CHAPTER 1: INTRODUCTION

We are moving towards to world of Internet. Where every physical object will be controlled and communicated with the internet. A research shows that, Internet of Things (IoT) connected devices installed base worldwide from 2015 to 2025 will be 75.44 billons.

Water is the most essential one in our world. Water is required for all basic purposes and needs. In day-to-day life water plays a major role. For drinking, bathing, cleaning, agriculture fields, industries and construction each and every work needs water. Water is naturally abundant and readily available source in nature. But now a day's lot of ground water level is decreased because of excess amount of water wastage. More bore wells were drilled for private water usage. So, the ground water level decreased greatly.

In industries water plays major role in manufacturing, and processing unit. Some industries which build nearer to bed of the rivers will greatly use the river water without any permission and they will consume more water more water than their permissible limits. So, industries like small scale and large-scale industries consume more amount of water, the water regulation management should take necessary activities to protect over usage of water by industries. Another major issue is water pollution, most of industries release the toxic wastes and chemical wet wastes to rivers and drainages, it greatly affects the life of people who lives near to the banks and people who consumes that water. The pollution control act should take necessary actions to reduce the water contamination. Another major issue is excess usage of water, so everyone should preserve the water. Though water is naturally available source, it should be preserved for future generation, without water nothing can be done. So, people should involve in water management system, government should create more awareness on conservation of water.

In urban areas water distribution is among those issues which are not taken seriously. There are a lot of issues related to water, among those a small issue is fight among the peoples of apartments for acquiring water as per their requirement. Here the system which will supply water in each block in channelized form from first to last user.

Embedded system had been implemented using ESP-32 WIFI MODULE, as one of the easily available option so that complete model will become cost effective [1]. ESP-32 will regulate the required quantity of water in proper time interval. When the flow rate of water will exceed the predetermined limit a solenoid valve will help in controlling the flow. Water supply has been done for defined duration with required speed of flow, by controlling solenoid valve turning on and off. Billing will be done as per the water utilized. If you are saving water, it means saving money. One more possibility we had considered is that more requirement of water occasionally. In such cases it is possible to put the message for more water requirement, based on the available water storage it will decided that how much water you are going to get. System will continuously update about the water utilized and available storage at central place. All the details will be updated on cloud through IoT. User can communicate through the mobile application implemented for demand, monitoring and billing system.

1.1 Literature Survey

As per literature survey water management systems [2] had been already implemented and invented by various researches. In the implemented system various features has been working together like uniform water distribution, monitoring of water level available in a tank, supply on demand, and online billing and payment of the water utilized. Using existing IoT (mobile network) these data could be sent to the remote server for billing from each flat and accepting request, monitoring and getting notifications are also done in this project. In this paper author has implemented a system which is monitoring the water utilization and preparing a bill as per utilization of water also water monitoring has been done remotely. Control and real time monitoring have been focused in this paper, by electronic flow rate sensors [3].

When the system is turned on the amount of water utilized by each user is monitored and controlled by using micro controller by counting the pulses from all channels continuously. Water level indicating sensors were used to determine the level of the water in the master tank, based on the level pumping motor has been controlled. This paper presents an IoT device which helps to manage/monitor and plan the usage of water by observing the level of water in the tank [4].

The water utilization details will be updated time to time in real time and notification will go on registered mobile number that Today's water supply is over so that user will also become alert while spending water [5]. Complete embedded system is designed by using this controller. It will control turning on and off the valve and data communication on IoT [6].

Flow meter is used to measure the flow of water which passed through it. Inside the meter there is turbine's structure available, when water is entered into the pipe the turbines are rotated and flow meter provide the pulses accordingly [7]. This get measured based on the volume of water flowing. For the communication with the internet, we required one open server, as the data is sent to the cloud and the data can received to client as well as stored in the server [8].

The Blynk open server is used in the system for IoT purpose. The total Liters is used by each flat is displayed on the Blynk app. This blynk app is provided to each flat as well as owner of apartment. The request can possible through this app for extra requirement of water of each flat and according to the water level of main water tank the request is accepted by the owner of the apartment and extra charges is taken for the extra usage of water [9].

1.2 Problem Statement

The traditional water management system could not limit the wastage of water and also cannot provide a complete survey especially in highly populated residential buildings.

1.3 Problem Formulation

In order to address the issue, the proposed system is employed. It overcomes the complications of existing system and focuses on providing functionalities like monitoring the water consumption, alerting after crossing the limit and sending them to email. The system framework consists NodeMCU (ESP-32) development board interfaced with Flow sensor, Solenoid valve and the Wi-Fi module for the cloud connectivity.

1.4 Objective of the Thesis

The main objective of this proposed work is to install a water management system, using ESP-32 module and sensors, is used to measure all the parameters like water quality, water level and water consumption etc, in real time and can be remotely reviewed over smart phones. The main objective is to limit the water wastage and to measure the quantity of water distributed (to every household) by using flow rate sensors.

1.5 Organization of Thesis

The thesis is organized into five chapters including the chapter of introduction. Each chapter is different from the other and is described along with the necessary theory required to comprehend it.

Chapter 1 deals with introduction of IoT based water management system, literature survey, problem statement, problem formulation and objective.

Chapter 2 deals with the Internet of Things. In this chapter, the process of controlling, operation of various devices with less or no human intervention are termed as automation, also its applications are elaborated.

In **Chapter 3** we have described the components involved in implementing our project including the functionality of each component.

Chapter 4 explains about work flow of the project and also, we have discussed about the results obtained and comparison between existing and proposed system.

Chapter 5 Concludes the work performed. The possible limitations in proceeding research towards this work are discussed. The future work that can be done in improving the current scenario is mentioned.

CHAPTER 2: INTERNET OF THINGS

2.1 Introduction

The Internet of Things **(IoT)** in layman's terms. The Internet of Things (IoT) is a system of physical things embedded with sensors, software, electronics and connectivity to allow it to perform better by exchanging information with other connected devices, the operator or the manufacturer.

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with Unique Identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

The internet of things (IoT) is also known as internet of all connected devices or Web of things. The internet of things is a network just like the internet. It comes as significant change in how human interact with surroundings. To put it simply, this may be the idea of basically connecting any device to the on and off switch to the net. This incorporates from cell phone, coffeemaker, washing machines, headphones, lamps, wearable devices it.

Internet of things is a sensor-based network where any device connecting to the internet and any other connected device to exchange data over internet. Even the IoT is really just a huge network of connected things and people all of which collect and share data regarding how they have been used and about the environment.

2.2 IoT Simple Definition

IoT is short for Internet of Things. The Internet of Things refers to the ever-growing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems.

2.3 Concept of IoT

The IoT concept was coined by a member of the Radio Frequency Identification (RFID) development community in 1999, and it has recently become more relevant to the practical world largely because of the growth of mobile devices, embedded and ubiquitous communication, cloud computing and data analytics. Imagine a world where billions of objects can sense, communicate and share information, all interconnected over public or private Internet Protocol (IP) networks. These interconnected objects have data regularly collected, analysed and used to initiate action, providing a wealth of intelligence for planning, management and decision making. This is the world of the Internet of Things (IoT).

Internet of things common definition is defining as: Internet of things (IoT) is a network of physical objects. The internet is not only a network of computers, but it has evolved into a network of device of all type and sizes , vehicles, smart phones, home appliances, toys, cameras, medical instruments and industrial systems, animals, people, buildings, all connected ,all communicating & sharing information based on stipulated protocols in order to achieve smart reorganizations, positioning, tracing, safe & control & even personal real time online monitoring , online upgrade, process control & administration. We define IoT into three categories as below: Internet of things is an internet of three things: (1). People to people, (2) People to machine /things, (3) Things /machine to things /machine, Interacting through internet. Internet of Things Vision: Internet of Things (IoT) is a concept and a paradigm that considers pervasive presence in the environment of a variety of things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/objects to create new applications/services and reach common goals. In this context the research and development challenges to create a smart world are enormous. A world where the real, digital and the virtual are converging to create smart environments that make energy, transport, cities and many other areas more intelligent.

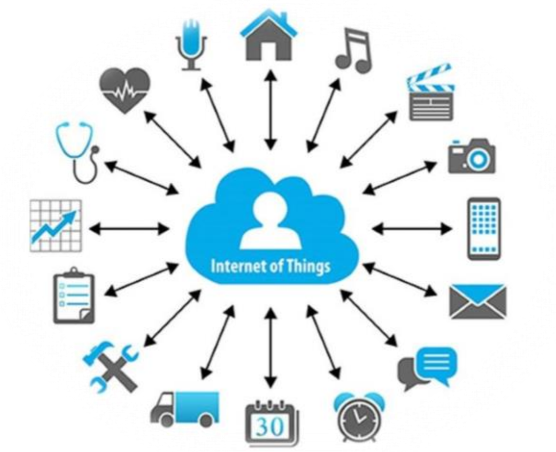


Fig.No.2.1: Simple block diagram of IoT

The IoT involves extending Internet connectivity beyond standard devices, such as desktops, laptops, Smartphone's and tablets, to any range of traditionally dumb or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled.

2.4 History

Definition of the Internet of things has evolved due to convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of things.

The concept of a network of smart devices was discussed as early as 1982, with a modified Coke vending machine at Carnegie Mellon University becoming the first Internet-connected appliance, able to report its inventory and whether newly loaded drinks were cold or not. Mark Weiser's 1991 paper on ubiquitous computing, "The Computer of the 21st Century", as well as academic venues such as UbiComp and PerCom produced the contemporary vision of the IoT. In 1994, Reza Raji described the concept in IEEE Spectrum as "[moving] small packets of data to a large set of nodes, so as to integrate and automate everything from home appliances to entire factories". Between 1993 and 1997, several companies proposed solutions like Microsoft's at Work or Novell's NEST. The field gained momentum when Bill Joy envisioned Device to Device (D2D) communication as a part of his "Six Webs" framework, presented at the World Economic Forum at Davos in 1999.

The term "Internet of things" was likely coined by Kevin Ashton of Procter & Gamble, later MIT's Auto-ID Center, in 1999,[13] though he prefers the phrase "Internet for things". At that point, he viewed Radio-frequency identification (RFID) as essential to the Internet of things, which would allow computers to manage all individual things.

A research article mentioning the Internet of Things was submitted to the conference for Nordic Researchers in Norway, in June 2002, which was preceded by an article published in Finnish in January 2002. The implementation described there was developed by Kary Framing and his team at Helsinki University of Technology and more closely matches the modern one, i.e., an information system infrastructure for implementing smart, connected objects.

Defining the Internet of things as "simply the point in time when more 'things or objects' were connected to the Internet than people", Cisco Systems estimated that the IoT was "born" between 2008 and 2009, with the things/people ratio growing from 0.08 in 2003 to 1.84 in 2010.

