lighting. LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology.

LEDs have many advantages over incandescent light sources, including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. Light-emitting diodes are used in applications as diverse as aviation lighting, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, lighted wallpaper and medical devices.

Unlike a laser, the color of light emitted from an LED is neither coherent nor monochromatic, but the spectrum is narrow with respect to human vision, and functionally monochromatic

TYPES

LEDs are made in different packages for different applications. A single or a few LED junctions may be packed in one miniature device for use as an indicator or pilot lamp. An LED array may include controlling circuits within the same package, which may range from a simple resistor, blinking or color changing control, or an addressable controller for RGB devices. Higher-powered white-emitting devices will be mounted on heat sinks and will be used for illumination. Alphanumeric displays in dot matrix or bar formats are widely available. Special packages permit connection of LEDs to optical fibers for high-speed data communication links.

MINIATURE

These are mostly single-die LEDs used as indicators, and they come in various sizes from 2 mm to 8 mm, through-hole and mount packages. Typical current ratings range from around 1 mA to above 20 mA. Multiple LED dies attached to a flexible backing tape form an LED strip light.

Common package shapes include round, with a domed or flat top, rectangular with a flat top (as used in bar-graph displays), and triangular or square with a flat top. The encapsulation may also be clear or tinted to improve contrast and viewing angle. Infrared devices may have a black tint to block visible light while passing infrared radiation.

Ultra-high-output LEDs are designed for viewing in direct sunlight

5 V and 12 V LEDs are ordinary miniature LEDs that have a series resistor for direct connection to a 5 V or 12 V supply.

HIGH POWER

High-power LEDs (HP-LEDs) or high-output LEDs (HO-LEDs) can be driven at currents from hundreds of mA to more than an ampere, compared with the tens of mA for other LEDs. Some can emit over a thousand lumens. LED power densities up to 300 W/cm^2 have been achieved. Since overheating is destructive, the HP-LEDs must be mounted on a heat sink to allow for heat dissipation. If the heat from an HP-LED is not removed, the device fails in seconds. One HP-LED can often replace an incandescent bulb in a flashlight, or be set in an array to form a powerful LED lamp

AC DRIVEN

LEDs developed by Seoul Semiconductor can operate on AC power without a DC converter. For each half-cycle, part of the LED emits light and part is dark, and this is reversed during the next half-cycle. The efficacy of this type of HP-LED is typically 40 lm/W. A large number of LED elements in series may be able to operate directly from line voltage. In 2009, Seoul Semiconductor released a

high DC voltage LED, named as 'Acrich MJT', capable of being driven from AC power with a simple controlling circuit. The low-power dissipation of these LEDs affords them more flexibility than the original AC LED design

Application-specific variations

Flashing

Flashing LEDs are used as attention seeking indicators without requiring external electronics. Flashing LEDs resemble standard LEDs but they contain an integrated multivibrator circuit that causes the LED to flash with a typical period of one second. In diffused lens LEDs, this circuit is visible as a small black dot. Most flashing LEDs emit light of one color, but more sophisticated devices can flash between multiple colors and even fade through a color sequence using RGB color mixing.

Bi-color

Bi-color LEDs contain two different LED emitters in one case. There are two types of these. One type consists of two dies connected to the same two leads antiparallel to each other. Current flow in one direction emits one color, and current in the opposite direction emits the other color. The other type consists of two dies with separate leads for both dies and another lead for common anode or cathode so that they can be controlled independently. The most common bi-color combination is red/traditional green; however, other available combinations include amber/traditional green, red/pure green, red/blue, and blue/pure green.

RGB Tri-color

Tri-color LEDs contain three different LED emitters in one case. Each emitter is connected to a separate lead so they can be controlled independently. A four-lead arrangement is typical with one common lead (anode or cathode) and an additional lead for each color. Others, however, have only two leads (positive and negative) and have a built-in electronic controller.



Fig:4.17: RGB-SMD-LED

RGB LEDs consist of one red, one green, and one blue LED.^[104] By independently adjusting each of the three, RGB LEDs are capable of producing a wide color gamut. Unlike dedicated-color LEDs, however, these do not produce pure wavelengths. Modules may not be optimized for smooth color mixing.

Decorative-multicolor

Decorative-multicolor LEDs incorporate several emitters of different colors supplied by only two lead-out wires. Colors are switched internally by varying the supply voltage.

Alphanumeric

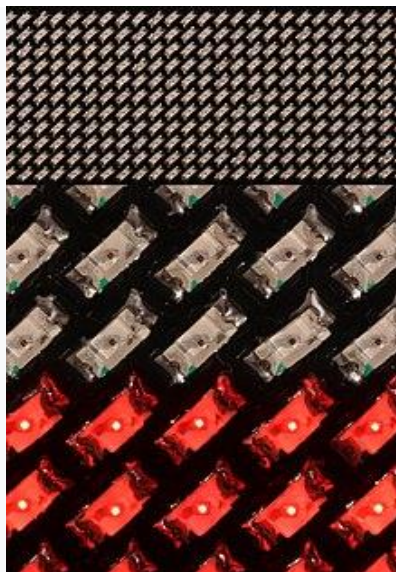


Fig:4.18

Composite image of a 11x44 LED matrix lapel name tag display using 1608/0603-type SMD LEDs. Top: A little over half of the 21x86 mm display. Center: Close-up of LEDs in ambient light. Bottom: LEDs in their own red light.

