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DR. D. Y. PATIL INSTITUTE OF TECHNOLOGY

(Formerly Dr. D. Y. Patil Institute of Engineering and Technology)
Sant Tukaram Nagar, Pimpri, Pune.

IOT Miniproject

(2019 Course)

Second Year Engineering

Department Of

Artificial Intelligence & Data Science

Year: 2021 - 2022

Batch- A1

Guided By

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CERTIFICATE

This is to certify that Mr./ Ms. _____

Division _____Branch_____ has successfully completed the work Of **IOT Miniproject** and has submitted the work book associated under my supervision, in the partial fulfillment of Second Year Bachelor of Engineering (Choice Based Credit System) (2019 course) of Savitribai Phule Pune University.

Date:

Place:

Guide	Head	Principal
(Name & Sign)	(Name & Sign)	(Name & Sign)

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Water Level Monitoring System

Presented By-

Batch - A1

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Abstract

Due to exploitation of water resources and speeding of climate change due to human activities, water becoming a luxury these days and keeping tab on water consumption is a necessity now.

We know that water conservation starts from a family and a person in a family can easily track their water consumption either by observing day to day activities or checking water level of their overhead tank every day.

But for a municipal government who is concerned about the areas they governing cannot track each and every family's water consumption by physically sending a person every day. Instead, they can check level of municipal supply tanks where the level of water is direct reflection of water consumed by the people in the area. Again, we have to deploy several people to take readings of tens of municipal overhead tanks several times a day.

It is a human nature to get inert sometimes or many times and one could manipulate the readings and could push the idea of water consumption of an area in wrong direction and this could also delay the water supply because the actual water level could vary significantly from the manipulated readings which could lead to unexpected shutdown of water supply.

By installing IoT based water level monitoring systems in all the important municipal water tanks the local government can know the level of water in real time and they can fill the tank on time and also can understand the consumption of water in the area. The collected data can be sent to higher level governments where they can draw national level conclusions on water consumption.

IoT based water level monitoring system can also be installed on individual houses / apartments so that one can check water level of their tank in real time from their own comfort and also track their consumption overtime.

Introduction

General we see a lot of water overflowing from the water tanks, this results in a large scale of water wastage in our household.so to avoid this condition

We can use Internet of Things to solve this problem. Technology nowadays has become an integrated part of people's lives. It has, and continues to influence many aspects of daily life and has allowed better social interaction, ease of transportation, the ability to indulge in entertainment and media and has helped in the development in medicine. The creation of many devices such as mobile phones and computers have caused many people to rely on technology to communicate with their friends, store information such as pictures, movies, documents, and music.

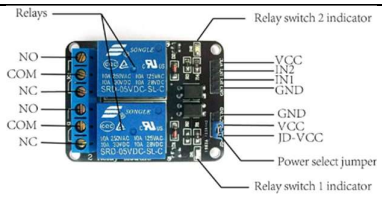
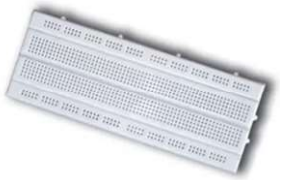
The internet has become a common interface that many devices use in order to simplify the daily life of many people giving the ability to search for information, store their own information in the cloud while also giving them better ways of managing information.
From the time of its introduction, the number of people that use mobile phones and the internet to communicate with other people has increased dramatically to become one of the major means of communication.

It is very difficult at times to keep a real-time track of every water drop consumed or wasted. Moreover, the orientation of the tank hinders the facility of monitoring the water levels. Therefore, using an IoT-based solution assists in keeping an accurate record of the water levels. It consists of sensor devices, which automatically detect the level of water inside any tank. The solution provides actionable insights for the managers to make wise & necessary decisions in situations of leakages or overspilling of tanks. It is due to the customizable feature of the solution that sets a threshold value beyond which an alert system gets triggered and notifies the concerned authority.

OBJECTIVES

The main aim of this system is to monitor the water level at rural areas so that they help in detecting the wastage of water and measures can be taken to avoid unnecessary overflowing of water in the areas where monitoring is a difficult task.

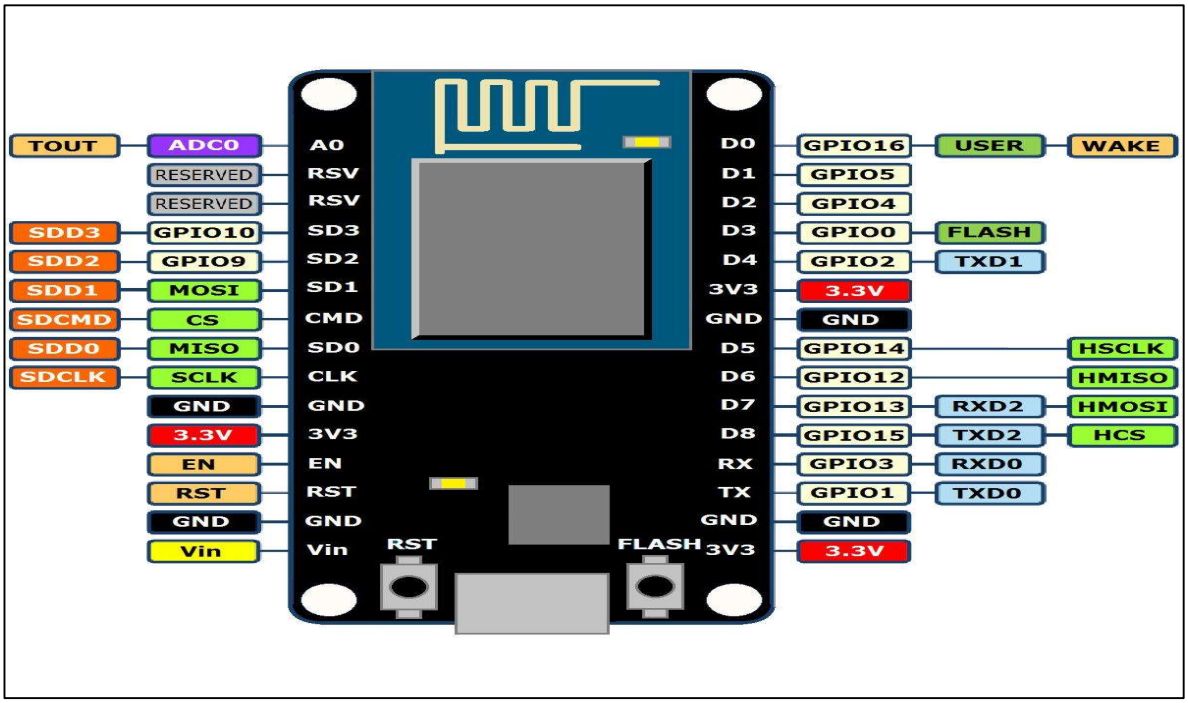
Components

Sr. No	Components	Name	Cost
1.		NODEMCU ESP8266	RS.400
2.		ULTRASONIC SENSOR HC-SR04	RS.75
3.		LCD DISPLAY 16X2 WITH I2C MODULE	RS.235
4.		Channel Relay	RS.50
5.		Jumper Wires	RS.58
6.		Breadboard	RS.65
7.		Water Pump	RS.150

NodeMCU(ESP8266 Wi-Fi module)

The NodeMCU (*N*ode *M*icro*C*ontroller *U*nit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. You must 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. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 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.