2.5 Working of IoT

An IoT system consists of sensors/devices which “talk” to the cloud through some kind of connectivity. Once the data gets to the cloud, software processes it and then might decide to perform an action, such as sending an alert or automatically adjusting the sensors/devices without the need for the user

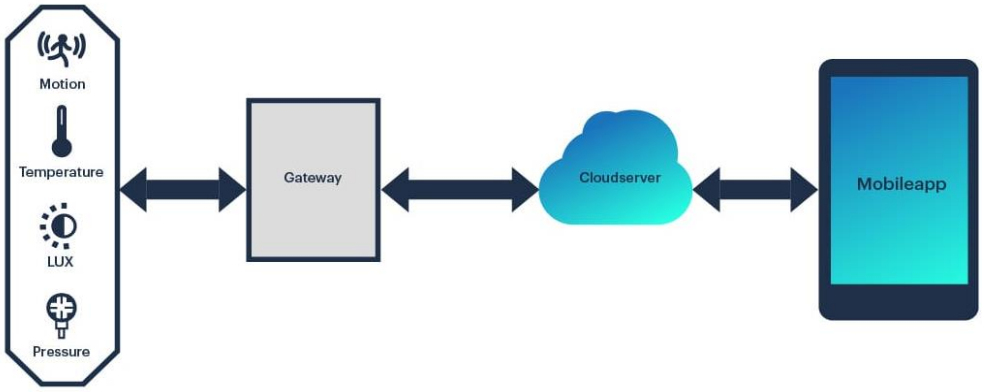


Fig.No.2.2: Working of IoT

The Internet of Things (**IoT**), also sometimes referred to as the Internet of Everything (IoE), consists of all the web-enabled devices that collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors and communication hardware.

2.6 IoT Explanation

A complete IoT system integrates four distinct components: sensors/devices, connectivity, data processing, and a user interface. Below we will briefly explain each component and what it does.

2.6.1 Sensors/Devices

First, sensors or devices collect data from their environment. This could be as simple as a temperature reading or as complex as a full video feed.

We use “sensors/devices,” because multiple sensors can be bundled together or sensors can be part of a device that does more than just sense things. For example, your phone is a device that has multiple sensors (camera, accelerometer, GPS, etc.), but your phone is not just a sensor. However, whether it’s a standalone sensor or a full device, in this first step data is being collected from the environment by something.

2.6.2 Connectivity

Next, that data is sent to the cloud (*what’s the cloud?*), but it needs a way to get there! The sensors/devices can be connected to the cloud through a variety of methods including: cellular, satellite, Wi-Fi, Bluetooth, low-power wide-area networks (LPWAN), or connecting directly to the internet via ethernet. Each option has tradeoffs between power consumption, range and bandwidth (here’s a simple explanation). Choosing which connectivity option is best comes down to the specific IoT application, but they all accomplish the same task getting data to the cloud.

2.6.3 Data Processing

Once the data gets to the cloud, software performs some kind of processing on it. This could be very simple, such as checking that the temperature reading is within an acceptable range. Or it could also be very complex, such as using computer vision on video to identify objects (such as intruders in your house).

But what happens when the temperature is too high or if there *is* an intruder in your house? That’s where the user comes in.

2.6.4 User Interface

Next, the information is made useful to the end-user in some way. This could be via an alert to the user (email, text, notification, etc.). For example, a text alert when the temperature is too high in the company’s cold storage. Also, a user might have an interface that allows them to proactively check in on the system. For example, a user might want to check the video feeds in their house via a phone app or a web browser.

However, it's not always a one-way street. Depending on the IoT application, the user may also be able to perform an action and affect the system. For example, the user might remotely adjust the temperature in the cold storage via an app on their phone.

And some actions are performed automatically. Rather than waiting for you to adjust the temperature, the system could do it automatically via predefined rules. And rather than just call you to alert you of an intruder, the IoT system could also automatically notify relevant authorities.

2.7 IoT System Actually Works

An IoT system consists of sensors/devices which "talk" to the cloud through some kind of connectivity. Once the data gets to the cloud, software processes it and then might decide to perform an action, such as sending an alert or automatically adjusting the sensors/devices without the need for the user.

But if the user input *is* needed or if the user simply wants to check in on the system, a user interface allows them to do so. Any adjustments or actions that the user makes are then sent in the opposite direction through the system: from the user interface, to the cloud, and back to the sensors/devices to make some kind of change.

Want more simple explanations related to IoT? You can find them in our free eBook on everything you need to know to build a foundational knowledge of IoT and related technologies.

Many of us have dreamed of smart homes where our appliances do our bidding automatically. The alarm sounds and the coffee pot starts brewing the moment you want to start your day. Lights come on as you walk through the house. Some unseen computing device responds to your voice commands to read your schedule and messages to you while you get ready, then turns on the TV news. Your car drives you to work via the least congested route, freeing you up to get caught up on your reading or prep for your morning meeting while in transit.

We've read and seen such things in science fiction for decades, but they're now either already possible or on the brink of coming into being. And this entire new tech is forming the basis of what people are calling the Internet of Things.

The Internet of Things (IoT), also sometimes referred to as the Internet of Everything (IoE), consists of all the web-enabled devices that collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors and communication hardware. These devices, often called "connected" or "smart" devices, can sometimes talk to other related devices, a process called machine-to-machine(M2M) communication, and act on the information they get from one another. Humans can interact with the gadgets to set them up, give them instructions or access the data, but the devices do most of the work on their own without human intervention. Their existence has been made possible by all the tiny mobile components that are available these days, as well as the always-online nature of our home and business networks.

Connected devices also generate massive amounts of Internet traffic, including loads of data that can be used to make the devices useful, but can also be mined for other purposes. All this new data, and the Internet-accessible nature of the devices, raises both privacy and security concerns.

But this technology allows for a level of real-time information that we've never had before. We can monitor our homes and families remotely to keep them safe. Businesses can improve processes to increase productivity and reduce material waste and unforeseen downtime. Sensors in city infrastructure can help reduce road congestion and warn us when infrastructure is in danger of crumbling. Gadgets out in the open can monitor for changing environmental conditions and warn us of impending disasters. These devices are popping up everywhere, and these abilities can be used to enhance nearly any physical object.

2.8 Can IoT Work Without Internet?

The network supports a range IoT applications suited to devices in motion or remote locations, or that must be secure before connection to the cloud. Because USSD is a feature in all cellular networks, it can provide secure IoT connectivity without involving the internet.

You may have heard the IoT loosely described as 'an array of edge sensor and actuator devices, connected via the Internet to cloud-based computing and analytics resources.' This description works well enough for the Big Picture – but zoom in more closely, and you'll find that it's sometimes not entirely accurate.

The issue lies with the IoT's edge devices. There are very large numbers of them, and their population is growing rapidly. However, not all are connected directly to the Internet. It's not always possible or even desirable to do so.

First, let's consider some near-future forecasts. According to a Juniper report, the number of IoT-connected devices, sensors and actuators will reach over 46 billion in 2021; compared with a United States Census Bureau world population estimate of just over 7.7 billion for 2021, this equates to very nearly six devices per capita.

These are large volumes, and would represent a considerable number of internet connections if they were all connected to the Internet. However, as mentioned, not all IoT devices are directly connected. Typically, an array of devices in a home or factory area will communicate via a non-IP bus such as ZigBee to a router and the router alone will maintain the edge's presence on the internet, allowing communication with the system's remote cloud server. As we shall see, some devices, particularly small sensors, benefit from eliminating the overhead of a high-performance IP-based network. Additionally, the presence of an IP address increases a device's vulnerability to hacking.

Other applications may be based in remote rural communities or otherwise out of reach, so no permanent reliable internet connection is available. Possibilities may be limited to collecting data into a logging device, then transporting it on a memory stick to a location where it can be analyzed to generate meaningful information and recommendations for action.

With the right technologies, however, long-distance communications can be achieved without the Internet or IP addresses being involved. One example is provided by Thing stream, which is a long-distance device connectivity network, built on Unstructured Supplementary Service Data (USSD) messaging. USSD offers secure IoT connectivity without the Internet being involved at all.

Low Power Wide Area Network (Lora WAN) is another option, as it's a Low Power Wide Area Network. This allows IoT devices to communicate over distances from a few kilometers to several tens of kilometers - depending on the environment – with gateways that interface to standard IP networks.

From the above, it becomes clear that there are very many IoT devices operating without Internet connections in a variety of circumstances, summarized as

- No Internet connection is available, so it's not an option
- An array of sensors has characteristics unsuitable for direct connection to an IP-type Internet connection
- Security concerns related to hacking of Internet devices

2.9 Applications

Applications for IoT device is often divided into consumer, commercial, industrial, and infrastructure spaces.

2.9.1 Consumer Application

i) Smart Home

IoT devices are a part of the larger concept of home automation, which can include lighting, heating and air conditioning, media and security systems. Long term benefits could include energy savings by automatically ensuring lights and electronics are turned off.

A smart home or automated home could be based on a platform or hubs that control smart devices and appliances. For instance, using Apple's Home Kit, manufacturers can get their home products and accessories be controlled by an application in iOS devices such as the iPhone and the Watch. This could be a dedicated app or iOS native applications such as Siri. This can be demonstrated in the case of Lenovo's Smart Home Essentials, which is a line of smart home devices that are controlled through Apple's Home app or Siri without the need for a Wi-Fi bridge. There are also dedicated smart home hubs that are offered as standalone platforms to connect different smart home products and these include the Amazon Echo, Google Home, Apple's Home Pod, and Samsung's Smart Things.

2.9.2 Commercial Application

i) Medical and Healthcare

The Internet of Medical Things (also called the internet of health things) is an application of the IoT for medical and health related purposes, data collection and analysis for research, and monitoring. IoT devices can be used to enable remote health monitoring and emergency notification systems. These health monitoring devices can range from blood pressure and heart rate monitors to advanced devices capable of monitoring specialized implants, such as pacemakers, Fit bit electronic wristbands, or advanced hearing aids. The application of the IoT in healthcare plays a fundamental role in managing chronic diseases and in disease prevention and control.

Specialized sensors can also be equipped within living spaces to monitor the health and general well-being of senior citizens, while also ensuring that proper treatment is being administered and assisting people regain lost mobility via therapy as well. These sensors create a network of intelligent sensors that are able to collect, process, transfer and analyse valuable information in different environments, such as connecting in-home monitoring devices to hospital-based systems.

Advances in plastic and fabric electronics fabrication methods have enabled ultra-low cost, use-and-throw IoMT sensors as of 2018 IoMT was not only being applied in the clinical laboratory industry, but also in the healthcare and health insurance industries. IoMT in the healthcare industry is now permitting doctors, patients and others involved (i.e. guardians of patients, nurses, families, etc.) to be part of a system, where patient records are saved in a database, allowing doctors and the rest of the medical staff to have access to the patient's information.

. Remote monitoring is made possible through the connection of powerful wireless solutions. The connectivity enables health practitioners to capture patient’s data and applying complex algorithms in health data analysis.

2.9.3 Transportation

The IoT can assist in the integration of communications, control, and information processing across various transportation systems. Application of the IoT extends to all aspects of transportation systems (i.e., the vehicle, the infrastructure, and the driver or user). Dynamic interaction between these components of a transport system enables inter and intra vehicular communication, smart traffic control, smart parking, electronic toll collection systems, logistic and fleet management, vehicle control, and safety and road assistance.

In Logistics and Fleet Management for example, The IoT platform can continuously monitor the location and conditions of cargo and assets via wireless sensors and send specific alerts when management exceptions occur (delays, damages, thefts, etc.). This can only be possible with the IoT and its seamless connectivity among devices. Sensors such as Humidity, Temperature, and GPS device send data to the IoT platform and then the data is analysed and send further to the users. This way, users can track the real-time status of vehicles and can make appropriate decisions. If combined with Machine Learning then it also helps in reducing traffic accidents by introducing drowsiness alerts to drivers and providing self-driven cars too.