Alphanumeric LEDs are available in seven-segment, starburst, and dot-matrix format. Seven-segment displays handle all numbers and a limited set of letters. Starburst displays can display all letters. Dot-matrix displays typically use 5x7 pixels per character. Seven-segment LED displays were in widespread use in the 1970s and 1980s, but rising use of liquid crystal displays, with their lower power needs and greater display flexibility, has reduced the popularity of numeric and alphanumeric LED displays.

Digital RGB

Digital RGB addressable LEDs contain their own "smart" control electronics. In addition to power and ground, these provide connections for data-in, data-out, and sometimes a clock or strobe signal. These are connected in a daisy chain. Data sent to the first LED of the chain can control the brightness and color of each LED independently of the others. They are used where a combination of maximum control and minimum visible electronics are needed such as strings for Christmas and LED matrices. Some even have refresh rates in the kHz range, allowing for basic video applications. These devices are known by their part number (WS2812 being common) or a brand name such as NeoPixel

Filament

An LED filament consists of multiple LED chips connected in series on a common longitudinal substrate that forms a thin rod reminiscent of a traditional incandescent filament. These are being used as a low-cost decorative alternative for traditional light bulbs that are being phased out in many countries. The filaments use a rather high voltage, allowing them to work efficiently with mains voltages. Often a simple rectifier and capacitive current limiting are employed to create a low-cost replacement for a traditional light bulb without the complexity of the low voltage, high current converter that single die LEDs need. Usually, they are packaged in bulb similar to the lamps they were designed to replace, and filled with inert gas to remove heat efficiently.

Chip-on-board arrays

Surface-mounted LEDs are frequently produced in chip on board (COB) arrays, allowing better heat dissipation than with a single LED of comparable luminous output. The LEDs can be arranged around a cylinder, and are called "corn cob lights" because of the rows of yellow LEDs.

4.8 4X4 MEMBRANE SWITCH KEYPAD



Fig:4.19: Matrix Keyboard

Matrix Keyboard is a kind of keyboard whose layout is like a matrix and it's used as a peripheral equipment of MCU. The structure of matrix keyboard is more complex than that of other common keyboards, and the condition is similar to that of the recognition. The column line is connected with the anode of the power supply through resistors and let the I/O port of MCU connected with the row line work as an output terminal. The I/O port connected with the column line will be the input.

Because during the circuit design, there is much more need of external input. It will consume much IO source if we control a button separately, we have the matrix keyboard. The most common types are 4*4 and 8*8. Among them, the type 4*4 is even more common than 8*8.

On a keyboard, if there are too many buttons, we will arrange them into the form of matrix to decrease the using of the I/O port. In the internal structure of

the matrix keyboard, each horizontal line and each vertical line are not connected directly at the intersection, but at the button. Therefore, a port (eg. P1) can form $4 \times 4 = 16$ buttons, and the number is twice as much as that of the button whose port cable is connected with keyboard.

The larger the number of the wires, the clearer the difference. For example, if there is an additional wire, we can get a keyboard with 20 buttons; using the port cable directly, we can get one additional key (key 9). So if there is much need of buttons, it is wise to use matrix analysis.

membrane keyboard Membrane keypad is an application case of membrane switch with arrayed buttons. Membrane keypad is a kind of currently widespread operation system in the world that has the advantages of both practicality and beauty. It is composed of panel, upper circuit, isolation layer and bottom circuit. Due to these advantages: nice appearance, modern design, tiny in size, light weight, strong sealing (moisture proof, dust proof, oil pollution prevention, acid and alkali resistance), quake resistance and long service life, etc., it is commonly used in these fields, like medical instrument, computer control, digital machine tool, electronic weighing device, post and telecommunication, photocopier, refrigerator, microwave oven, electric fan, washing machine, electronic gaming machines.

MAIN FEATURES:

1. ADVANTAGES:

- Artistic appearance, original
- Small in size, thin and light, helps the keyboard to optimize to the level of being light, thin, short, small, and of high intelligence.
- Dampproof, dustproof, oil-resistant, preventing noxious gas, strong sealing, acid-resistant, and vibration proof.
- Long service life, bend-resistant

2. ELECTRONIC PROPERTIES:

- Rated Current: 35V (DC), 100mA, 1W.
- Contact Resistance: $10\Omega \sim 500\Omega$
- Insulation Resistance: $100M\Omega \sim 100V$
- Dielectric Strength: 250VRms (50~60Hz 1min)

- Electric Shock Shake: <5ms
- Longevity: touch type: ≥ 1 million times

3. MECHANICAL PROPERTY

- Working Voltage: touch: 170~397g (6~14oz)
- Switching Path: T-Touch: 0.6~1.5mm

4. ENVIRONMENTAL PARAMETER:

- Working Temperature: -40 ~ +80
- Storage Temperature: -40 ~ +80
- Temperature: 40,90% ~ 95%, 240h
- Vibration: 20G, maximum (10~200Hz, Mil-SLD-202 M204. conditio

CHAPTER-5

SOFTWARE DESCRIPTIONS

5.1 ARDUINO IDE

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

The Arduino hardware and software were designed for artists, designers, hobbyists, hackers, newbies, and anyone interested in creating interactive objects or environments. Arduino can interact with buttons, LEDs, motors, speakers, GPS units, cameras, the internet, and even your smart-phone or your TV! This flexibility combined with the fact that the Arduino software is free, the hardware boards are pretty cheap, and both the software and hardware are easy to learn has led to a large community of users who have contributed code and released instructions for a **huge** variety of Arduino-based projects