The VIN pin can be used to directly supply the ESP8266 and its peripherals, if you have a regulated 5V voltage source.
The 3.3V pins are the output of an on-board voltage regulator. These pins can be used to supply power to external components.

GND is a ground pin of ESP8266 NodeMCU development board.

I2C Pins are used to hook up all sorts of I2C sensors and peripherals in your project. Both I2C Master and I2C Slave are supported. I2C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum. It should be noted that I2C clock frequency should be higher than the slowest clock frequency of the slave device.

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

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

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

SPI Pins ESP8266 features two SPIs (SPI and HSPI) in slave and master modes.

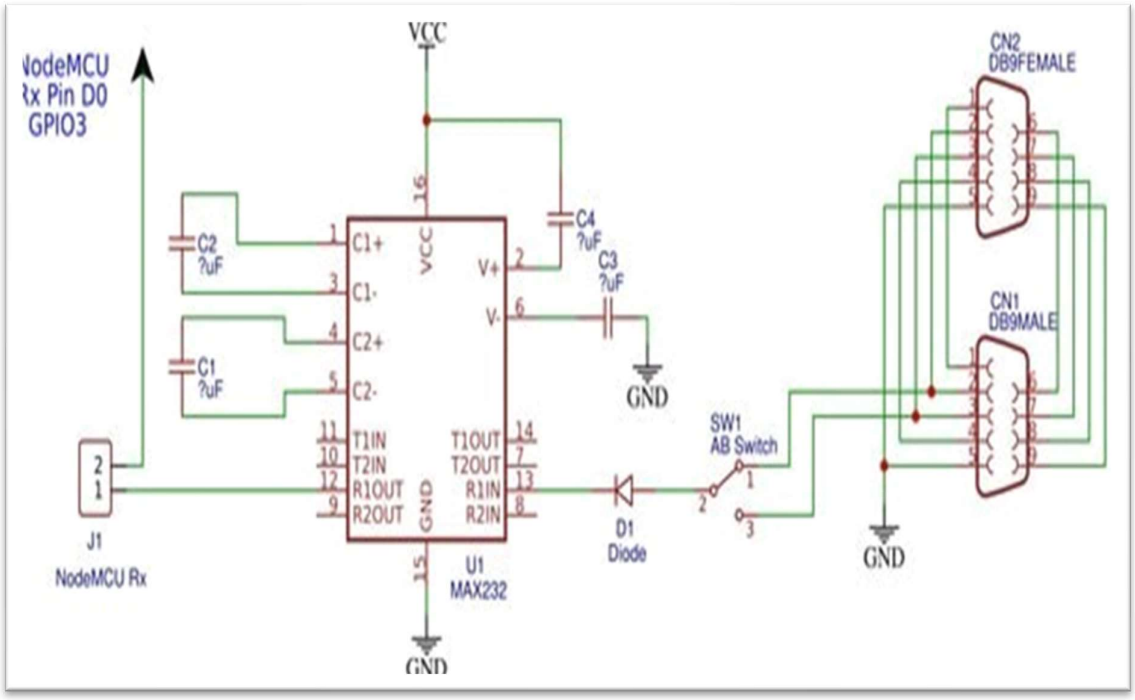
SDIO Pins ESP8266 features Secure Digital Input/Output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported

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

Control Pins are used to control ESP8266. These pins include Chip Enable pin (EN), Reset pin (RST) and WAKE pin.

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

NodeMCU Carrier Board Schematic



Ultrasonic sensor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity.

High- frequency sound waves reflect from boundaries to produce distinct echo patterns.

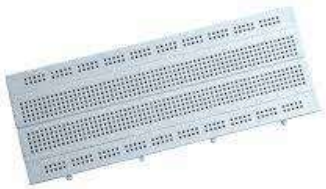
The working principle of this module is simple. It sends an ultrasonic pulse out at 40kHz which travels through the air and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated.

Ultrasonic sensors are a great solution for the detection of clear objects. For liquid level measurement, applications that use infrared sensors, for instance, struggle with this particular use case because of target translucence.

For presence detection, ultrasonic sensors detect objects regardless of the color, surface, or material (unless the material is very soft like wool, as it would absorb sound.)

To detect transparent and other items where optical technologies may fail, ultrasonic sensors are a reliable choice.

Breadboard



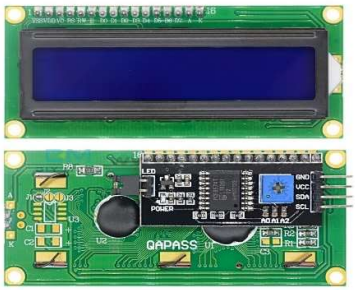
A breadboard is used to build and test circuits quickly before finalizing any circuit design. A typical breadboard is shown below: The bread board has strips of metal which run underneath the board and connect the holes on the top of the board. The metal strips are laid out as shown below. Note that the top and bottom rows of holes are connected horizontally while the remaining holes are connected vertically.

To use the bread board, the legs of components are placed in the holes. Each set of holes connected by a metal strip underneath forms a node. The long top and bottom row of holes are usually used for power supply connections. The rest of the circuit is built by placing components and connecting them together with jumper wires. ICs are placed in the middle of the board so that half of the legs are on one side of the middle line and half on the other.

Jumper wires

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

LCD DISPLAY 16X2 WITH I2C MODULE:



This display overcomes the drawback of LCD 1602 Parallel LCD Display in which you'll waste about 8 Pins on your Arduino for the display to get working. Luckily in this product, an I2C adapter is directly soldered right onto the pins of the display. So all you need to connect are the I2C pins, which shows a good library and little of coding.

The I2C is a type of serial bus developed by Philips, which uses two bidirectional lines, called SDA (Serial Data Line) and SCL (Serial Clock Line). Both must be connected via pulled-up resistors. The usage voltages are standard as 5V and 3.3V.
If you already have the I2C adapter soldered onto the board like in this product, the wiring is quite easy. You should usually have only four pins to hook up. VCC and GND of course. The LCD display works with 5 Volts. So we go for the 5V Pin.

The values shown on the display can be either a simple text or numerical values read by the sensors, such as temperature or pressure, or even the number of cycles that the Arduino is performing.

4 pins for the LCD display:

PIN DETAILS:-
1. VCC,
2. GND,
3. SDA,
4. SCL.

It will saves at least 4 digital / analog pins on Arduino. Usually, Arduino LCD display projects will run out of pin resources easily, especially with Arduino Uno. And it is also very complicated with the wire soldering and connection.