2.9.4 Industrial Applications

The Industrial Internet of Things (IIoT) refers to interconnected sensors, instruments, and other devices networked together with computers' industrial applications, including, but not limited to, manufacturing and energy management. This connectivity allows for data collection, exchange and analysis, potentially facilitating improvements in productivity and efficiency as well as other economic benefits.

The IIoT is an evolution of a Distributed Control System (DCS) that allows for a higher degree of automation by using cloud computing to refine and optimize the process controls.

2.9.5 Manufacturing

The IoT can realize the seamless integration of various manufacturing devices equipped with sensing, identification, processing, communication, actuation, and networking capabilities. Based on such a highly integrated smart cyber physical space, it opens the door to create whole new business and market opportunities for manufacturing.

Digital control systems to automate process controls, operator tools and service information systems to optimize plant safety and security are within the purview of the IoT. But it also extends itself to asset management via predictive maintenance, statistical evaluation, and measurements to maximize reliability. Smart industrial management systems can also be integrated with the Smart Grid, thereby enabling real-time energy optimization.

The term industrial Internet of things (IIoT) is often encountered in the manufacturing industries, referring to the industrial subset of the IoT. IIoT in manufacturing could generate so much business value that it will eventually lead to the Fourth Industrial Revolution, so the so-called Industry 4.0. It is estimated that in the future, successful companies will be able to increase their revenue through Internet of things by creating new business models and improve productivity, exploit analytics for innovation, and transform workforce. The potential of growth by implementing IIoT may generate $12 trillion of global GDP by 2030.

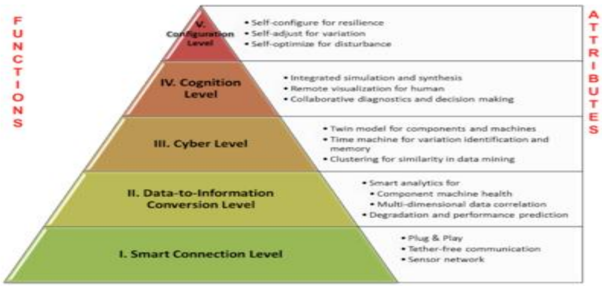


Fig.No.2.3: Design architecture of cyber-physical systems

Industrial big data analytics will play a vital role in manufacturing asset predictive maintenance, although that is not the only capability of industrial big data. Cyber-Physical Systems (CPS) is the core technology of industrial big data and it will be an interface between human and the cyber world. Cyber-physical systems can be designed by following the 5C (connection, conversion, cyber, cognition, and configuration) architecture, and it will transform the collected data into actionable information, and eventually interfere with the physical assets to optimize processes.

2.9.6 Agriculture

There are numerous IoT applications in farming such as collecting data on temperature, rainfall, humidity, wind speed, pest infestation, and soil content. This data can be used to automate farming techniques, take informed decisions to improve quality and quantity, minimize risk and waste, and reduce effort required to manage crops. For example, farmers can now monitor soil temperature and moisture from afar, and even apply IoT-acquired data to precision fertilization programs.

2.9.7 Metropolitan Scale Deployments

There are several planned or ongoing large-scale deployments of the IoT, to enable better management of cities and systems. For example, Song do, South Korea, the first of its kind fully equipped and wired smart city, is gradually being built, with approximately 70 percent of the business district completed as of June 2018. Much of the city is planned to be wired and automated, with little or no human intervention.

Another application is a currently undergoing project in Santander, Spain. For this deployment, two approaches have been adopted. This city of 180,000 inhabitants has already seen 18,000 download of its city smart phone app. The app is connected to 10,000 sensors that enable services like parking search, environmental monitoring, digital city agenda, and more.

Cisco also participates in smart cities projects. Cisco has started deploying technologies for Smart Wi-Fi, Smart Safety & Security, Smart Lighting, Smart Parking, Smart Transports, Smart Bus Stops, Smart Kiosks, and Remote Expert for Government Services (REGS) and Smart Education in the five km area in the city of Vijayawada. New applications can include security, energy and fleet management, digital signage, public Wi-Fi, paperless ticketing and others.

2.9.8 Environmental Monitoring

Environmental monitoring applications of the IoT typically use sensors to assist in environmental protection by monitoring air or water quality, atmospheric or soil conditions, and can even include areas like monitoring the movements of wildlife and their habitats. Development of resource constrained devices connected to the Internet also means that other applications like earthquake or tsunami early-warning systems can also be used by emergency services to provide more effective aid. IoT devices in this application typically span a large geographic area and can also be mobile. It has been argued that the standardization IoT brings to wireless sensing will revolutionize this area.

The IoT's major significant trend in recent years is the explosive growth of devices connected and controlled by the Internet. The wide range of applications for IoT technology mean that the specifics can be very different from one device to the next but there are basic characteristics shared by most.

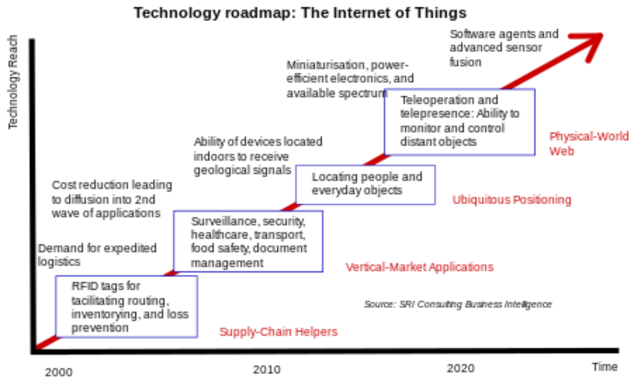


Fig.No.2.4: Technology roadmap: Internet of things

The IoT creates opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions.

The number of IoT devices increased 31% year-over-year to 8.4 billion in the year 2017 and it is estimated that there will be 30 billion devices by 2020.The global market value of IoT is projected to reach $7.1 trillion by 2020.

2.10 Advantages

The fire detecting robot helps in following ways:

- To detect the exact direction of the fire source.
- Capability of sensing accurately with increased flexibility.
- Reduce human effort.
- Reliable and economical.
- Not sensitive to weather conditions.

2.11 Summary

The Internet of Things refers to the communication that occurs between objects and other Internet-enabled devices and systems. Sensors/devices communicate with the cloud and process it to do an automatic action.

CHAPTER 3: COMPONENTS AND SOFTWARE REQUIREMENTS

3.1 Introduction

In this chapter we will learn about essential characteristics, description and working of each component and their Specifications which are used in our thesis. The components are NodeMCU (ESP-32) development board, Relay module, Flow sensor, Solenoid valve, PH-Sensor board.

3.2 Flow Sensor

Water Flow Sensor, as the name suggests, is a device to measure the flow of water. Basically, the YF-S201 Water Flow Sensor consists of a Flap Wheel (or a Turbine Wheel) that spins when water flows through the sensor. At the centre of this flap wheel, there is magnet fixed. Flow sensors are able to detect leaks, blockages, pipe bursts, and changes in liquid concentration due to contamination or pollution.

Model: YF-S201

Working Range: 1 – 30 L/min

We use a water flow sensor to measure the water flow rate. The water flow rate is the volume of fluid that passes per unit time. People often use water flow sensor for automatic water heater control, DIY coffee machines, water vending machines, etc. There are a variety of flow sensors of different principles, but for makers using Arduino or Raspberry Pi, the most common flow sensor is based on a Hall device.

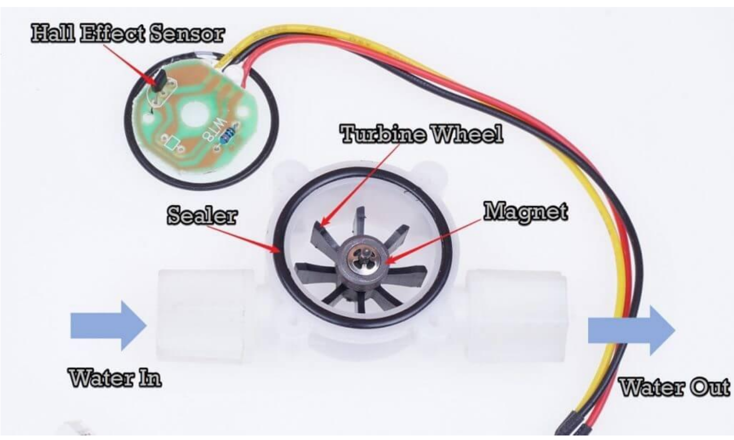


Fig.No.3.1: Water flow sensor work principle

It's quite simple inside. The main components are the Hall Effect sensor, turbine wheel, and magnet. The water flows in through the inlet and out through the outlet. The water current drove the wheel to turn, and the magnet on the wheel turned with it. Magnetic field rotation triggers the Hall sensor, which outputs high-level and low-level square waves (pulse).

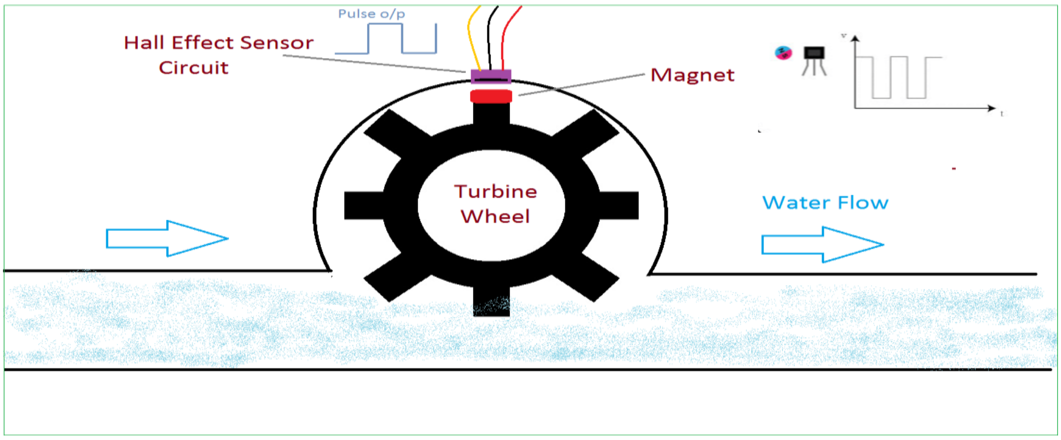


Fig.No. 3.2: Water flow sensor working principle

For every round of the wheel, the volume of water flowing through is a certain amount, as is the number of square waves output. Therefore, we can calculate the flow of water by counting the number of square waves (pulse).

3.3 NODEMCU (ESP-32)

NodeMCU is an open source IoT platform. This includes firmware which runs on the ESP32 Wi-Fi Module from Espressif Systems, and hardware which is based on the ESP-32 module. The term "NodeMCU" by default refers to the firmware rather than the dev kits. NodeMCU firmware was developed so that AT commands can be replaced with Lua scripting making the life of developers easier. So, it would be redundant to use AT commands again in NodeMCU.

Fig.No.3.3: NodeMCU (ESP-32)

The ESP32 is a low-cost Wi-Fi chip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif. Usable pins. The ESP32 has 17 GPIO pins (**0**-16), however, you can only use 11of them, because 6 pins (GPIO 6 - 11) are used to connect the flash memory chip.