There are many varieties of Arduino boards (explained on the next page) that can be used for different purposes. Some boards look a bit different from the one below, but most Arduinos have the majority of these components in common:



Fig:5.1: Arduino IDE

Programs written using Arduino Software (IDE) are called **sketches**. These sketches are written in the text editor and are saved with the file extension.ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor

The Arduino IDE is incredibly minimalistic, yet it provides a near-complete environment for most Arduino-based projects. The top menu bar has the standard options, including “File” (new, load save, etc.), “Edit” (font, copy, paste, etc.), “Sketch” (for compiling and programming), “Tools” (useful options for testing projects), and “Help”. The middle section of the IDE is a simple text editor that where you can enter the program code. The bottom section of the IDE is dedicated to an output window that is used to see the status of the compilation, how much memory has been used, any errors that were found in the program, and various other useful messages.

Projects made using the Arduino are called sketches, and such sketches are usually written in a cut-down version of C++ (a number of C++ features are not included). Because programming a microcontroller is somewhat different

from programming a computer, there are a number of device-specific libraries (e.g., changing pin modes, output data on pins, reading analog values, and timers). This sometimes confuses users who think Arduino is programmed in an “Arduino language.” However, the Arduino is, in fact, programmed in C++. It just uses unique libraries for the device.

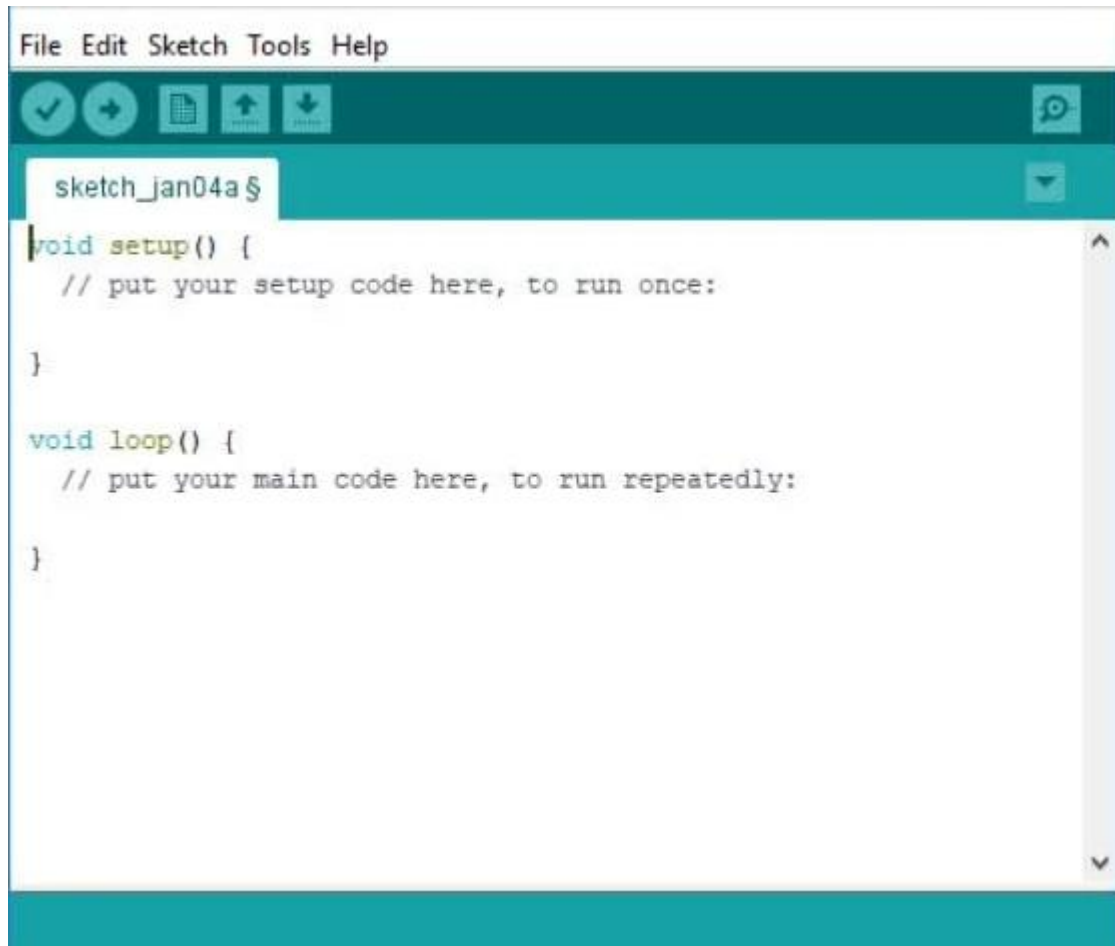


Fig:5.2: Setup

The Arduino IDE supports the languages c and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

5.2 INTERNET OF THINGS:

- The term Internet of Things generally refers to scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, allowing these devices to generate, exchange and consume data with minimal human intervention. There is, however, no single, universal definition.
- Enabling Technologies: The concept of combining computers, sensors, and networks to monitor and control devices has existed for decades. The recent confluence of several technology market trends, however, is bringing the Internet of Things closer to widespread reality. These include Ubiquitous Connectivity, Widespread Adoption of IP-based Networking, Computing Economics, Miniaturization, Advances in Data.
- Connectivity Models: IoT implementations use different technical communications models, each with its own characteristics. Four common communications models described by the Internet Architecture Board include: Device-to-Device, Device-to-Cloud, Device-to-Gateway, and Back-End Data-Sharing. These models highlight the flexibility in the ways that IoT devices can connect and provide value to the user.

