A

MAJOR PROJECT REPORT ON

WATER QUALITY CHECK IN LARGE AQUATC AREA USING WIRELESS SENSOR NETWORK

Submitted in partial fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY

In

ELECTRONICS AND COMMUNICATION ENGINEERING

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MALLA REDDY COLLEGE OF ENGINEERING

(Approved by AICTE-Permanently Affiliated to JNTU-Hyderabad)

Accredited by NBA & NAAC, Recognized section 2(f) & 12(B) of UGC New Delhi ISO 9001:2015 certified Institution

Maisammaguda, Dhulapally (Post via Kompally), Secunderabad- 500100

2022 - 2023

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CERTIFICATE

This is to certify that the Major Project report on "WATER QUALITY CHECK IN LARGE AQUATIC AREA USING WIRELESS SENSOR NETWORK" is successfully done by the following students of Department of Electronics and Communication Engineering of our college in partial fulfilment of the requirement for the award of B.Tech degree in the year 2022-2023. The results embodied in this report have not been submitted to any other University for the award of any diploma or degree.

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Submitted for the viva voice examination held on: _____

Internal Examiner **External Examiner**

DECLARATION

It is that Elendra chary, Rijwan ,Avinash, Saideep, Imran with Regd.no.19Q91A0430, 19Q91A0437,19Q91A0417,20Q95A0405,19Q91A0438 are hereby declaring that the major project report entitled **"WATER QUALITY CHECK IN LARGE AQUATC AREA USING WIRELESS SENSOR NETWORK"** has done by us under the guidance of Assistant Professor, Department of ECE is submitted in the partial fulfilment of the requirements for the award of degree of **BACHELOR OF TECHNOLOGY in ELECTRONICS AND COMMUNICATION ENGINEERING**

The Results embedded in this project report have not been submitted to any other University or institute for the award of any degree or diploma.

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ABSTRACT

In this project, a low cost, real-time water quality monitoring system which can be applied in remote wireless communication system and the customized buoy. It detects water temperature, dissolved oxygen and conductivity in a pre- programmed time interval. The developed prototype disseminates the gathered information in graphical and tabular formats through a customized web-based portal and preregistered mobile phones to better serve relevant end-users. To check the effectivity , the buoy's stability in harsh environmental conditions, system energy consumption, data transmission efficiency and web-based display of information were carefully evaluated. The experimental results prove that the system has great prospect and can be practically used for environmental monitoring rivers, lakes, coastal areas and other water bodies is presented. The main hardware of the system consists of off-the-shelf electro-chemical sensors, a micro controller, a by providing stakeholders with relevant and timely information for sound decision making.

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CHAPTER-1

1.1 INTRODUCTION:

Nowadays, water is considered as one of the most scarce natural resources on our planet . It is important to humankind, animals, and plants. Depending on the quality of water, it may either be a source of life and good health or a source of diseases and deaths. The growing environmental degradation in recent years brought about by development, population increase and climate change increases the need for researchers to look into its negative impact in the environment, especially in water sources and its implication. Increasing water pollution in oceans, lake, and river triggers worldwide demand more advanced methods in environmental monitoring systems particularly in the field of water quality monitoring. Moreover, developing countries like the Philippines rely on the conventional methods of collecting water samples and water analysis. Due to lack of technical know-how and a huge amount in the initial investment, water analyses are usually done through conventional procedures or by using portable testers which are not only expensive and laborious but also lack the capabilities for real-time data acquisition, analyses and fast dissemination of gathered information which are crucial and essentials for effective water quality monitoring Endeavour.

1.2 LITERATURE REVIEW

[1]A research paper was published in 2015 where a team was working on making an IOT and remote sensingbased water quality monitoring system seeing the water quality in Fiji Islands as it required frequent data collection . Taking help from this, we used Arduino and mega 2560 to make a Water Quality Monitoring System which can give real time data of the water quality on a phone-based application. In 2009, another research paper was published which used Zigbee based wireless sensor for the monitoring of water of far distant places. One of the research paper we read was published in 2013 which analyzed the limitations of the existing water quality monitoring system used for agricultural purposes and differentiated between the earlier methods and the new wireless water quality monitoring system. They talked about the issues like wiring system, low performance of the system and the price ratio

[2] Another research paper published in 2010 which used web-server-embedded technology with mobile telecommunication technology to create a water monitoring system but for the purpose of intensive fishing. The results demonstrate that multi-parametric, long-distance and online monitoring for water quality information can be accurately acquired and predicted by using this established monitoring system