SPECIFICATION AND FUTURES: -

1. Compatible with Arduino/Genuino UNO, Mega, Micro, Nano, Mini
2. I2C Address: 0x20-0x27(0x20 default)
3. Back lit (Blue with white char color)
4. Supply voltage: 5V
5. Interface: I2C/TWI x1, Gadgeteer interface x2
6. Adjustable contrast
7. Size: 82 x 35 x 18 mm (3.2×1.4×0.7 in)
8. White text on the blue background
9. Interface Address: 0x27
10. Character Color: White
11. Backlight: Blue
12. Supply voltage: 5V

Single-Channel Relay Module Specifications

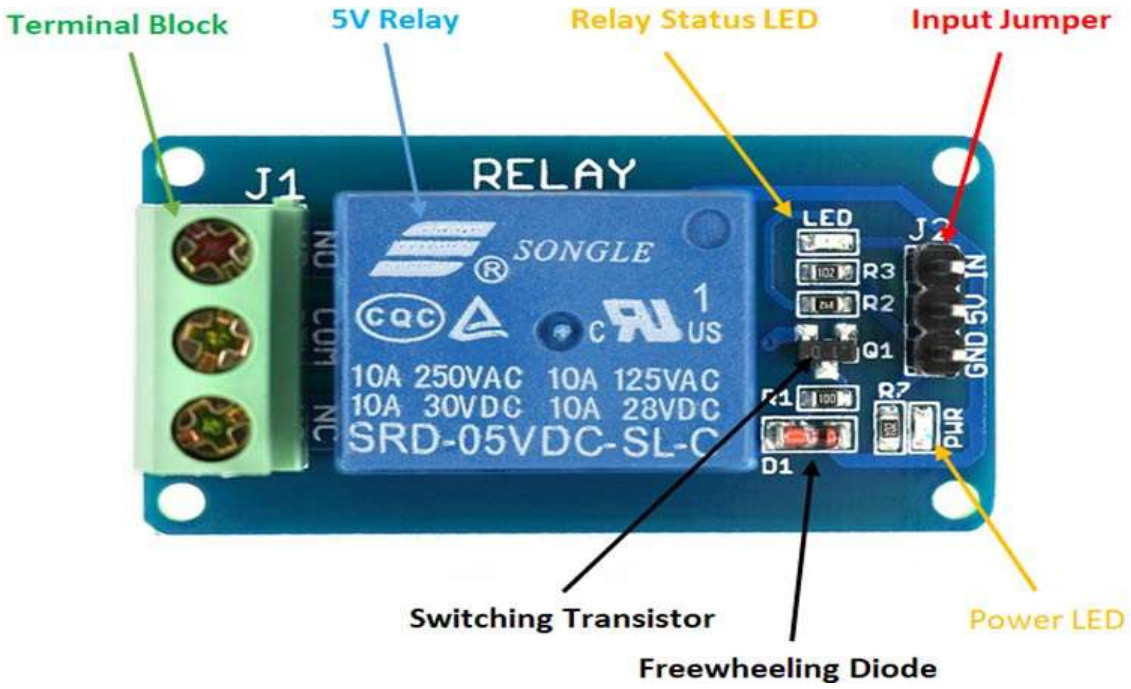
- Supply voltage – 3.75V to 6V
- Quiescent current: 2mA
- Current when the relay is active: ~70mA
- Relay maximum contact voltage – 250VAC or 30VDC
- Relay maximum current – 10A

components Present on a 5V Single Channel Relay Module

The following are the major components present on a relay module; we will get into the details later in this article.

5V Relay, Transistor, Diode, LEDs, Resistors, Male Header pins, 3-pin screw-type terminal connector, etc.

Understanding 5V Single-Channel Relay Module



The single-channel relay module is much more than just a plain relay, it contains components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active.

First is the screw terminal block. This is the part of the module that is in contact with mains so a reliable connection is needed. Adding screw terminals makes it easier to connect thick mains cables, which might be difficult to solder directly. The three connections on the terminal block are connected to the normally open, normally closed, and common terminals of the relay.

The second is the relay itself, which, in this case, is a blue plastic case. Lots of information can be gleaned from the markings on the relay itself. The part number of the relay on the bottom says “05VDC”, which means that the relay coil is activated at 5V minimum – any voltage lower than this will not be able to reliably close the contacts of the relay. There are also voltage and current markings, which represent the maximum voltage and current, the relay can switch. For example, the top left marking says “10A 250VAC”, which means the relay can switch a

maximum load of 10A when connected to a 250V mains circuit. The bottom left rating says “10A 30VDC”, meaning the relay can switch a maximum current of 10A DC before the contacts get damaged.

The 'relay status LED' turns on whenever the relay is active and provides an indication of current flowing through the relay coil.

The input jumper is used to supply power to the relay coil and LEDs. The jumper also has the input pin, which when pulled high activates the relay.

The switching transistor takes an input that cannot supply enough current to directly drive the relay coil and amplifies it using the supply voltage to drive the relay coil. This way, the input can be driven from a microcontroller or sensor output. The freewheeling diode prevents voltage spikes when the relay is switched off.

The power LED is connected to V_{CC} and turns on whenever the module is powered.

SOFTWARE USED:

1.Arduino Uno on the Arduino Desktop IDE

If you want to program your Arduino Uno while offline you need to install the Arduino Desktop IDE The Uno is programmed using the Arduino Software (IDE), our Integrated Development Environment common to all our boards. Before you can move on, you must have installed the Arduino Software (IDE) on your PC, as explained in the home page of our Getting Started. Connect your Uno board with an A B USB cable; sometimes this

cable is called a USB printer cable.

The USB connection with the PC is necessary to program the board and not just to power it up. The Uno automatically draw power from either the USB or an external power supply. Connect the board to your computer using the USB cable. The green power LED (labelled PWR) should go on.

2. BLYNK android application:

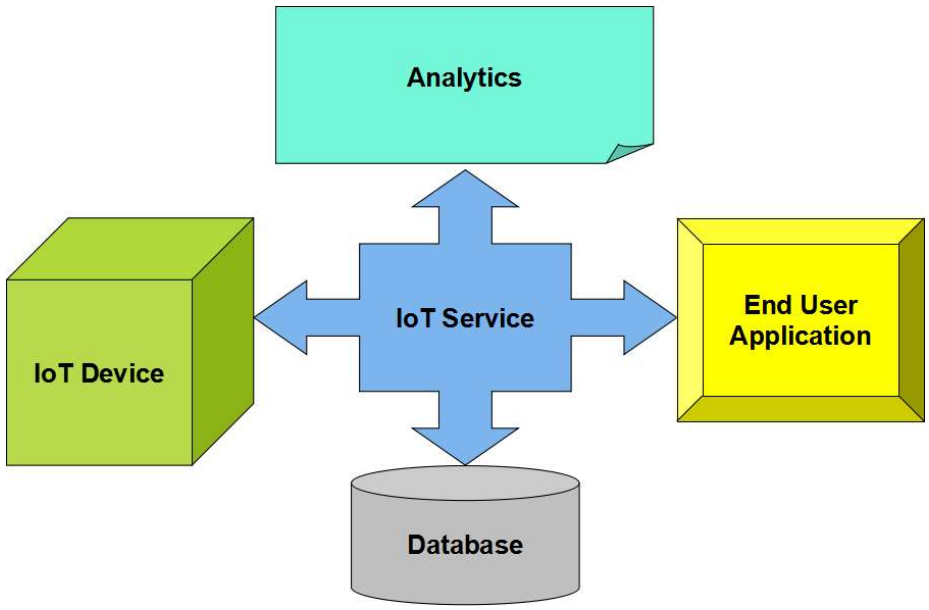
Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your Android device. Blink's affordable smart home security cameras and systems help you monitor your home directly from your smartphone. With multi-system support and simple setup, you can easily control multiple Blink cameras within one app. The Blink Home Monitor app will alert you to what matters, day or night, no matter where you are. Just Blink and you're home.