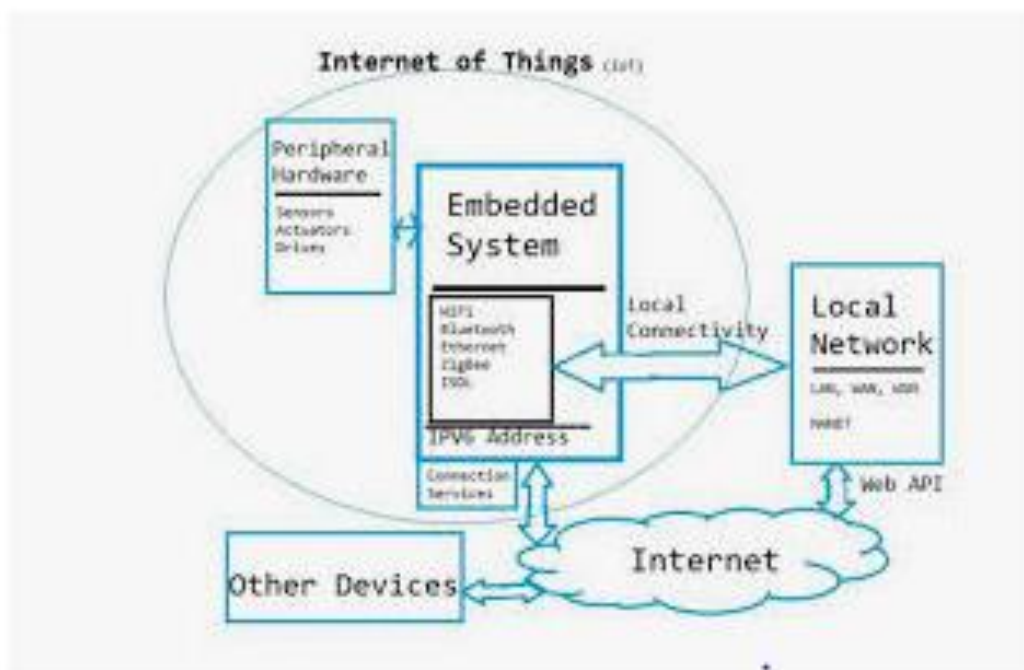


Fig:5.3: Internet of Things

IoT devices are implemented using both hardware and software components. Dedicated hardware components are used to implement the interface with the physical world, and to perform tasks which are more computationally complex. Microcontrollers are used to execute software that interprets inputs and controls the system. This module discusses the roles of both the hardware and software components in the system. The functions of common hardware components are described and the interface between the software and hardware through the microcontroller is explained. IoT devices often use an operating system to support the interaction between the software and the microcontroller. We will define the role of an operating system in an IoT device and how an IoT operating system differs from a standard one.

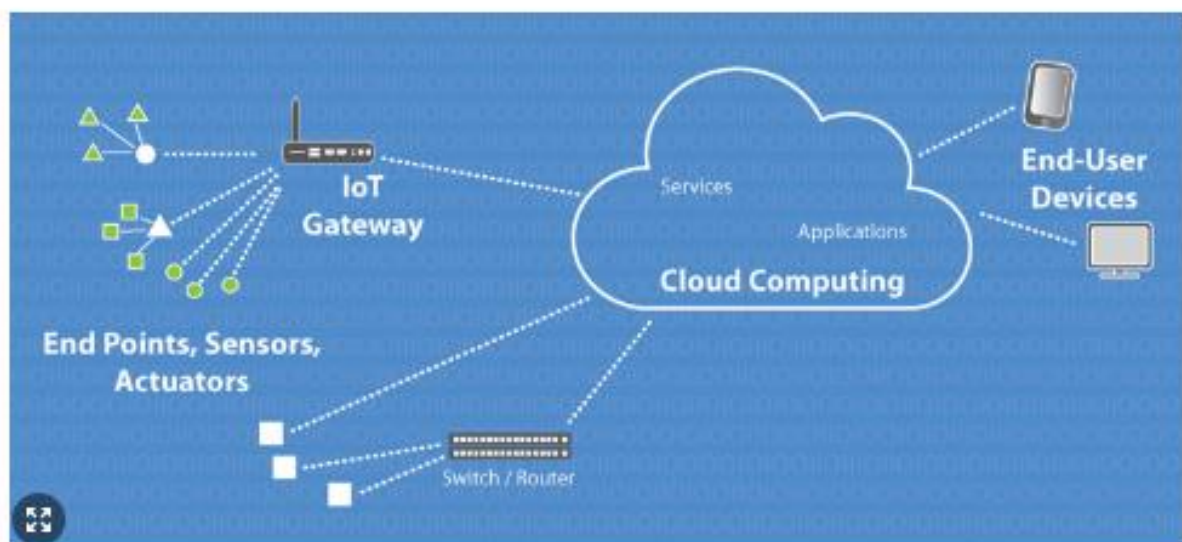


Fig:5.4: IOT

How IoT works

An IoT ecosystem consists of web-enabled smart devices that use embedded processors, sensors and communication hardware to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these

devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data.

The connectivity, networking and communication protocols used with these web-enabled devices largely depend on the specific IoT applications deployed.