NodeMCU is like brand name of a board that has a Wi-Fi module ESP32 and some associated circuit. ESP32 module in tune has a micro controller with Wi-Fi. You can program ESP32 using Arduino, NodeMCU IDE or ESP32 SDK. NodeMCU is development board for ESP32, which is Wi-Fi chip with 32bit microcontroller.

NodeMCU Development board is featured with Wi-Fi capability, analog pin, digital pins and serial communication protocols. To get start with using NodeMCU for IoT applications first we need to know about how to write/download NodeMCU firmware in NodeMCU Development Boards.

3.3.1 ESP32 Features

- Open-source
- Interactive
- Programmable
- Low cost
- Simple
- Smart
- WI-FI enabled
- USB-TTL included
- Plug & Play

3.3.2 NodeMCU DEVKIT 1.0 Specifications

- Voltage: 3.3v.
- Wi-Fi Direct (P2P), soft-AP
- Current consumption: 10uA~170mA.
- Flash memory attachable: 16 MB max (512Knormal).
- Integrated TCP/IP protocol stack.
- Processor speed: 80~160MHz.

- RAM: 32K+80K.
- 802.11 b/g/n protocol
- Integrated TCP/IP protocol stack
- Built-in low-power 32-bit CPU
- SDIO 2.0, SPI, UART

3.3.3 Advantages & Disadvantages

Advantages

- Low energy consumption
- Integrated support for WIFI network
- Reduced size of the board
- Low Cost

Disadvantages

- Need to learn a new language and IDE
- Less pin out

3.3.4 NodeMCU Pin Out

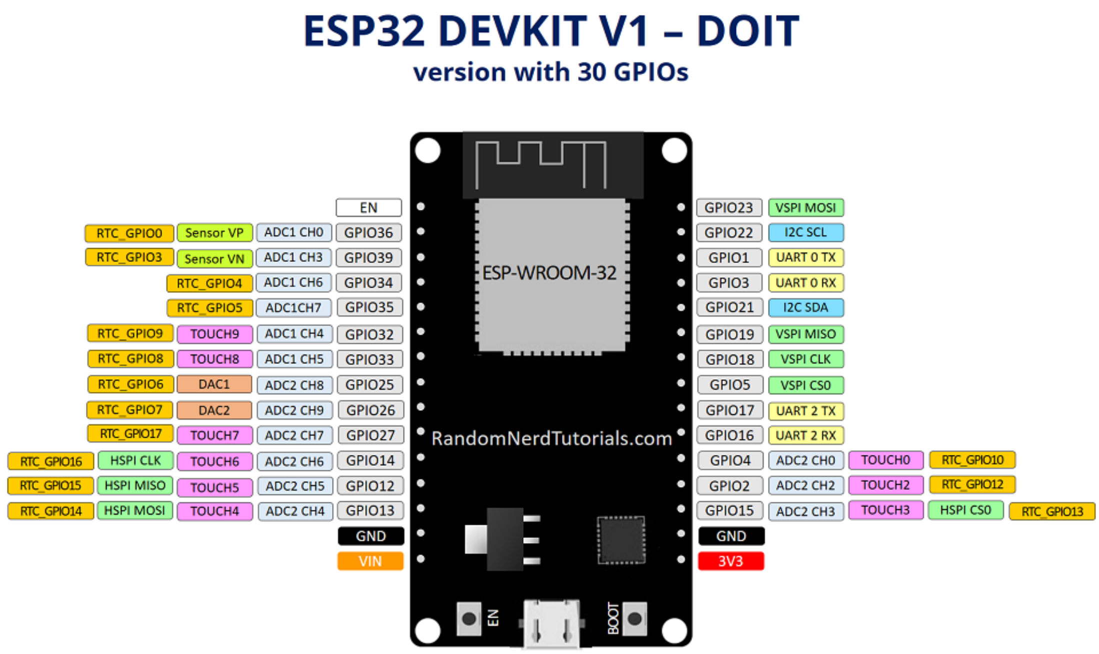


Fig.No.3.4: NodeMCU pin diagram

Since NodeMCU is open-source platform, their hardware design is open for edit/modify/build. The Flash button on NodeMCU is connected between io 0 and ground. You can use it as a button. Set pin Mode (0, INPUT_PULLUP) and you will read Io 0 LOW if the button is pressed. To put the module in flashing mode, first the Flash button must be hold and Reset button pushed, then Flash button released. To place the NodeMCU into FLASH mode is super easy. Press the RESET button on the board + FLASH button at the same time. Release the RESET button.

3.4 Relay Module

3.4.1 Introduction

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contractor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults in modern electric power systems these functions are performed by digital instruments still called "protective relays". A relay is used to switch on a high-powered circuit with a small current.

Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts. Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition. AC controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands. It was used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another.

3.4.2 Basic Design and Operation

A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core (a solenoid), an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts (there are two contacts in the relay pictured). The armature is hinged to the yoke and mechanically linked to one or more sets of moving contacts. The armature is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. Other relays may have more or fewer sets of contacts depending on their function. The relay in the picture also has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, and the circuit track on the printed circuit (PCB) via the yoke, which is soldered to the PCB.

Fig.No.3.5 Relay Module

When an electric current is passed through the coil it generates a magnetic field that activates the armature and the consequent movement of the movable contact either makes or breaks (depending upon construction) a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Usually, this force is provided by a spring, but gravity is also used commonly in industrial motor starters.

3.4.3 Applications

Relays are used wherever it is necessary to control a high power or high voltage circuit with a low power circuit, especially when galvanic isolation is desirable. The first application of relays was in long telegraph lines, where the weak signal received at an intermediate station could control a contact, regenerating the signal for further transmission. High-voltage or high-current devices can be controlled with small, low voltage wiring and pilots switches. Operators can be isolated from the high voltage circuit. Low power devices such as microprocessors can drive relays to control electrical loads beyond their direct drive capability. In an automobile, a starter relay allows the high current of the cranking motor to be controlled with small wiring and contacts in the ignition key.

3.4.4 Different Types of Relays

- Electromagnetic Relays. These relays are constructed with electrical, mechanical and magnetic components, and have operating coil and mechanical contacts. ...
- Solid State Relays. Solid State uses solid state components to perform the switching operation without moving any parts.
- Hybrid Relay.
- Thermal Relay.
- Reed Relay.

3.4.5 Relay Use in Circuit

But while electrical relays can be used to allow low power electronic or computer type circuits to switch relatively high currents or voltages either “ON” or “OFF”, some form of relay switch circuit is required to control it.

Relays are electromechanical devices that use an electromagnet to operate a pair of movable contacts from an open position to a closed position.

Control Pins:

IN pin is used to control the relay. It is an active low pin, meaning the relay will be activated when you pull the pin LOW and it will become inactive when you pull the pin HIGH.
GND is the ground connection.
VCC pin supplies power to the module.

Output Terminal:

COM pin is connected to the signal you are planning to switch.
NC pin is connected to the COM pin by default, unless you send a signal from the Arduino to the relay module to break the connection.
NO pin is open by default, unless you send a signal from the Arduino to the relay module to make the connection.

3.5 Solenoid valve

A solenoid valve is an electrically controlled valve. The valve features a solenoid, which is an electric coil with a movable ferromagnetic core (plunger) in its center. In the rest position, the plunger closes off a small orifice. An electric current through the coil creates a magnetic field. The magnetic field exerts an upwards force on the plunger opening the orifice. This is the basic principle that is used to open and close solenoid valves. Solenoid valves are used wherever fluid flow has to be controlled automatically. They are being used to an increasing degree in the most varied types of plants and equipment.

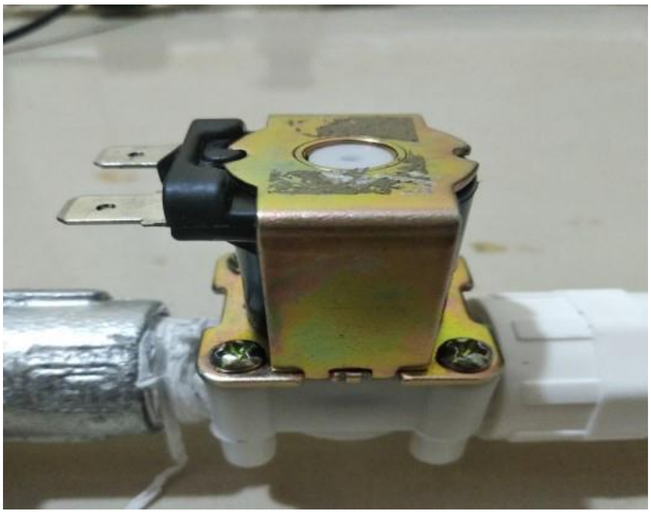


Fig.No.3.6 Solenoid valve

3.5.1 A Few Considerations:

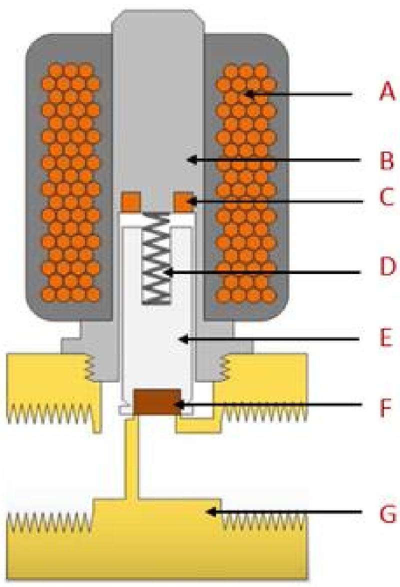
Before choosing this solenoid valve for a project there are a few things that should be considered:

• Water can only flow in one direction through this valve.
• There is a 3 PSI minimum pressure requirement on the inlet otherwise the valve will not shut off.
• This solenoid valve is not rated for food safety or use with anything but water.

3.5.2 Working:

This valve is very similar to those found in a lawn irrigation system – the only real difference being the size. The inlet water pressure actually holds the valve closed so if you do not have any inlet water pressure (3psi minimum) the valve will never close!

A solenoid valve consists of two main components: a solenoid and a valve body (G). Fig.No.3.6 shows the components. A solenoid has an electromagnetically inductive coil (A) around an iron core at the center called the plunger (E). At rest, it can be normally open (NO) or normally closed (NC). In the de-energized state, a normally open valve is open and a normally closed valve is closed. When current flows through the solenoid, the coil is energized and creates a magnetic field. This creates a magnetic attraction with the plunger, moving it and overcoming the spring (D) force. If the valve is normally closed, the plunger is lifted so that the seal (F) opens the orifice and allows the flow of the media through the valve. If the valve



is normally open, the plunger moves downward so that the seal (F) blocks the orifice and stops the flow of the media through the valve. The shading ring (C) prevents vibration and humming in AC coils.

Fig.No.3.7 Components of a solenoid valve; coil (A); armature (B); shading ring (C); spring (D); plunger (E); seal (F); valve body (G)

3.5.3 Features:

- **Electric power reduction:** A short current pulse is fed to open or close the valve and the electric power is reduced far enough to hold it in position. This helps in conserving energy.
- **Latching:** Latching or pulse coil version provides a solution for applications with low frequency switching. The valve is energized by a short electric pulse to move the plunger. A permanent magnet is then used to keep the plunger in that position with no additional spring or magnetic field. This lowers power consumption and heat development in the valve.
- **High Pressure:** High pressure versions are designed for pressure requirements up to 250 bar.
- **Manual override:** Optional manual override feature provides better safety and convenience during commissioning, testing, maintenance, and in case of a power failure. In some versions, the valve cannot electrically actuate when the manual control is locked.
- **Media separation:** Media separation design allows isolation of the media from the valve's working parts, making it a good solution for aggressive or slightly contaminated media.
- **Vacuum:** Valves that do not require a minimum pressure differential are suitable for rough vacuums. Universal direct acting or semi-direct acting solenoid valves are well suited for these applications. For more stringent leakage rate requirements special vacuum versions are available.