3. ThingSpeak:

The Internet of Things (IoT) is a system of 'connected things'. The things generally comprise of anembedded operating system and an ability to communicate with the internet or with the neighbouring things. One of the key elements of a generic IoT system that bridges the various 'things' is an IoT service.

An interesting implication from the 'things' comprising the IoT systems is that the things by themselves cannot do anything. At a bare minimum, they should have an ability to connect to other 'things'. But the real power of IoT is harnessed when the things connect to a 'service' either directly or via other 'things'.

In such systems, the service plays the role of an invisible manager by providing capabilities ranging from simple data collection and monitoring to complex data analytics. The below diagram illustrates where an IoT service fits in an IoT ecosystem:



What is ThingSpeak

ThingSpeak is a platform providing various services exclusively targeted for building IoT applications. It offers the capabilities of real-time data collection, visualizing the collected data in

the form of charts, ability to create plugins and apps for collaborating with web services, socialnetwork and other APIs. We will consider each of these features in detail below.

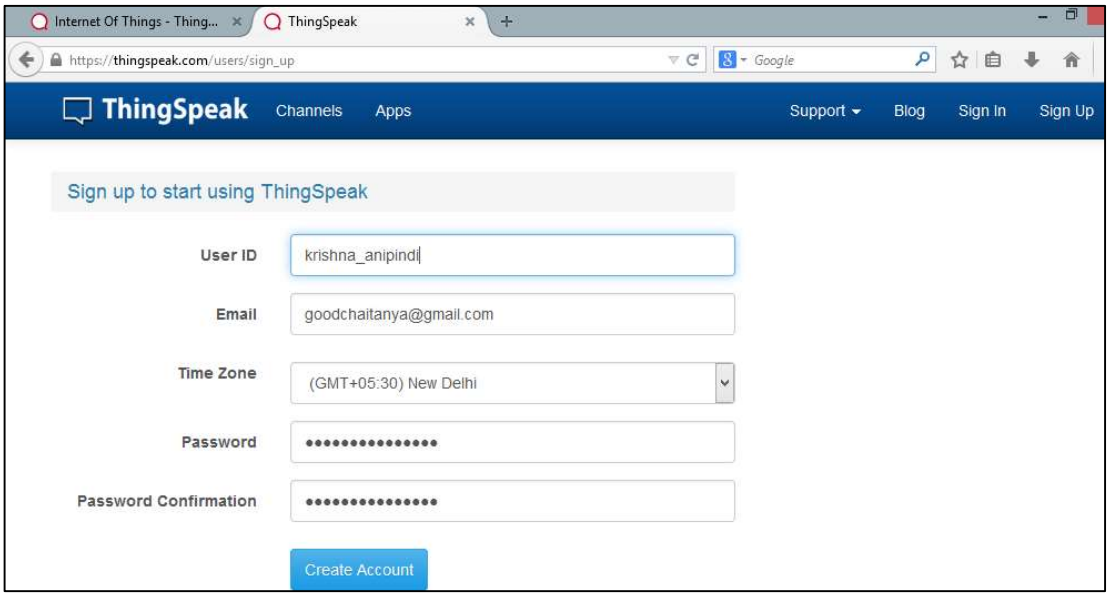
The core element of ThingSpeak is a 'ThingSpeak Channel'. A channel stores the data that wesend to ThingSpeak and comprises of the below elements:

- 8 fields for storing data of any type - These can be used to store the data from a sensor or froman embedded device.
- 3 location fields - Can be used to store the latitude, longitude and the elevation. These are veryuseful for tracking a moving device.
- 1 status field - A short message to describe the data stored in the channel.

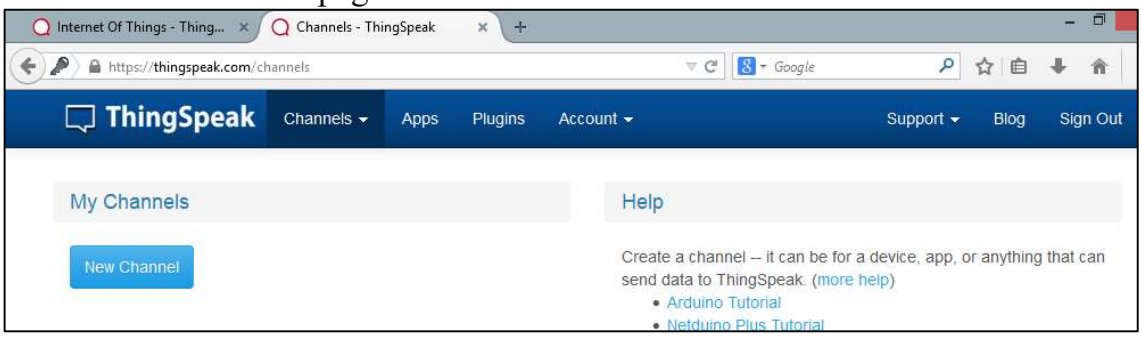
To use ThingSpeak, we need to signup and create a channel. Once we have a channel, we can send the data, allow ThingSpeak to process it and also retrieve the same. Let us start exploringThingSpeak by signing up and setting up a channel.

Getting Started

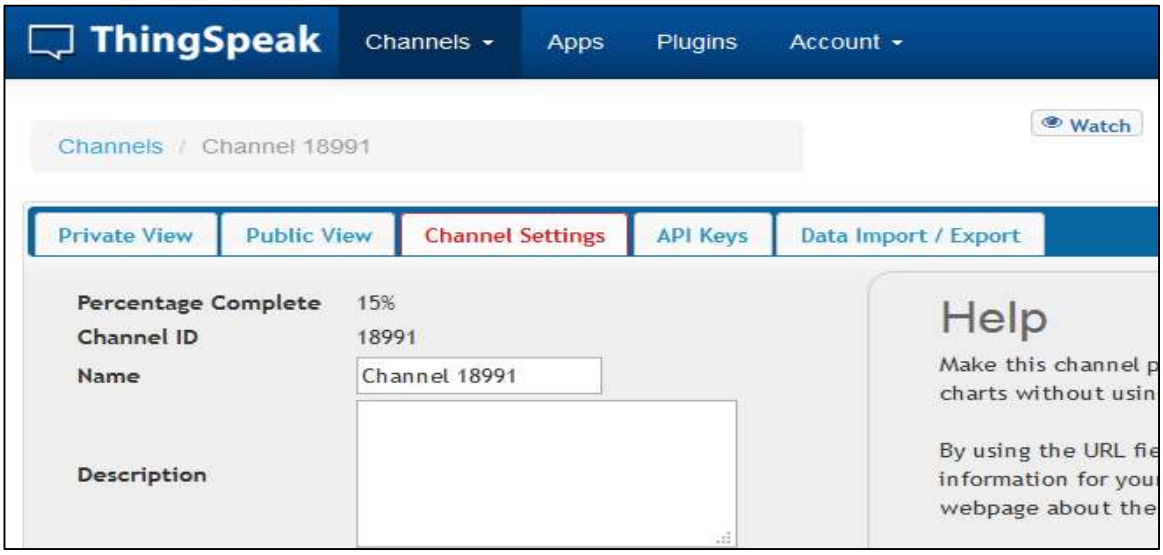
Open https://thingspeak.com/ and click on the ‘Get Started Now’ button on the center of the page and you will be redirected to the sign-up page(you will reach the same page when you clickthe ‘Sign Up’ button on the extreme right). Fill out the required details and click on the ‘Create Account’ button.