Example of an IoT system

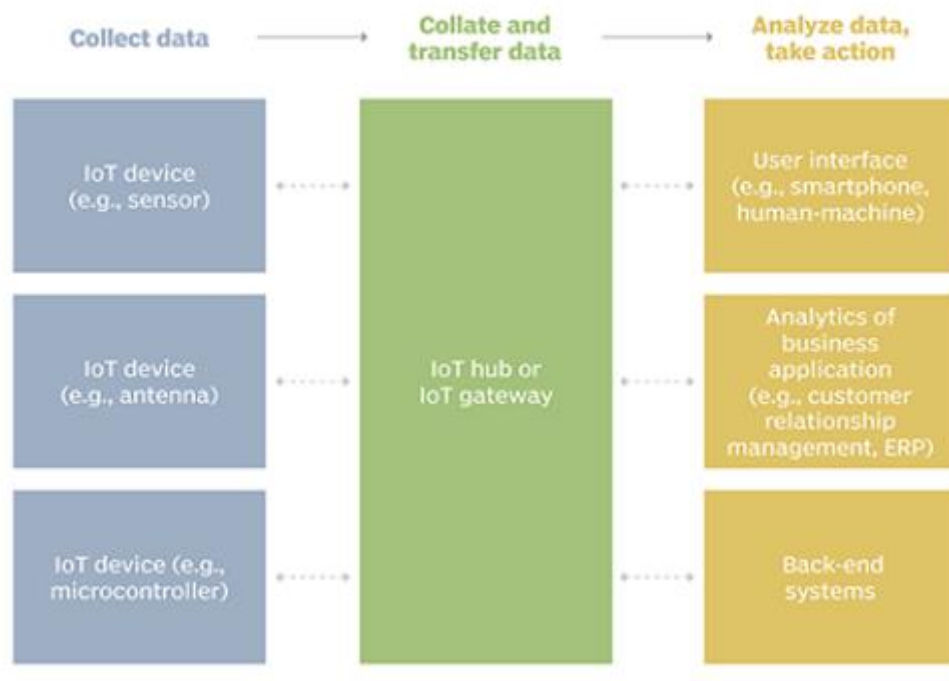


Fig:5.5: IoT System

Benefits of IoT

The internet of things offers a number of benefits to organizations, enabling them to:

- monitor their overall business processes;
- improve the customer experience;
- save time and money;

- enhance employee productivity;
- integrate and adapt business models;
- make better business decisions; and
- generate more revenue.

IoT encourages companies to rethink the ways they approach their businesses, industries and markets and gives them the tools to improve their business strategies.

Consumer and enterprise IoT applications

There are numerous real-world applications of the internet of things, ranging from consumer IoT and enterprise IoT to manufacturing and industrial IoT (IIoT). IoT applications span numerous verticals, including automotive, telco, energy and more.

In the consumer segment, for example, smart homes that are equipped with smart thermostats, smart appliances and connected heating, lighting and electronic devices can be controlled remotely via computers, smartphones or other mobile devices.

Wearable devices with sensors and software can collect and analyze user data, sending messages to other technologies about the users with the aim of making users' lives easier and more comfortable. Wearable devices are also used for public safety -- for example, improving first responders' response times during emergencies by providing optimized routes to a location or by tracking construction workers' or firefighters' vital signs at life-threatening sites.

In healthcare, IoT offers many benefits, including the ability to monitor patients more closely to use the data that's generated and analyze it. Hospitals often use IIoT systems to complete tasks such as inventory management, for both pharmaceuticals and medical instruments.

5.3 EMBEDDED C:

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software.

Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all-device working is based on microcontroller that are programmed by embedded C.

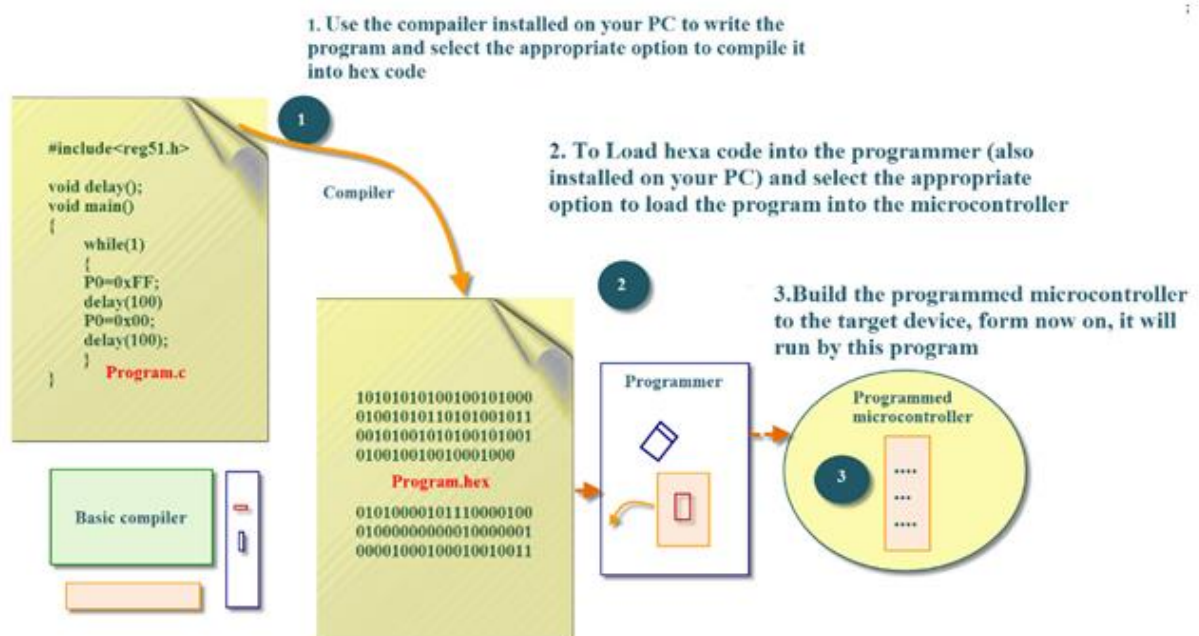


Fig:5.6

The Embedded C code written in above block diagram is used for blinking the LED connected with Port0 of microcontroller.