- **Adjustable response time:** The time it takes the valve to open or close can be adjusted, typically by rotating screws on the valve's body. This feature can help prevent a water hammer
- **Position feedback:** The switching status of a solenoid valve can be indicated with an electrical or optical position feedback as a binary or NAMUR signal. NAMUR is a sensor output that indicates the on or off state of the valve.
- **Low noise:** Valves have a damped design to reduce the noise during the closing of the valve.

3.6 PH-Sensor board

3.6.1 Introduction

A **pH sensor** is one of the most essential tools that's typically used for water measurements. This type of **sensor** is able to measure the amount of alkalinity and acidity in water and other solutions.

This PH rod is designed on ATMEGA8 IC, On board LDR for light value, Thermistor for temperature value. It gives Serial data at its Tx pin

PH value W: depth of rod immersed **L:** light value **T:** temperature value

PH: W L T

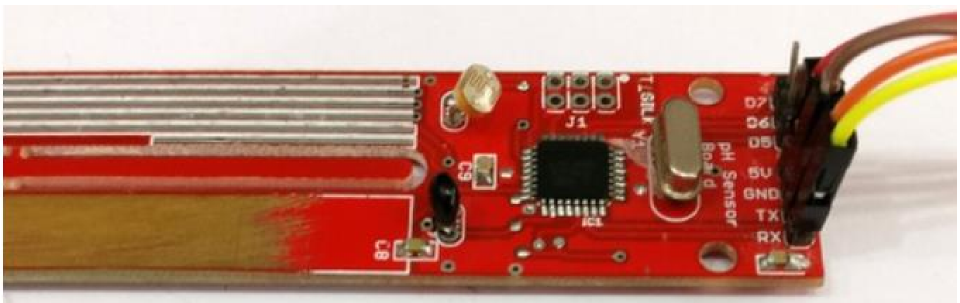


Fig.No.3.8 PH-Sensor board

3.6.2 Working

A pH sensor helps to **measure the acidity or alkalinity of the water with a value between 0-14**. When the pH value dips below seven, the water starts to become more acidic. Any number above seven equates to more alkaline. Each type of pH sensor works differently to measure the quality of the water. The pH of water can help determine the quality of water. Measuring the pH can also provide indications of pipe corrosion, solids accumulation, and other harmful byproducts of an industrial process.

In an environmental setting, the changing pH could also be an early indicator *increasing pollution*. If the pH level reaches above 8.5, the water would be considered hard, which would likely cause scale development in boilers and pipes. As aforementioned, there are **four main types of pH sensors** that you can select from, which include combination sensors, differential sensors, laboratory sensors, and process sensors, each of which is suitable to different applications. If you require continuous monitoring of pH levels in a tank or pipe, it's essential that you choose an industrial sensor as opposed to a lightweight lab sensor.

3.7 Blynk Application

Blynk is a Platform with IOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets. After downloading the Blynk app, you can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen.

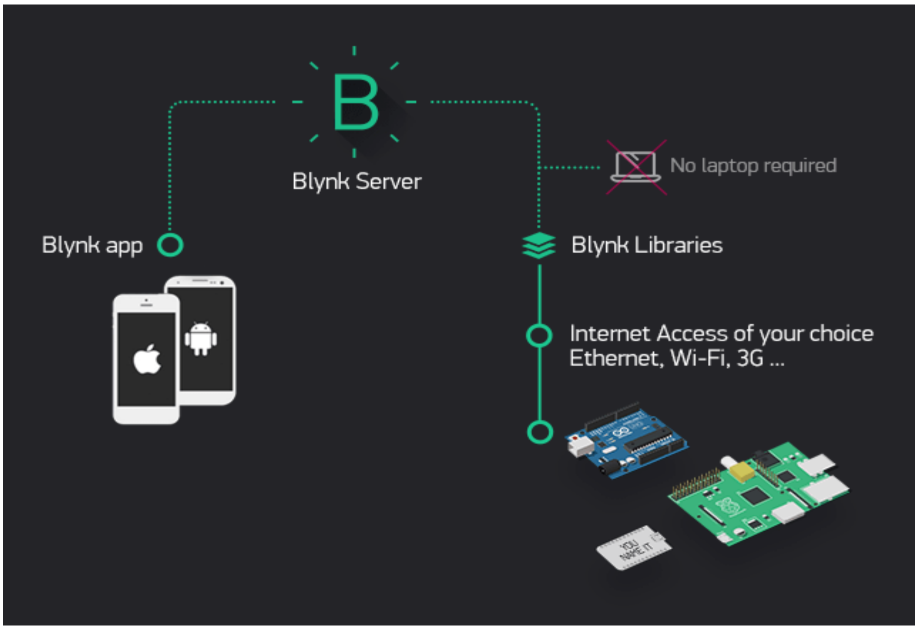


Fig.No. 3.9: Working of Blynk platform

After you download the Blynk App, you'll need to create a New Blynk account. This account is separate from the accounts used for the Blynk Forums; in case you already have one. We recommend using a real email address because it will simplify things later. After you've successfully logged into your account, start by creating a new project. Select the hardware model to use. Check out the list of supported hardware.

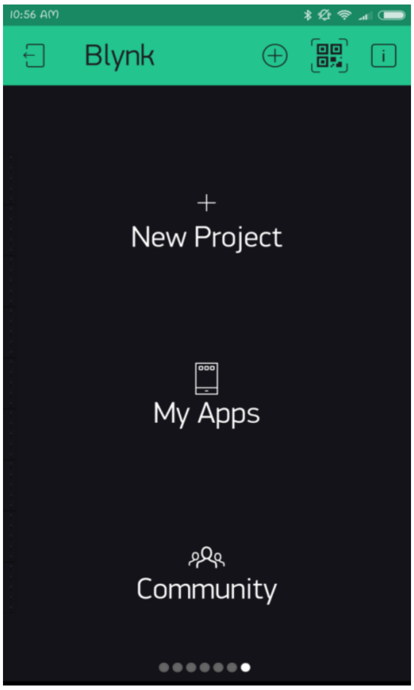


Fig.No. 3.10: Blynk App Home Screen

Auth Token is a unique identifier which is needed to connect your hardware to your smartphone. Every new project you create will have its own Auth Tokenas shown in figure below. You'll get Auth Token automatically on your email after project creation. Your project canvas is empty, let's add two labelled value in order to display the latitude, longitudinal values Now to get a nofication we should add a notification all these options can be get from the widget box. Latitude ,longitudinal values are connected to the virtual pin V1,V2.

Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.

Blynk Server - responsible for all the communications between the smart phone and hardware. You can use the Blynk Cloud or run your private Blynk server locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.

Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and outcoming commands.

Now imagine: every time you press a Button in the Blynk app, the message travels to the Blynk Cloud, where it magically finds its way to your hardware. It works the same in the opposite direction and everything happens in a blynk of an eye.

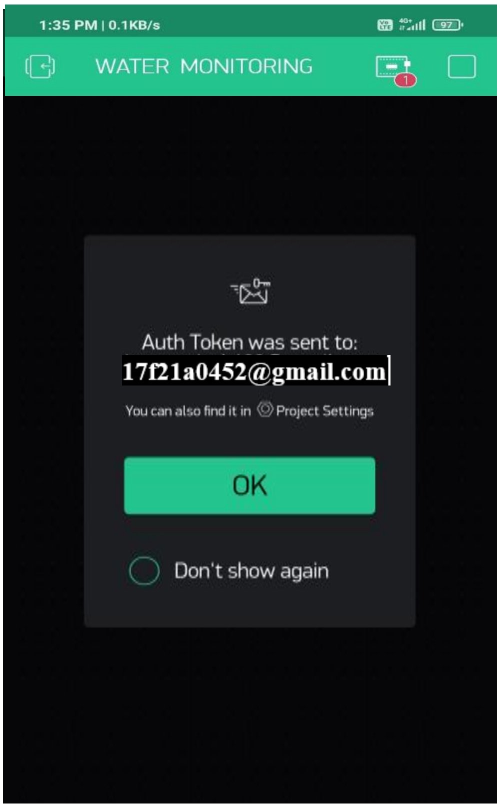


Fig.No.3.11: Auth Token

3.8 Installing ESP32 in Arduino IDE

Important: before starting this installation procedure, make sure you have the latest version of the Arduino IDE installed in your computer. If you don't, uninstall it and install it again. Otherwise, it may not work.

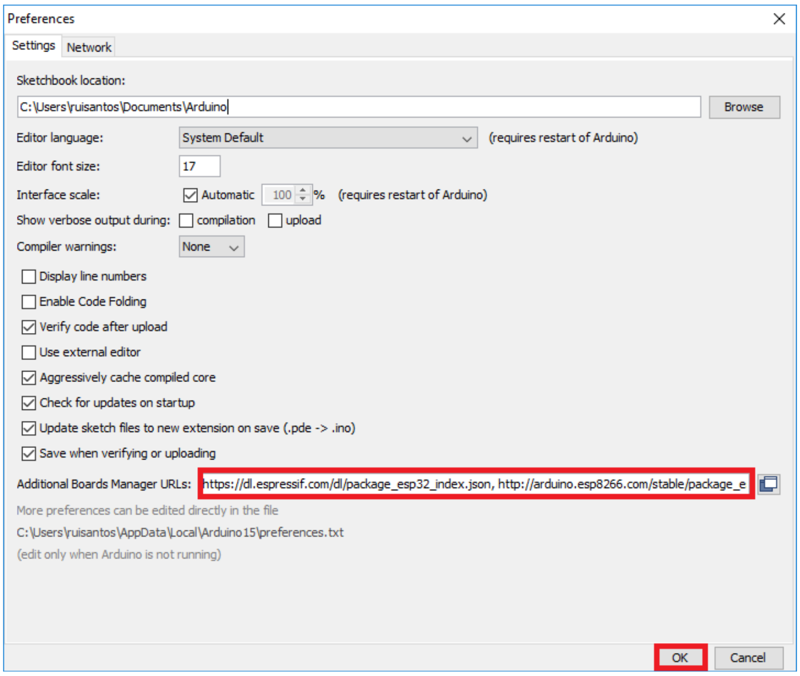
The ESP32 is currently being integrated with the Arduino IDE just like it was done for the ESP8266. This add-on for the Arduino IDE allows you to program the ESP32 using the Arduino IDE and its programming language. You can find the latest Windows instructions at the official GitHub repository

3.8.1. Installing the ESP32 Board

To install the ESP32 board in your Arduino IDE, follow these next instructions:

1) Open the preferences window from the Arduino IDE. Go to **File** □ **Preferences**

2) Enter **https://dl.espressif.com/dl/package_esp32_index.json** into the "**Additional Board Manager URLs**" field as shown in the figure below. Then, click the "**OK**" button.