Now you should see a page with a confirmation that the account was successfully created. Theconfirmation message disappears after a few seconds and the final page should look as in the below screen:



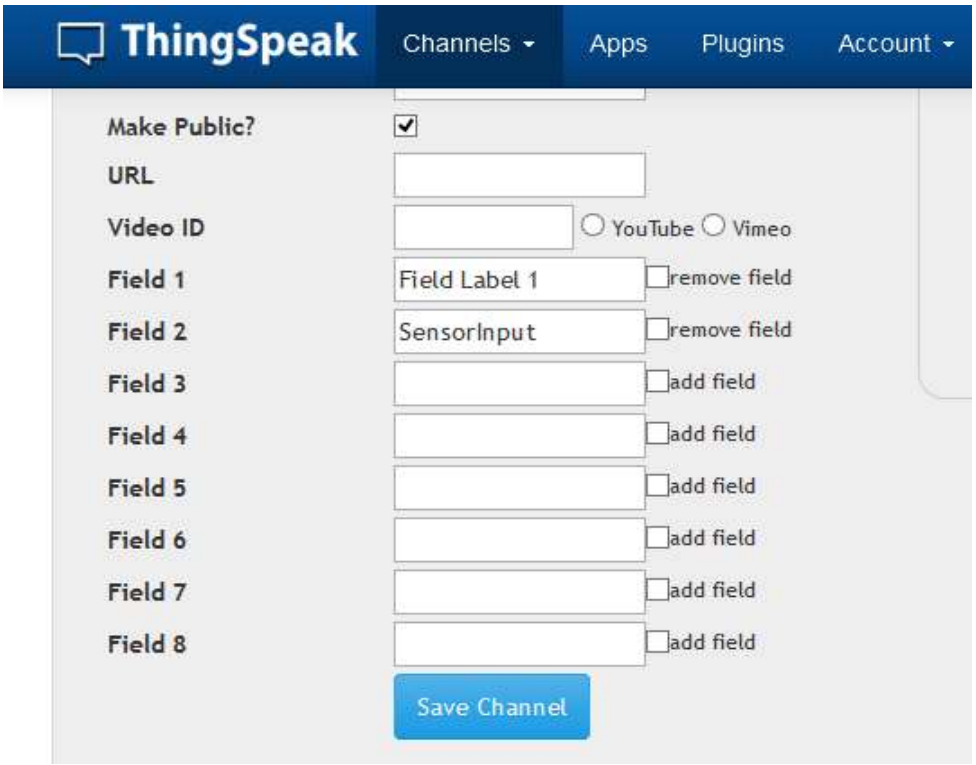
Go ahead and click on ‘New Channel’. You should see a page like the below:



You can change the name to fit your need and you can add a description corresponding to the channel. You can add any other useful description into the metadata field. In the same page, youshould see the fields for Latitude, Longitude and Elevation. Also, when you scroll down you should see a check box that says 'Make Public?'. Let us consider the significance of the various fields and the tabs:

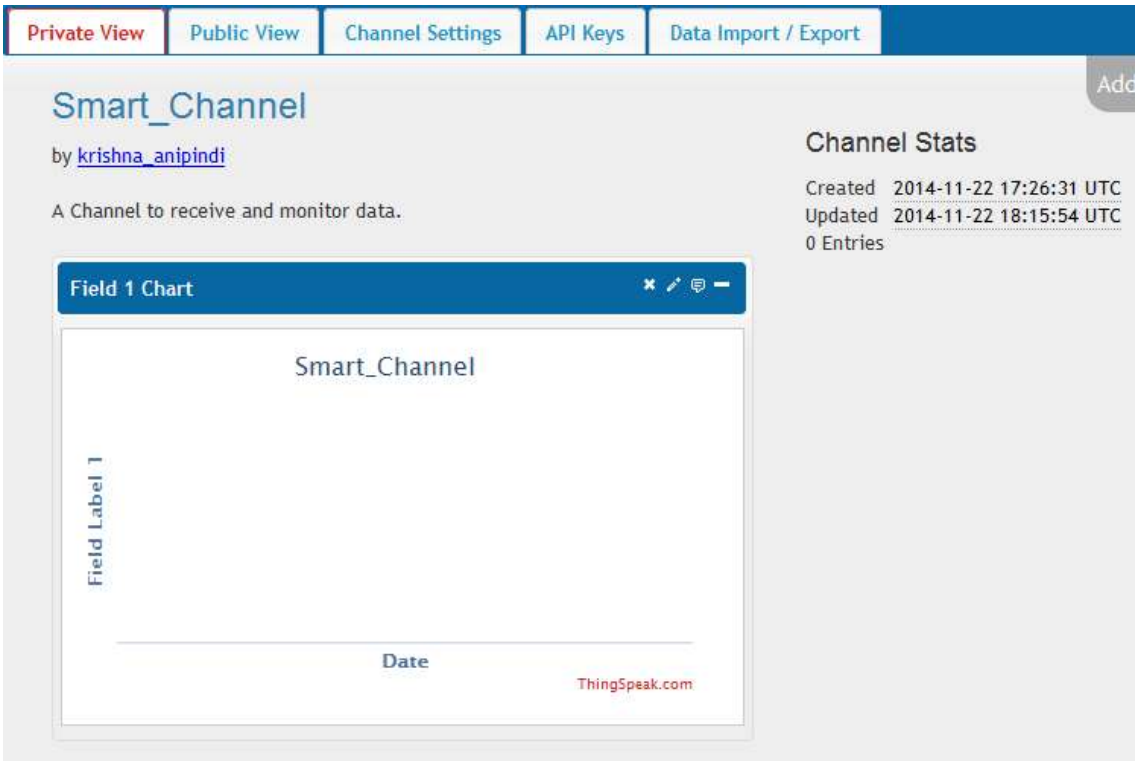
- Latitude, longitude and elevation - These fields correspond to the location of a 'thing' and areespecially significant for moving things.
- Make Public? - If the channel is made public, anyone can view the channel's data feed and thecorresponding charts. If this check box is not checked, the channel is private, which means forevery read or write operation, the user has to pass a corresponding API key.
- URL - This can be the URL of your blog or website and if specified, will appear on the public viewof the channel.
- Video ID - This is the ID corresponding to your YouTube or Vimeo ID. If specified, the videoappears on the public view of the channel.

Fields 1 to 8 - These are the fields which correspond to the data sent by a sensor or a ‘thing’. A field has to be added before it can be used to store data. By default, Field 1 is added. In case you try posting to fields that you have not added, your request will still be successful, but you will notbe able to see the field in the charts and the corresponding data. You can click on the small box before the ‘add field’ text corresponding to each field to add it. Once you click the ‘add field’ box a default label name appears in the text box corresponding to each field and the ‘add field’ text changes to ‘remove field’. You can edit the field text that appears by default when a field is added to make more sense. For example, in the below screen, I have modified the text for Field 2to ‘SensorInput’. To remove a field which is added, just check on the ‘remove field’ box. Once youclick this, the text



‘remove field’ changes back to ‘add field’ and the corresponding field text is cleared.