In embedded system programming C code is preferred over other language. Due to the following reasons:

- Easy to understand
- High Reliability
- Portability

- Scalability

Function is a collection of statements that is used for performing a specific task and a collection of one or more functions is called a programming language.

Most consumers are familiar with application software that provide functionality on a computer. Embedded software however is often less visible, but no less complicated. Unlike application software, embedded software has fixed hardware requirements and capabilities, and addition of third-party hardware or software is strictly controlled.

Embedded software needs to include all needed device drivers at manufacturing time, and the device drivers are written for the specific hardware. The software is highly dependent on the CPU and specific chips chosen. Most embedded software engineers have at least a passing knowledge of reading schematics, and reading data sheets for components to determine usage of registers and communication system. Conversion between decimal, hexadecimal and binary is useful as well as using bit manipulation.

Web applications are rarely used, although XML files and other output may be passed to a computer for display. File systems with folders are typically absent as are SQL databases.

Software development requires use of a cross compiler, which runs on a computer but produces executable code for the target device. Debugging requires use of an in-circuit emulator, JTAG or SWD. Software developers often have access to the complete kernel (OS) source code.

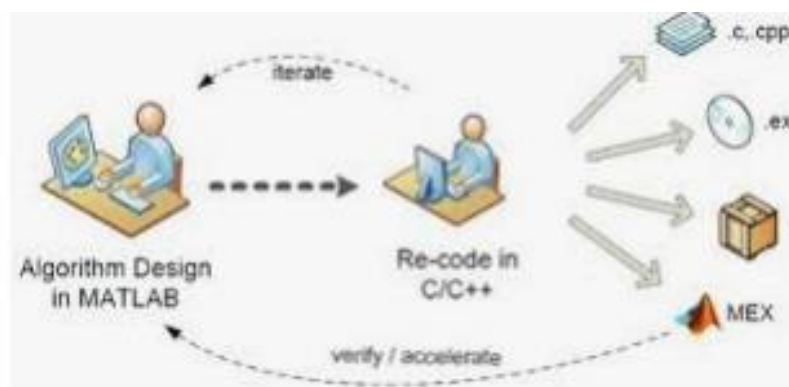
Size of the storage memory and RAM can vary significantly. Some systems run in 16 KB of Flash and 4 KB of RAM with a CPU operating at 8 MHz, other systems can rival contemporary computers.[8] These space requirements lead to more work being done in C or embedded C++, instead of C++. Interpreted languages like BASIC (while e.g. Parallax Propeller can use compiled BASIC) and Java (Java ME Embedded 8.3[9] is available for e.g. ARM Cortex-M4, Cortex-M7 microcontrollers and older ARM11 used in Raspberry Pi and Intel Galileo Gen. 2) are not commonly used; while an implementation

of the interpreted Python 3 language – MicroPython – is however available expressly for microcontroller use, e.g. 32-bit ARM-based (such as BBC micro:bit) and 16-bit PIC microcontrollers.

Communications between processors and between one processor and other components are essential. Besides direct memory addressing, common protocols include I²C, SPI, serial ports, and USB.

Communications protocols designed for use in embedded systems are available as closed source from companies including InterNiche Technologies and CMX Systems. Open-source protocols stem from uIP, lwip, and others

- This program explains how to use structure within structure in C using normal variable. “student_college_detail” structure is declared inside “student_detail” structure in this program. Both structure variables Please note that members of “student_college_detail” structure are accessed by 2 dot(.) operator and members of “student” are normal structure variables.
- “_detail” structure are accessed by single dot(.) operator.



Embedded C Program with Examples ...

A Keyword is a special word with a special meaning to the compiler (a C Compiler for example, is a software that is used to convert program written in C to Machine Code). For example, if we take the Keil's Cx51 Compiler (a

popular C Compiler for 8051 based Microcontrollers) the following are some of the keywords:

- bit
- sbit
- sfr
- small
- large

These are few of the many keywords associated with the Cx51 C Compiler along with the standard C Keywords.

5.4 PHP

PHP started out as a small open source project that evolved as more and more people found out how useful it was. Rasmus Lerdorf unleashed the first version of PHP way back in 1994. PHP is a recursive acronym for "PHP: Hypertext Preprocessor". PHP is a server side scripting language that is embedded in HTML. It is used to manage dynamic content, databases, session tracking, even build entire e-commerce sites. It is integrated with a number of popular databases, including MySQL, PostgreSQL, Oracle, Sybase, Informix, and Microsoft SQL Server.

PHP is pleasingly zippy in its execution, especially when compiled as an Apache module on the Unix side. The MySQL server, once started, executes even very complex queries with huge result sets in record-setting time. PHP supports a large number of major protocols such as POP3, IMAP, and LDAP. PHP4 added support for Java and distributed object architectures (COM and CORBA), making n-tier development a possibility for the first time. PHP is forgiving: PHP language tries to be as forgiving as possible. PHP Syntax is C-Like.