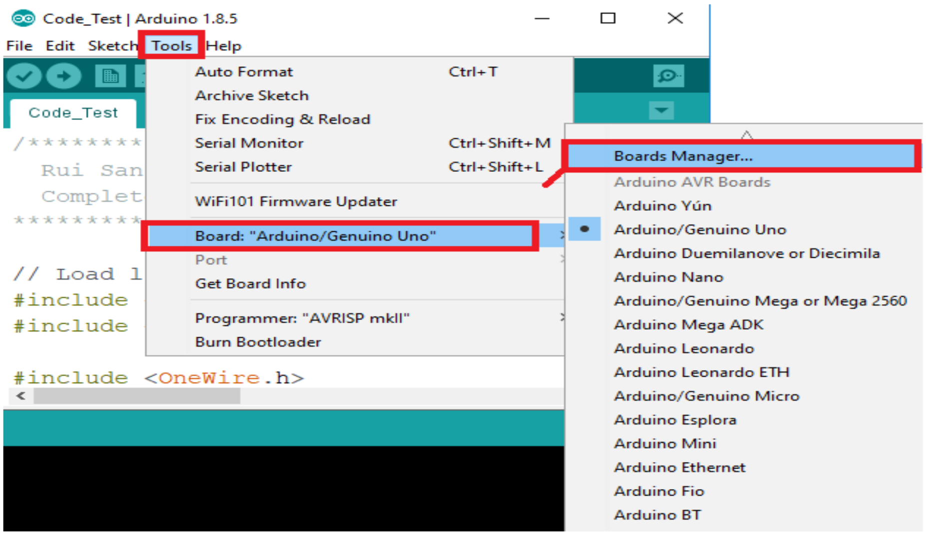


Note: if you already have the ESP8266 boards URL, you can separate the URLs with a comma as follows:

https://dl.espressif.com/dl/package_esp32_index.json,

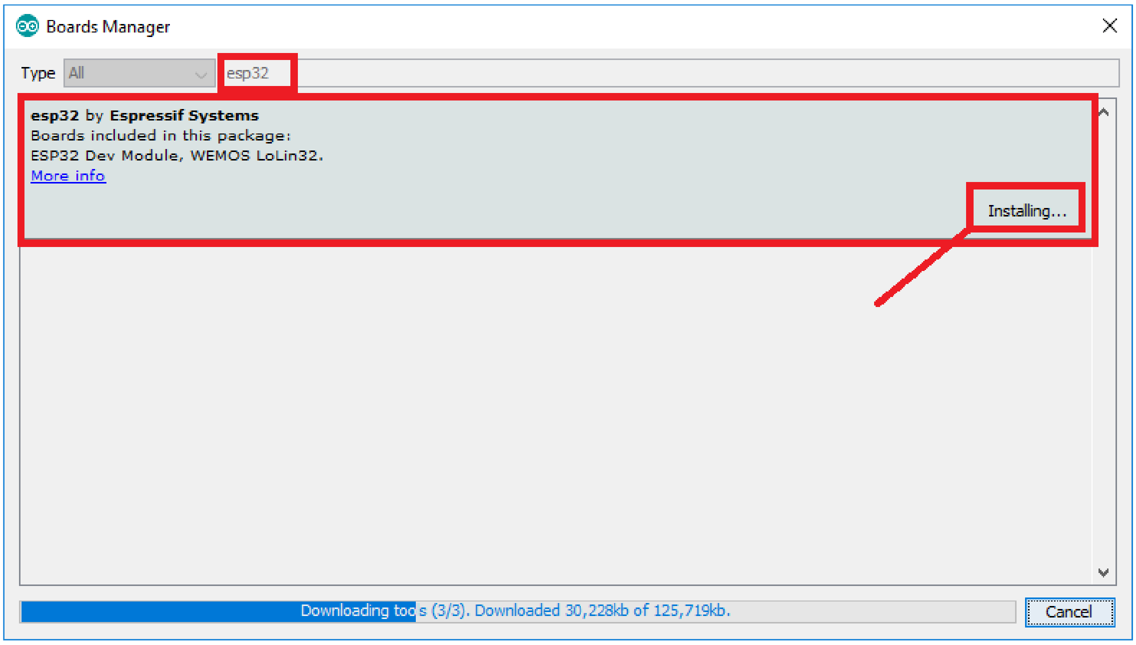
http://arduino.esp8266.com/stable/package_esp8266com_index.json

3) Open boards manager. Go to **Tools** □ **Board** □**Boards Manager…**



4. Search for ESP32 and press install button for the **"ESP32 by Espressif Systems ":**

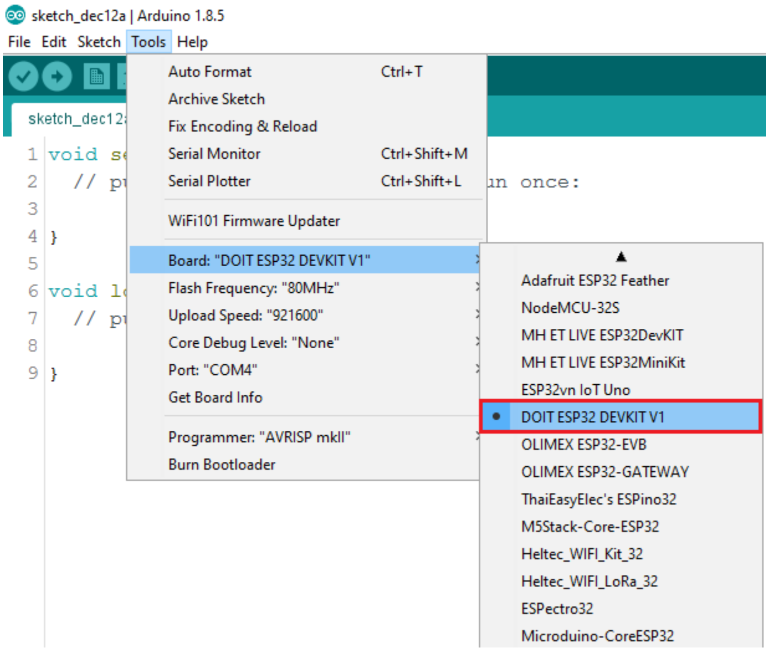
3.8.2 Testing the Installation



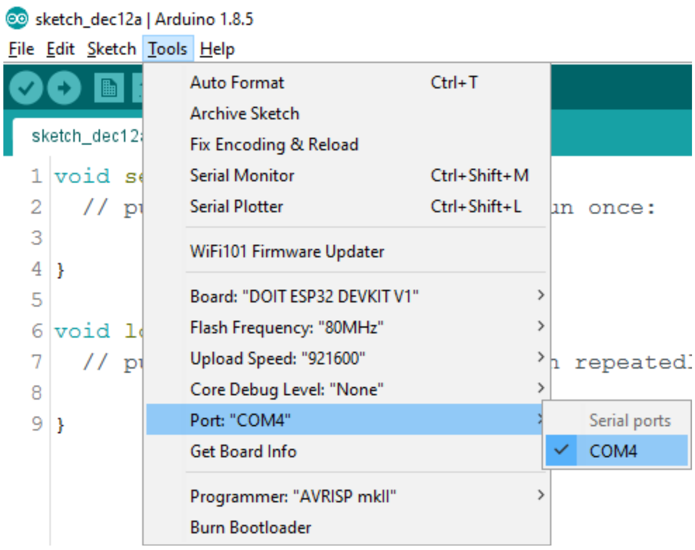
Plug your ESP32 DOIT DEVKIT V1 Board to your computer. Then, follow these steps:

1) Open Arduino IDE

2) Select your **Board** in **Tools** **Board** menu (in our case it's the **DOIT ESP32 DEVKIT V1**)



3) Select the Port (if you don't see the COM Port in your Arduino IDE, you need to install the ESP32 CP210x USB to UART Bridge VCP Drivers):



3.9 SUMMARY

In this chapter we have discussed, description, software installation and working of each component involved in our project. Few of those were ESP-32 WIFI module, Solenoid valve, Flow Sensor, Relay, and their Specifications.

CHAPTER 4: EXPERIMENTAL RESULTS

4.1 Introduction

In this Chapter, we have discussed about the connection scheme, working of the project and the code used for monitoring the water flow and controlling the water supply, and sending the data to the cloud. The Working Principle of the prototype is based upon a program which is dumped from Arduino IDE to ESP-32 WIFI MOODULE (ESP32) development board interfaced with Wi-Fi module which will execute the program based upon the instructions given in the code and display the results in the mobile application.

4.2 Operation

Both the hardware and the software parts of the design are interfaced to achieve the overall objective is to measure all the parameters like water quality, water level and water consumption etc, in real time and can be remotely reviewed over smart phones. The main objective is to limit the water wastage and to measure the quantity of water distributed (to every household) by using flow rate sensors. While the hardware part contains devices that make the measurement of water flow rate is possible and achievable, the software drives the operations and enables the functioning of the interconnected devices. The primary objective of the project is to assure the real time and can be remotely reviewed over smart phones. while at the same time managing the costs associated with the installation of the system. This project has therefore relied on **cost-effective** devices to ensure the overall cost-effectiveness of the project

A careful positioning of the **Flow sensor** enhances its operations. For example, inflow and outflow of the water is fixed and the Solenoid valve is connected before the flow sensor as it works based on flow rate. and **PH** sensor board is dipped inside the water tank so that it continuously monitors the **water quality**.

As soon as the water limit is exhausted will send a signal to the development board which immediately sends a notification to the owner and then it starts to send the mobile notification and sends an email to owners' email. **ESP32** controls the programs necessary for monitoring, controlling and sending emails. At the same time, we can have a live-stream through the **BLYNK** application