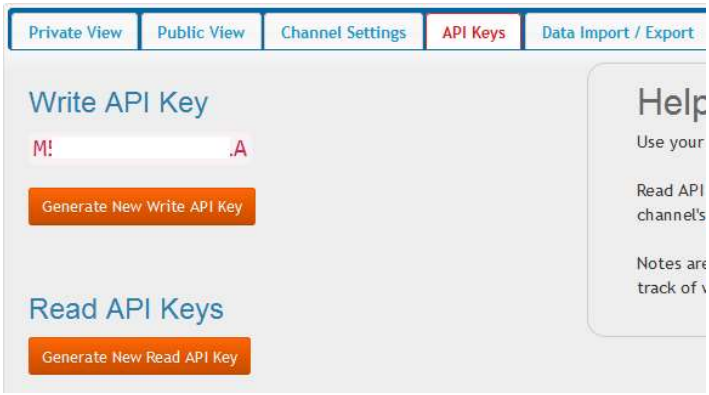
Once you have edited the fields, click on ‘Save Channel’ button. You should now see a page likethe below in which the ‘Private View’ tab is defaulted:



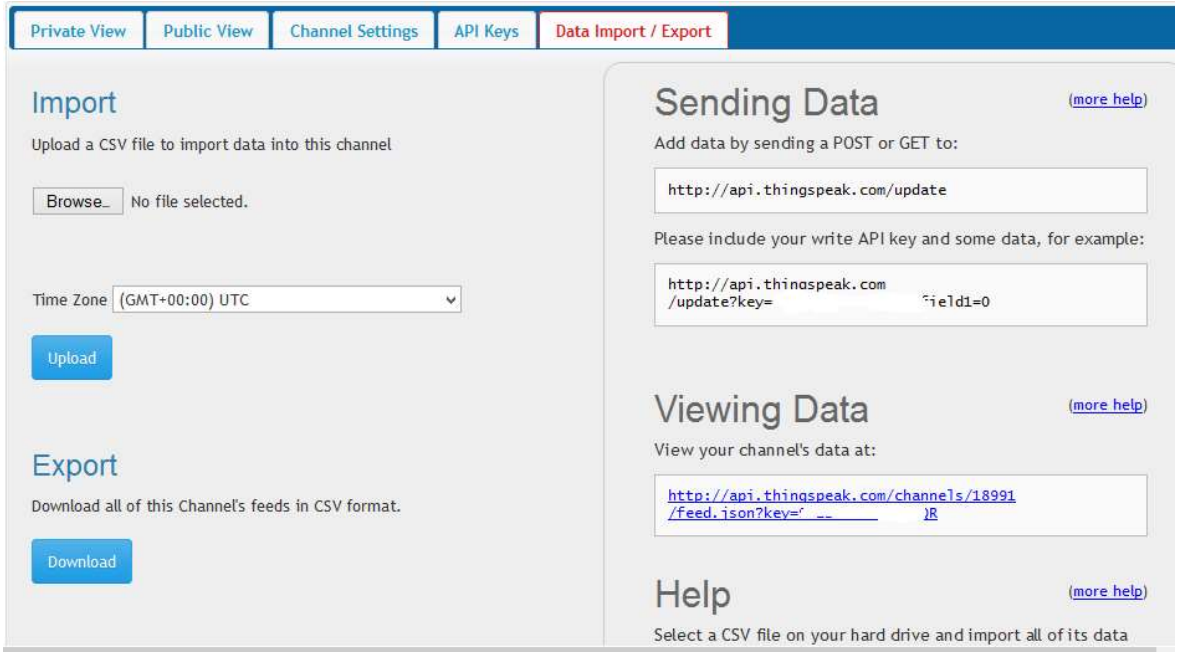
The Private View shows a chart corresponding to each of the fields that we have added. Now clickon the 'Public View' tab. This should look exactly similar to the what we see in the 'Private View' tab since our channel is public. In case your channel is not public('make public' check box not checked in the 'channel settings' tab), the public view tab shows a message that 'This channel is not public'.

Now click on the 'API Keys' tab. You should see a screen similar to the below. The write API key isused for sending data to the channel and the read API key(s) is used to read the channel data.
When we create a channel, by default, a write API key is generated. We generate read API keys byclicking the 'Generate New Read API Key' button under this tab.You can also add a note corresponding to each of the read API keys.

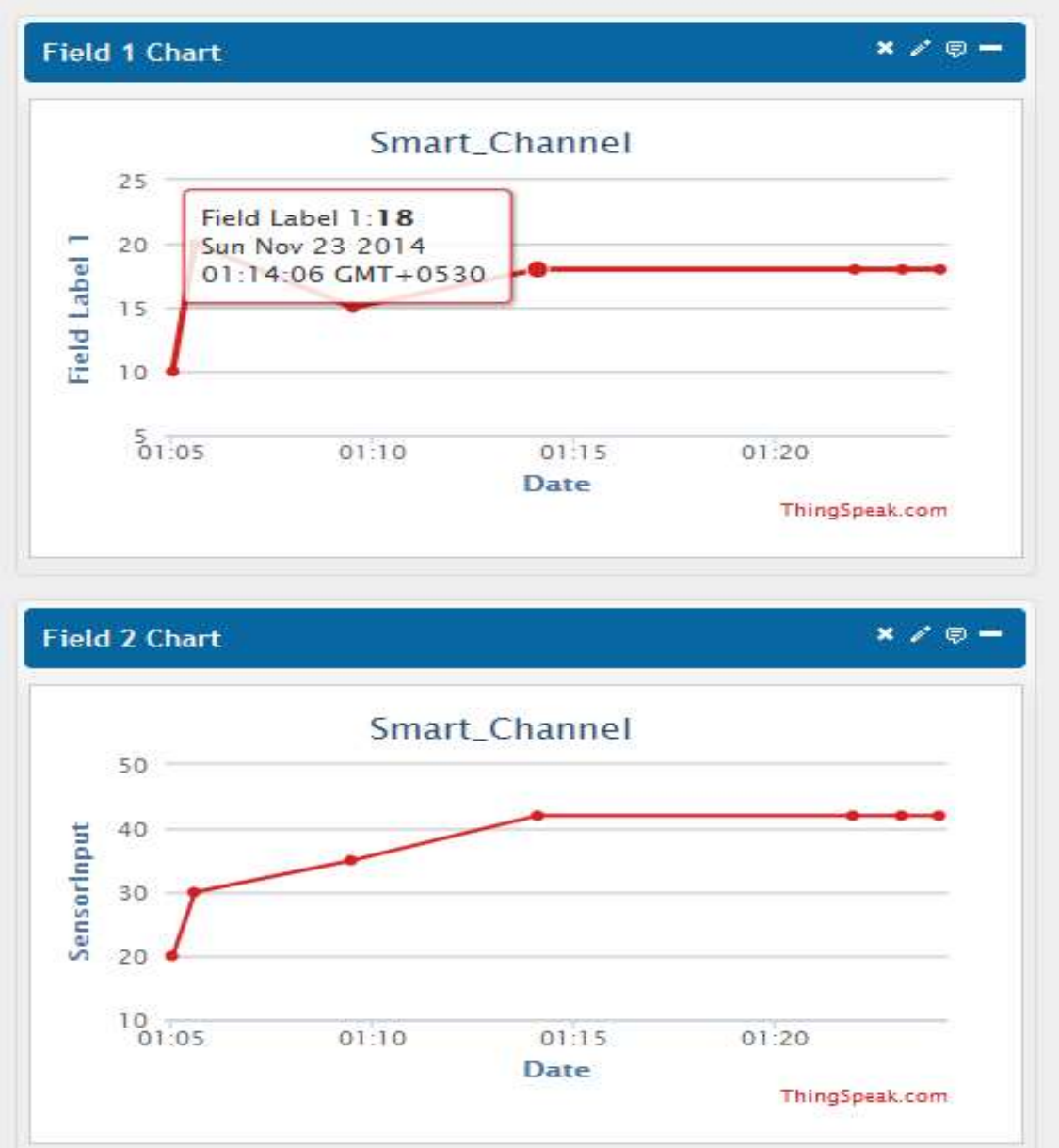
Note: Please note that clicking on the 'Generate New Write API Key' will over-write the previouskey. You will only have one Write API key at any point of time. Also, in case your channel is private, others can only view the channel's feed and charts by using a Read API key. Please sharethe Read API keys with people who are approved and authorized to view your channel.