1. PHP is an acronym for "PHP: Hypertext Preprocessor"
2. PHP is a widely-used, open source scripting language
3. PHP scripts are executed on the server
4. PHP is free to download and use
5. PHP files can contain text, HTML, CSS, JavaScript, and PHP code

6. PHP code is executed on the server, and the result is returned to the browser as plain HTML
7. PHP files have extension ".php"

CHARACTERISTICS OF PHP

Five important characteristics make PHP's practical nature possible –

Simplicity

Efficiency

Security

Flexibility

Familiarity

STRUCTURE

```
<!DOCTYPE html>
```

```
<html>
```

```
<body>
```

```
<?php
```

```
echo "My first PHP script!";
```

```
?>
```

```
</body>
```

```
</html>
```

5.5 CODE

```
#include <ESP8266WiFi.h>
```

```
#include <Wire.h>
```

```
#include <LiquidCrystal_I2C.h>
```

```
#include "Adafruit_MQTT.h"
```

```
#include "Adafruit_MQTT_Client.h"
```

```
#define WLAN_SSID    "MSJ"
```

```
#define WLAN_PASS    "7373771991"
```

```
#define AIO_SERVER    "io.adafruit.com"
```

```

#define AIO_SERVERPORT 1883
#define AIO_USERNAME "fardeenessa100"
#define AIO_KEY      "aio_BCCD10jnlGjG7TFGQXsA2zMsJANF"

LiquidCrystal_I2C lcd(0x27, 16, 2);

#define Optic D0

WiFiClient client;

Adafruit_MQTT_Client mqtt(&client, AIO_SERVER, AIO_SERVERPORT,
AIO_USERNAME, AIO_KEY);

Adafruit_MQTT_Subscribe onoffbutton = Adafruit_MQTT_Subscribe(&mqtt,
AIO_USERNAME "/feeds/sample");

void MQTT_connect();

void setup()
{
  lcd.begin();
  lcd.backlight();
  lcd.setCursor(5,0);
  lcd.print("Subsea");
  lcd.setCursor(2,1);
  lcd.print("Comm. System");
  delay(3000);
  lcd.clear();
  lcd.setCursor(3,0);
  lcd.print("Using Fiber");
  lcd.setCursor(0,1);
  lcd.print("Optics Umbilical");
  delay(3000);
  lcd.clear();

```

```

pinMode(Optic,OUTPUT);
Serial.begin(9600);
delay(10);

Serial.println(F("Adafruit MQTT demo"));

Serial.println();
Serial.println();
Serial.print("Connecting to ");
lcd.print("Connecting to ");
Serial.println(WLAN_SSID);
lcd.setCursor(0,1);
lcd.print(WLAN_SSID);

WiFi.begin(WLAN_SSID, WLAN_PASS);
while (WiFi.status() != WL_CONNECTED)
{
    delay(500);
    Serial.print(".");
    lcd.print(".");
}
Serial.println();
lcd.clear();

Serial.println("WiFi connected");
lcd.setCursor(0,0);
lcd.print("WiFi connected");
delay(1000);
lcd.clear();
Serial.println("IP address: ");
Serial.println(WiFi.localIP());

mqtt.subscribe(&onoffbutton);

```

```

}

uint32_t x=0;

void loop()
{
    MQTT_connect();

    Adafruit_MQTT_Subscribe *subscription;
    while ((subscription = mqtt.readSubscription(5000)))
    {
        if (subscription == &onoffbutton)
        {
            lcd.clear();
            Serial.print(F("Got: "));
            lcd.print(F("Got: "));
            Serial.println((char *)onoffbutton.lastread);
            lcd.setCursor(5,0);
            lcd.print((char *)onoffbutton.lastread);
            uint16_t state = atoi((char *)onoffbutton.lastread);
            digitalWrite(Optic,state);
        }
    }
}

void MQTT_connect()
{
    int8_t ret;

    if (mqtt.connected())
    {
        return;
    }
}

```

```

Serial.print("Connecting to MQTT... ");

uint8_t retries = 3;
while ((ret = mqtt.connect()) != 0)
{
    Serial.println(mqtt.connectErrorString(ret));
    Serial.println("Retrying MQTT connection in 5 seconds...");
    mqtt.disconnect();
    delay(5000);
    retries--;
    if (retries == 0)
    {
        while (1);
    }
}
Serial.println("MQTT Connected!");
}