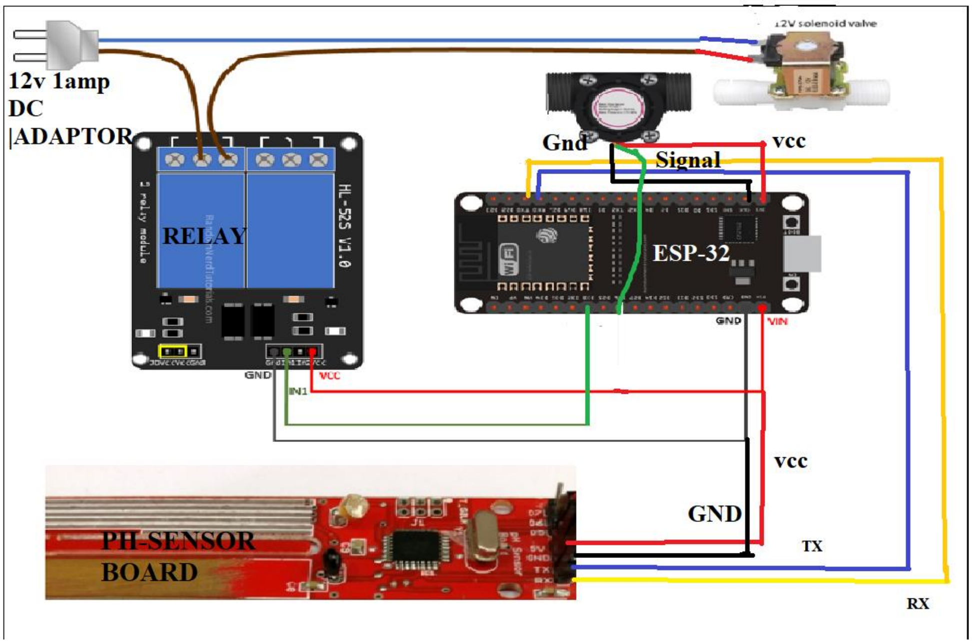


Fig. No. 4.1 Schematic Diagram

4.3 Program Code:

```
#define BLYNK_PRINT Serial       // DEFINE TO PRINT IN BLYNK

#include <WiFi.h> //HEADER FILE FOR WIFI CONNECTIVITY

#include <WiFiClient.h> // HEADER FILE FOR WIFI SUPPORT

#include <BlynkSimpleEsp32.h> // HEADER FILE TO CONNECT Blynk TO ESP BOARD

char auth[] = "ZnQdISFa9NxDt3T4zkFmybzbibjJe0IF";// authentication id given by BLYNK

char ssid[] = "Mi 10i likhith";//USER NAME OF WIFI TO BE CONNECTED FOR THE
ESP - 32 BOARD

char pass[] = "likhith28"; // PASSWORD FOR THE WIFI

volatile int flow_frequency; // Measures flow sensor pulses

// Calculated litres/hour

 float vol = 0.0,l_minute;
```

```
unsigned char flowsensor = 27;// Sensor Input
const int relayPin = 25;// relay output
unsigned long currentTime;
unsigned long cloopTime;
void flow () // Interrupt function
{
  flow_frequency++;
}
void setup()
{
  WiFi.begin(ssid, pass);
  Serial.begin(115200);
  pinMode(flowsensor, INPUT);
  pinMode(relayPin, OUTPUT);
  digitalWrite(flowsensor, HIGH); // Optional Internal Pull-Up
  digitalWrite(relayPin, HIGH);

  attachInterrupt(digitalPinToInterrupt(flowsensor), flow, RISING); // Setup Interrupt
  sei();//enable interrupts
  currentTime = millis();
  cloopTime = currentTime;
  Blynk.begin(auth, ssid, pass);
}
void loop ()
```

```
{

  currentTime = millis();
  // Every second, calculate and print litres/hour
  if(currentTime >= (cloopTime + 1000))
  {
   cloopTime = currentTime; // Updates cloopTime
   if(flow_frequency != 0)
   {
    // Pulse frequency (Hz) = 7.5Q, Q is flow rate in L/min.
    l_minute = (flow_frequency / 7.5); // (Pulse frequency x 60 min) / 7.5Q = flowrate in
L/hour

    Serial.print("Rate: ");
    Serial.print(l_minute);
    Serial.print(" L/M");
    Blynk.virtualWrite(V4,Rate);
    l_minute = l_minute/60;

    vol = vol +l_minute;
    Serial.print("Vol:");
    Serial.print(vol);
    Serial.print(" L");
    flow_frequency = 0; // Reset Counter
    Serial.print(l_minute, DEC); // Print litres/hour
```

```
    Serial.println(" L/Sec");


    Blynk.virtualWrite(V6,vol);
    if (vol >= 3 )
    {
    digitalWrite(relayPin, LOW);
    Serial.print("RELAY OFF");
    Blynk.notify("DEAR CUSTOMER TODAYS WATER LIMIT IS  EXHAUSTED");
    Blynk.email("17f21a0452@gmail.com","WATER","DEAR CUSTOMER TODAYS
WATER LIMIT IS  EXHAUSTED");


    }
    else
    {
    digitalWrite(relayPin, HIGH);
    Serial.print("RELAY ON");
    }
   }
  }


 for(int i=1; i<=10; i++) {
     String phdata = Serial.readStringUntil(':');
     Serial.println(phdata);
     if(phdata != "")
     {
```

```
            String ph = Serial.readStringUntil('$');


            Serial.println(ph);
            float phvalue=ph.toFloat();
             Serial.println();
            Serial.println("PH Value");
            Serial.println(phvalue);
            Blynk.virtualWrite(V4,phvalue);
            if(phvalue <= 7){
              Serial.println("ACIDIC");
            }
            if(phvalue >= 7 && phvalue <=8 ){
              Serial.println("****PURE WATER*****");
            }
            if(phvalue >=8 ){
              Serial.println("****BASE*****");
            }
        }
    }
    Blynk.run();
 //delay(1000);
}
```

4.4 UPLOADING THE CODE TO ESP BOARD

STEP 1 Connect the ESP-32 board using an USB cable.

STEP 2 Open new file.

STEP 3 write the code.

STEP 4 After that save the code.

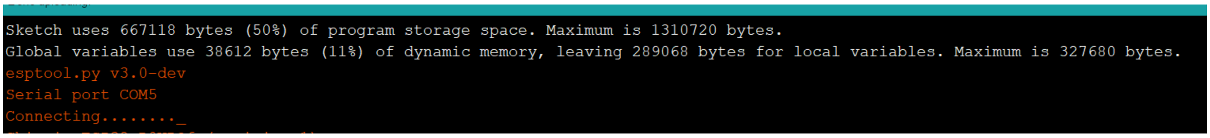
STEP 5 Compile the code using this  button.

STEP 6 You can see that done compiling means that there is no errors in the code.

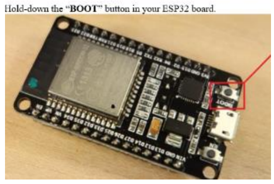
STEP 7 If you found any correct it.

STEP 8 Now upload the code to the board by clicking this  button Press the Upload button in the Arduino IDE. Wait a few seconds while the code compiles.

STEP 9 You can observe in below “Connecting…” as shown below fig



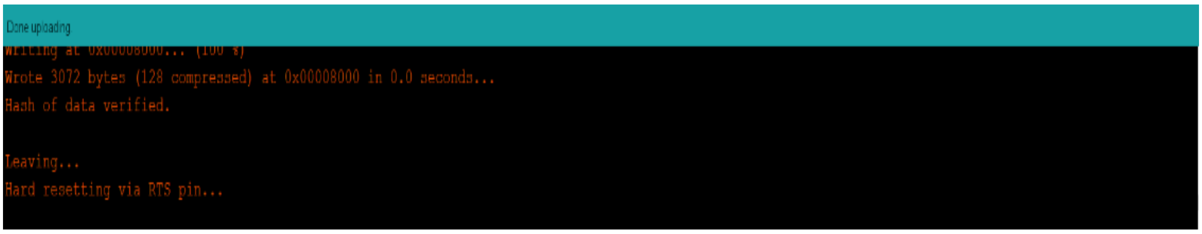
Hold-down the "BOOT" button in your ESP32 board.



STEP 10 Press the boot button for 3- 4 seconds and leave.

STEP 11 You can observe that code is uploading.

STEP 12 After uploading you can see that it shows “done uploading”.



STEP 13 Now connect the pins as per mentioned in the code i.e.,

4.5 Results and Discussion

The above program has all the conditions and instruction to be done by the NodeMCU ESP32 development board, basically all functions written in the program is executed automatically and gives the results depending upon the provided conditions.

The system designed in this case alerts the homeowner about Water usage limit via an email alert to the customers email address earlier on specified and a mobile notification.

Flowchart

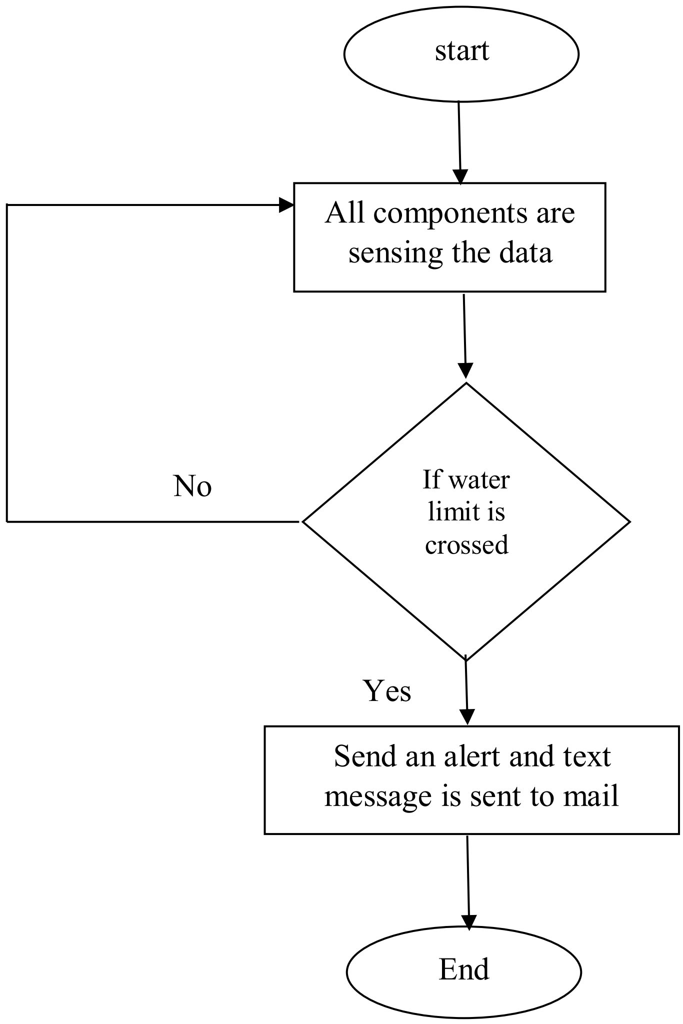


Fig. No. 4.2: Flow Chart

In this proposed conceptual system, ESP32 processes the incoming data from various modules and sensors. This board is selected because it reduces the requirement of various components like constant DC voltage regulator, burner hardware and does not requires a separate software to convert the code into hex file and burn it in the microprocessor. All work is done by Arduino IDE and is burnt in NODEMCU development board via a USB cable. It can be coded as required using Arduino IDE in C/C++ language and uploaded directly to the board. This board has a plethora of applications in the field of embedded electronics. This is where it is decided whether the values obtained by various sensors are within limit depending upon the logic code given to the development board.

In order to interface the device (development board) with our smart phone we need to provide authentication code which is unique for every new project. Also, we need to configure our development board with valid user id and password to connect to the internet.

Blynk.run(); are the function used to send data to servers and user and to run android app in mobile. All these data are secured through the blynk security systems.

4.6 SETTING UP BLYNK APP IN SMART PHONE

Blynk application can be found in the following formats

1. Android Blynk App

2. IOS Blynk App

After downloading the app from Google Play store (Android users), App store (Apple users) create an account and log in. (If possible than log in with your real mail id for better connectivity later.)

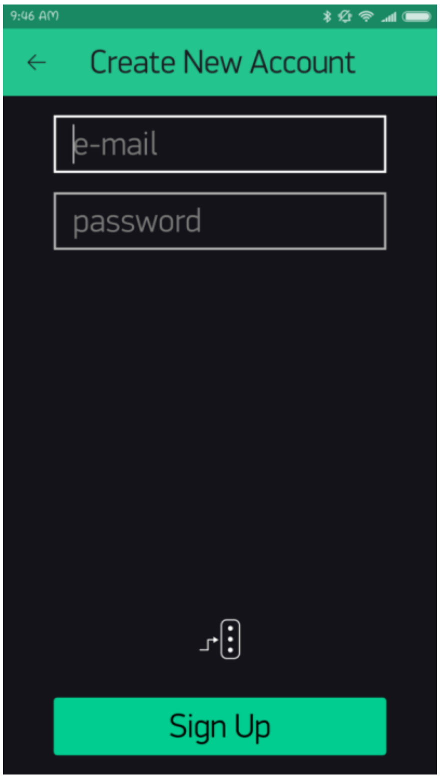


Fig. No.4.3: Blynk App account registration

Click the "Create New Project" in the app to create a new Blynk app. Give it any name. Blynk works with hundreds of hardware models and connection types. Select the Hardware type. After this, select connection type. In this project we have select Wi-Fi connectivity.