Now click on the 'Data Import/Export' tab and you should see a screen similar to the below. Thistab is used to import the 'Comma Separated Values(CSV)' data from a file into the channel. You can also download the channel's feed from here in CSV format. This tab also outlines how to sendand view data by providing the URIs to the send and view APIs.



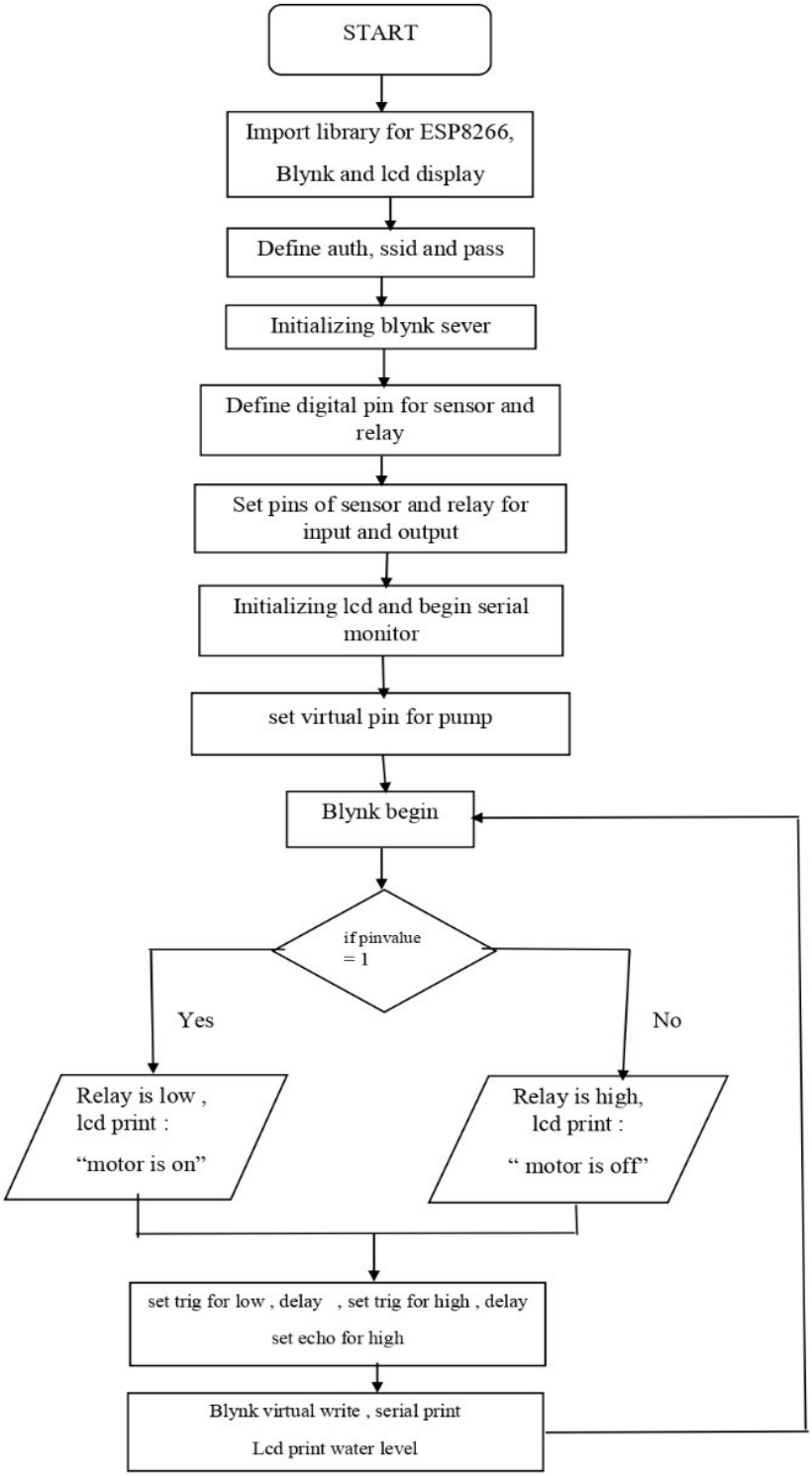
After a series of updates, the charts in the private view tab for each of the fields will look like thebelow:



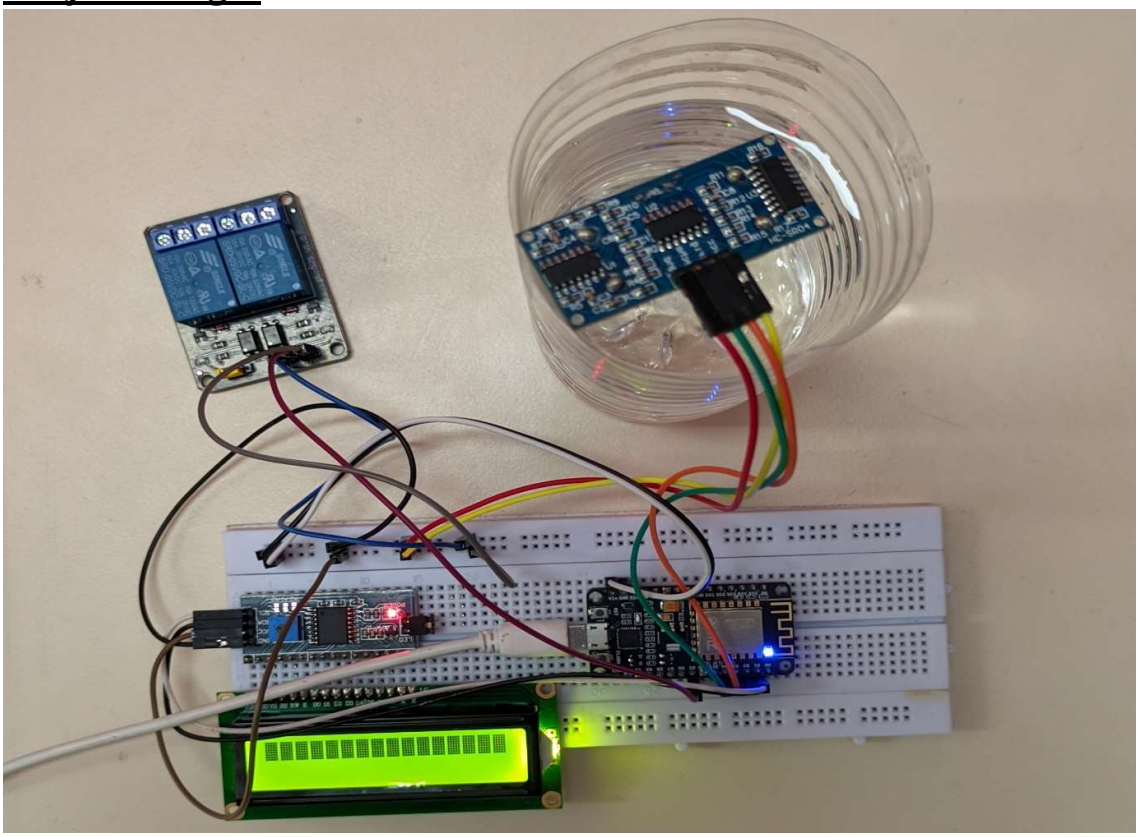
Each of the dots correspond to the value and the time at which the value was posted to the channel. Place the mouse over a dot to get more details on the exact date and the GMT offsetfrom which the value was posted.