[3]. One of the research paper published in 2009 talked about how to design a water quality monitoring system for rivers. The factors included the parameters one has to calculate, how to select the samples for the quality check and also how to come with location fir the location of sampling stations. They basically focus on an optimal water quality monitoring system which can determine allthe major quantities

[4]. A research paper published in 2009 tried to resolve the issues of manually taking down of reading of water quality check. It brought a new novel like system where water quality check in remote areas can be done through wireless system network. The system about which the paper talks takes down the readings very conveniently and the system runs very stably. The system had a very simple kind of structure and was independent of the geographical location it was used in [6]. One of the research

1.3 EXISTING SYSTEM:

- In existing system we are using arduino micro controller ,in which wifi and iot applications are not possible.
- And not much upgraded technology used.
- Values taken manually.

1.4 PROPOSED SYSTEM:

- In proposed system we are using nodemcu esp8266 microcontroller For iot applications and automatic monitoring of sensor data.
- We are using electrical conductivity and turbidity for water quality checking .
- In this we also used the Machine learing for predition of quality.
- Most acuuracy is given .

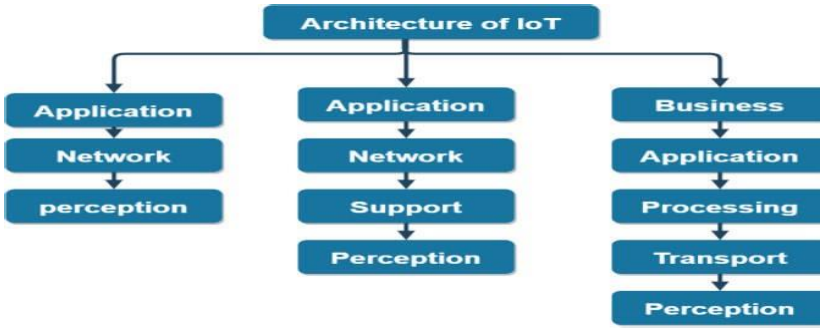
TECHNOLOGY USED

1.5 BASIC INTRODUCTION IOT:

IoT is short for Internet of Things. As the name implies, the Internet of Things is the Internet of things connected. There are two meanings here. First , the core and foundation of the Internet of Things is still the Internet, which is an extension and expansion network based on the Internet; second,its user-side extended and expanded information exchange and communication between objects. The Internet of Things is the third wave of the development of the world's information industry after computers and the Internet.

Until now, there isn't an accurate and recognized definition of the Internet of Things. This is mainly due to: First, the theoretical system of the Internet of Things has not been fully established, and it has not been recognized deep enough. Second, because the Internet of Things is closely related to the Internet, mobile communication networks, and sensor networks, researchers in these fields have different starting points and end points for thinking about the Internet of Things, and there is no consensus in the short term.

According to the industry information we have observed, the Internet of Things is an information carrier based on the Internet and traditional telecommunications networks, allowing all independently addressable common physical objects interconnected. It has three characteristics: common object equipment, autonomous terminal interconnection, and universal service intelligence.



Conceptual Layered Iot Architecture

1.6 BASIC INTRODUCTION OF HADWARE

1.6.1 NODE MCU

Microcontroller board based on the atmega328p (datasheet). Ithas14digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button as shown in Fig.2. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to DC adapter or battery to get started.

You can tinker with your UNO without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again. “Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases.

The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index. The Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip.

Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. Clock speed of Arduino UNO is 16MHz.The Arduino/Genuine Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically.

1.6.2 ARDUINO UNO:

setup (): A capacity present in each Arduino sketch. Run once before the loop () function. Frequently used to set pin mode to info or yield. The setup () function resembles like:

```
void setup( ){
    //code goes here
}
```

input: A pin mode that admissions data. output: A pin mode that sends data.

HIGH: Electrical sign present (5V for Uno). Additionally, ON or True in Boolean rationale. LOW: No electrical sign present (0V). Additionally OFF or False in Boolean rationale.

DigitalRead: Get a HIGH or LOW perusing from a pin previously proclaimed as an info. 8 DigitalWrite: Assign a HIGH or LOW an incentive to a pin previously pronounced as anoutput. AnalogRead: Get an incentive between or including 0 (LOW) and 1023 (HIGH). This permits you to get readings from simple sensors or interfaces that have multiple states.

AnalogWrite: Assign an incentive between or including 0 (LOW) and 255 (HIGH). This allows you to set output to a PWM esteem rather than simply HIGH or LOW.

PWM: Stands for Pulse-Width Modulation, a strategy for copying a simple sign through an advanced pin. An incentive between or including 0 and 255. Utilized with analogWrite.