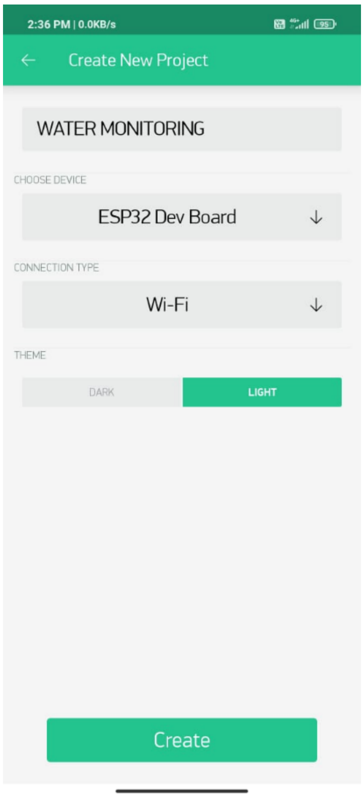


Fig. No.4.4: Blynk App Board Selection

Then you'll be presented with a blank new project. To open the widget box, click in the project window to open. We are selecting a notification widget from ESP32 Dev Board. Along with notification widget we are selecting Gauge widget to monitor the Water flow, LCD widget to monitor the PH-Value, and E-mail widget to send an Email

Follow the steps sown below

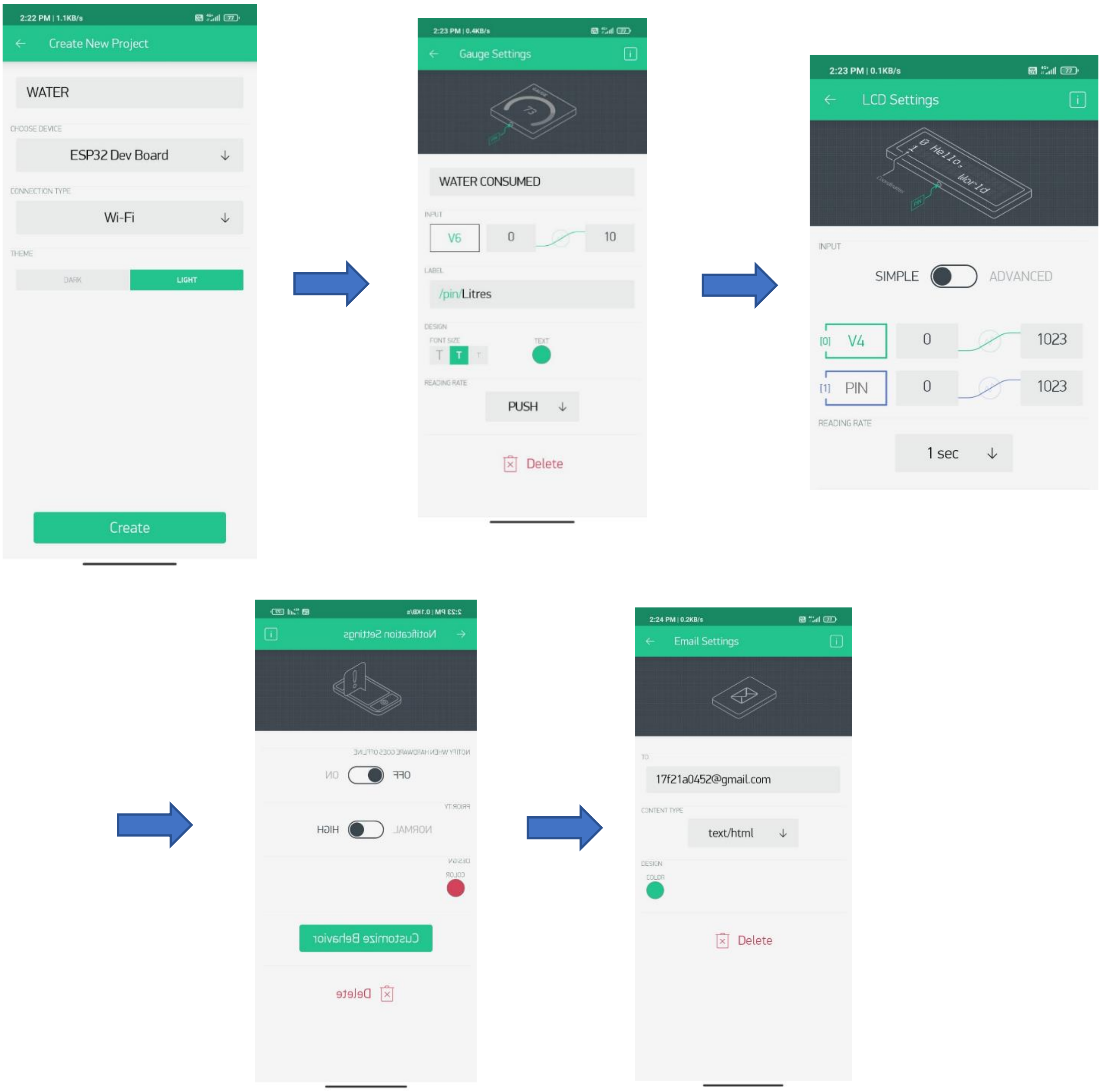


Fig. No.4.5: Setting up of Blynk App

4.7 Results Obtained

- Once set up is done you can check the output in mobile and we can get the mail and as well as notification.
- Output of live streaming is shown below.

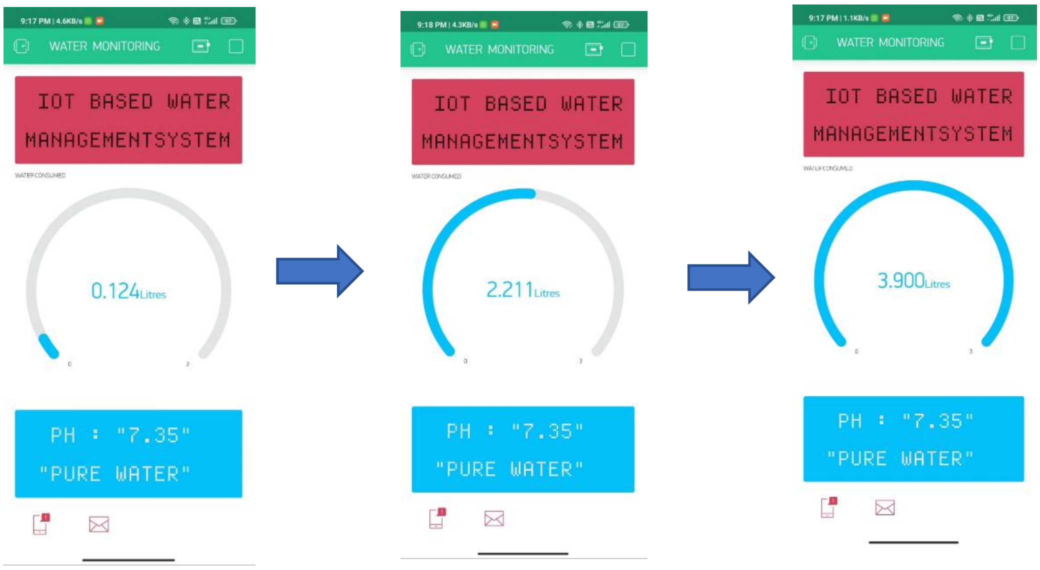
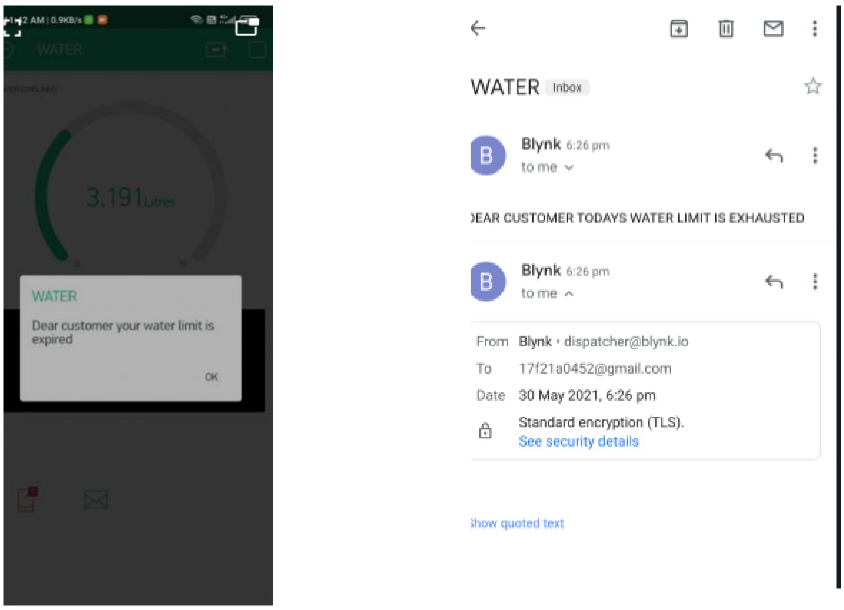


Fig. No.4.6: Live Streaming in Blynk App



NOTIFICATION **EMAIL NOTIFICATION**

Fig. No.4.7: Notification and Email alert

4.8 comparison between existing and proposed system

S. No	Parameters	IOT based Water management system using Arduino board (Existing system)	Low cost and latency IOT based Water based management system using ESP32(Proposed system)
1	Number of components required	Five (Arduino, Flow sensor, Solenoid valve, Wi-Fi Module and PH sensor)	Four (ESP32, Flow sensor, Solenoid valve, and PH sensor.
2.	Processor speed	1.6MHz	2.4 GHz
3.	Latency	More	Less
4	Cost of the system	More	Reduced to half of the existing system cost.
5	Source code length		Less than that of the existing system source code length.
6.	Power consumption	5 volts to 3.3 volts	3.3 v

Table.No.4.1: comparison between existing and proposed system

4.9 Summary

In this chapter we have discussed about connection schema, setting up the project and its widgets in Blynk Application, experimental procedure, its results and comparison between existing and proposed system.

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CHAPTER 5: CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

The proposed implementation uses IoT enabled devices and provides end user with cost effective, portable and no need of an individual to monitor persistently from control room. Suggested implementation successfully works within the vicinity of soft access point and can be easily implemented at the cost of meagre amount. Since ESP32 along with WIFI module is the main part of this design, automation is cheaper. Using this design customer could monitor and be alerted any time even if he/she is in any part of the world and can make suitable actions as we are using Internet of Things Technology. To cope up with rapidly changing technology, IoT is the best solution for monitoring and controlling.

5.2 Future Scope

The presented work can be extended by implementing request access for the customers, if people need excess amount of water. Further the water consumed by the customer is measured by using flow rate sensors and the amount should be paid by customers as per their usage of water measured by flow sensors.

In addition, instead of integrated Wi-Fi, configured as an access point, Long Range (LORA) wireless data communication technology can be implemented to overcome the limited vicinity issue.

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