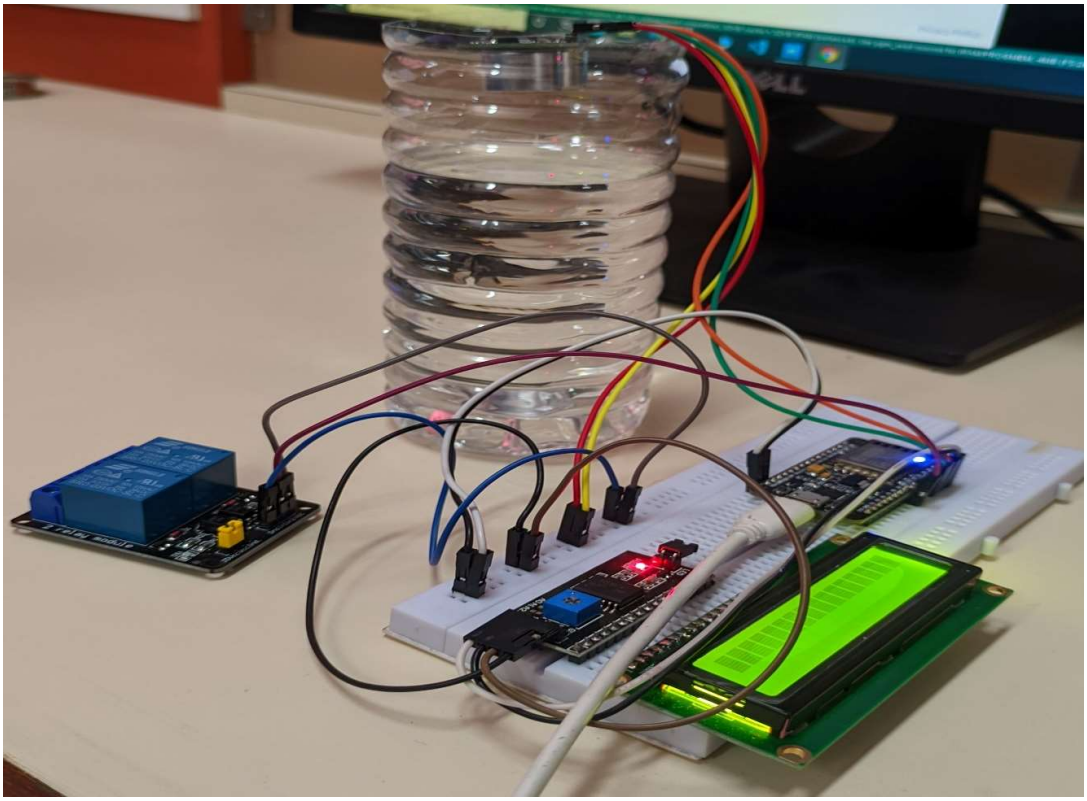
Please note that in the above example, I have sent some sample values to the channel. You cansend any data here, say the periodic readings from a temperature sensor or RPM values from amotor. The Y-axis show the names that we specified to each of the labels.

Flowchart


START
Import library for ESP8266, Blynk and lcd display
Define auth, ssid and pass
Initializing blynk sever
Define digital pin for sensor and relay
Set pins of sensor and relay for input and output
Initializing lcd and begin serial monitor
set virtual pin for pump
Blynk begin
if pinvalue = 1
Yes
No
Relay is low , lcd print : "motor is on"
Relay is high, lcd print : " motor is off"
set trig for low , delay , set trig for high , delay
set echo for high
Blynk virtual write , serial print
Lcd print water level

Project Images:





Explanation:

- 1] In our circuit the nodemcu is our main component which execute all the function in our project.
- 2] Our ultrasonic sensor connected with our nodemcu by 5v and gnd pins. trig pin is connected to D3 pin and echo pin is connected to D4 pin of our nodemcu.
- 3] Vcc and Gnd of our relay module connected to 5v and Gnd of our nodemcu respectively. And In1 pin is connected to D5 pin of our ESP8266.
- 4] SCL and SDA pin of our I2C module is connected with the D1 and D2 pin of our nodemcu respectively. And Vcc and Gnd is connected to 5v and GND of our nodemcu.
- 5] water pump is connected with our relay.

Implementation:

- We placed our ultrasonic sensor on the top of our tank to detact the water level and send real time data to nodemcu . which we can get to know in our android application .

- we connected relay to our water pump to on or off the water pump from our smartphone.

- Where we can get a virtual button to control the opration of our water pump and we also get to know the real time water level of our tank.

- Also, this iot based project doesn't require special different tank for it, existing water tanks can be used to implement this project.

APPLICATIONS:

- This project has enormous applications. It can be installed in the following areas:
- 1. Private houses or bungalows
- 2. Housing societies
- 3. Apartments
- 4. Institutions like schools and colleges, hostels
- 5. Hospitals 6. Offices
- 6. Municipal overhead tanks (with slight changes in hardware) This project can be implemented for a wide range of different sizes of water tanks making it a completely reliable solution.

FUTURE SCOPE:

- This IOT based water monitoring system can be further developed to calculate the water consumption in a time period.
- Then users can manage the water resource and reduce the water wastage.
- When water comes to a particular level, we can set an alarm or send emergency notifications to the user notifying about a flood situation.
- In the user interface, there is a label to show the motor status whether it is on or off.
- And there is a login to use because it must safe from unauthorized persons.
- User can change the upper and lower levels to control the motor.

CONCLUSION:

- 1]. The most important feature of this iot based system is that the users can see the water level and motor status from anywhere.
- 2] This system can be implemented for more than one tank or container for example. This can be used with a connected set of tanks as well. Thereby especially the industrial firms can manage the water effectively.
- 3] This can be further developed to calculate the water consumption in a time period. Then users can manage the water resource and reduce the water wastage.
- 4] As for recommendations, the users are advised to use proper internet connection. Otherwise, the users will not receive realtime data.
- 5] We have used ESP and Ultrasonic sensor which reduces cost effectively and makes this project economical. Also, this project doesn't require special different tank for it, existing water tanks can be used.
- 6] from this IOT based project we can manage water properly and this is very useful to solve problem of water wastage.

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