```

CHAPTER-6

RESULTS

6.1 OUTPUT SNAP 1



Fig:6.1: Output Snap 1

6.2 OUTPUT SNAP 2

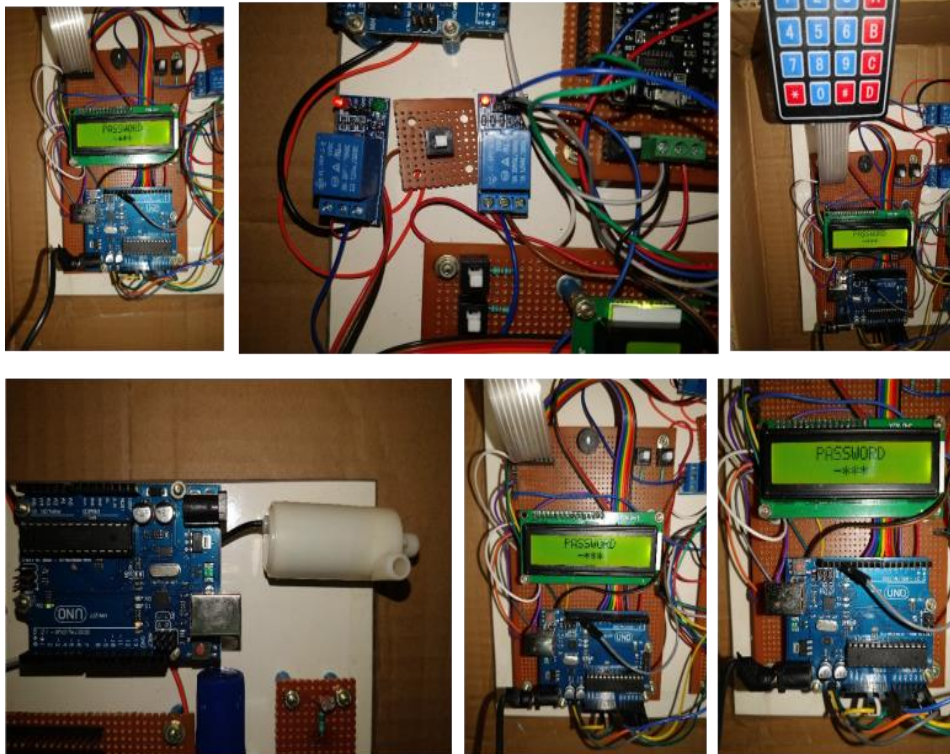


Fig:6.2: Output Snap 2

6.3 OUTPUT SNAP 3

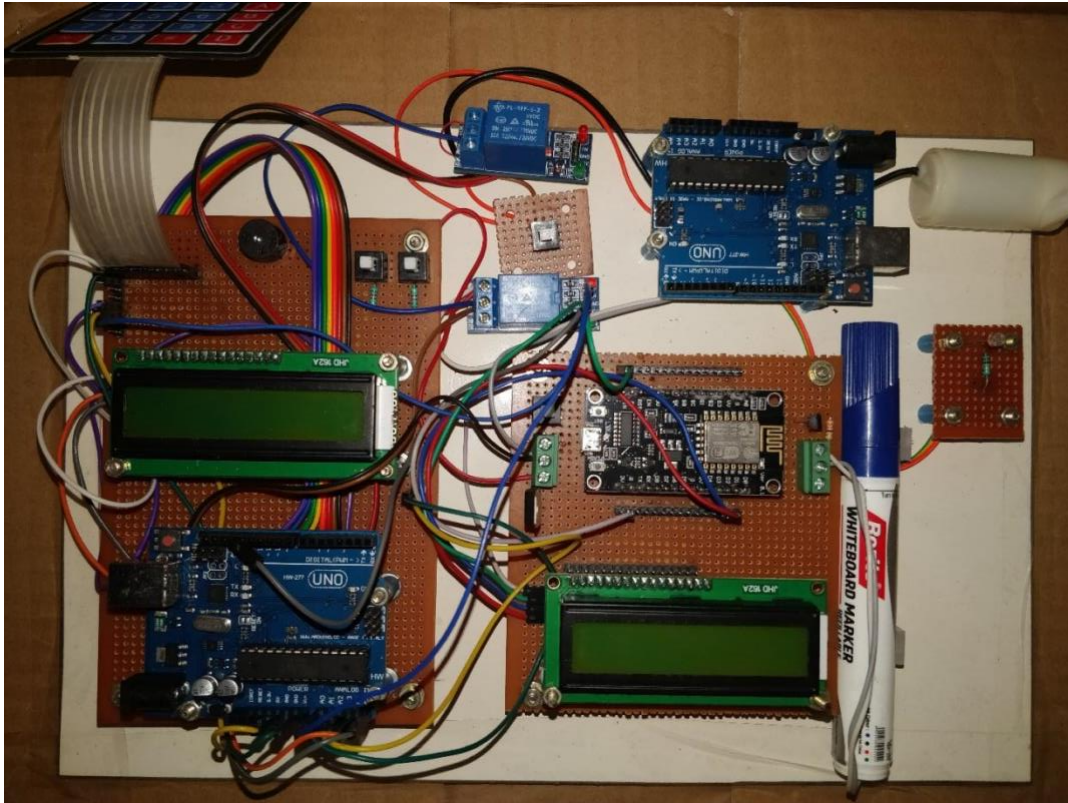


Fig:6.3: Output Snap 3

CHAPTER-7

CONCLUSION AND FUTURE SCOPE

Fiber optics communication in subsea - greener, cleaner, safer communication networks. Fiber communication in subsea is acting as a catalyst. As mentioned at the start of the presentation, this project objective is to develop subsea communication using fiber optics and therefore the same is developed and produces 100 per cent outcome as expected. It will manage the subsea equipment using fiber optics within few seconds. So, developing the time of communication in subsea directly reduce the overall price concerned within the project. Furthermore, the study on the ways of using this technique in current subsea equipment are to be analyzed and tested real-time within the field. As already there is fiber cable present in subsea umbilical, there is an excellent scope for the utilization and evolution of fiber communication technology in subsea.

The thought of fiber communication is deriving several because it is accessible and quicker means of transferring information. The optical communication system in subsea may become another resolution to ancient hydraulic Communication. The long-run appearance appears to be excellent for the Oil and gas industry as the downfall is about to complete. The device developed is controlling the subsea equipment within microseconds with the help of optic fiber (wired) as a medium, in future wireless Communication in Subsea can be developed using Li-Fi as a medium of communication.

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