1.6.3 DIGITAL :

An electronic sign communicated as paired code that can be either the presence or nonattendance of current, high and low voltages or short heartbeats at a specific recurrence. People see the world in simple, however robots, PCs and circuits utilize Digital. A computerized signal is a sign that has just two states. These states can shift contingent upon the sign, however basically characterized the states are ON or OFF, never in the middle. In the realm of Arduino, Digital signs are utilized for everything except for Analog Input.

Contingent upon the voltage of the Arduino the ON or HIGH of the Digital sign will be equivalent to the framework voltage, while the OFF or LOW sign will consistently rise to 0V. This is an extravagant method of saying that on a 5V Arduino the HIGH signals will be a little under 5V and on a 3.3V Arduino the HIGH signals will be somewhat under 3.3V.

where pinNumber is an Analog pin (A0 – A5) and worth is either INPUT or OUTPUT. To arrangement Digital pins utilize a similar order yet reference a Digital pin for pinNumber rather than an Analog In pin. Computerized pins default as info, so truly you just need to set them to OUTPUT in pinMode. To peruse these pins utilize the order**.**

1.6.4 ANALOG:

People see the world in simple. All that we see and hear is a ceaseless transmission of data to our faculties. The temperatures we see are rarely 100% hot or 100% cold, they are continually changing between our scopes of satisfactory temperatures. (What's more, in the event that they are out of our scope of adequate temperatures, at that point what are we doing there?) This ceaselestream is the thing that characterizes simple information. Advanced data, the correlative idea to Analog, gauges simple information utilizing just ones and zeros. In the realm of Arduino an Analog sign is essentially a sign that can be HIGH (on), LOW (off) or anything in the middle of these two states.

1.6.5 INPUT SIGNALS :

Simple Input enters your Arduino through the Analog In pins # 0 - # 5. These signs begin from simple sensors and interface gadgets. These simple sensors and gadgets use voltage levels to impart their data rather than a straightforward yes (HIGH) or no (LOW). Therefore you can't utilize a computerized pin as an information pin for these gadgets. Simple Input pins are utilized uniquely for getting Analog signs. It is simply conceivable to peruse the Analog Input sticks so there is no order vital in the arrangement( ) capacity to set up these pins for input. To peruse the Analog Input pins utilize the order:

analogRead(pinNumber); where pinNumber is the Analog Input pin number.

This capacity will restore an Analog Input perusing somewhere in the range of 0 and 1023. A perusing of zero relates to 0 Volts and a perusing of 1023 compares to 5 Volts. These voltage esteems are radiated by the simple sensors and interfaces. On the off chance that you have an Analog Input that could surpass Vcc + 5V you may change the voltage that 1023 relates to by utilizing the Aref pin.

This pin sets the greatest voltage boundary your Analog Input pins can peruse. The Aref pin's preset

worth is 5V.

Computerized Input can enter your Arduino through any of the Digital Pins # 0 - # 13. Advanced Input signals are either HIGH (On, 5V) or LOW (Off, 0V). Since the Digital pins can be utilized either as info or yield you should set up the Arduino to utilize these pins as contributions to your arrangement( )work. To do this sort the order:

Info can emerge out of a wide range of gadgets, however every gadget's sign will be either Analog or Digital, it is dependent upon the client to sort out which sort of information is required, connect the equipment and afterward type the right code to appropriately utilize these signs. 2x3 pin header Used to program At mega with bootloader. The number 1 on the two sides of the board shows link pin1 position.

Used to transfer draws on Atmega ICs without bootloader (accessible just in Arduino IDE variants 0011 and 0012). 3 pins jumper When in position 2-3, this jumper empowers sequential association (through X1 connector) to/from PC/gadgets. Utilize this as default position. When in position 1-2, it handicap sequential correspondence, and empowers outer draw down resistors on pin0 (RX) and pin1 (TX).

Utilize this just to forestall commotion on RX (that appears to be approaching information to Atmega), that occasionally makes sketch not beginning. While eliminating this jumper, sequential correspondence is impaired, and pin0 and pin1 fill in as a typical (gliding) advanced pin. Valuable when more advanced pins are required, yet just when sequential correspondence isn't essential. Outside draw down/pull-up resistor is required.

1.6.6 OUTPUT SIGNALS:

13Analog input to the Arduino pins is consistently Digital, anyway there are two unique kinds of Digital Output; ordinary Digital Output and Pulse Width Modulation Output (PWM). Yield is just conceivable with Digital pins # 0 - # 13. The Digital pins are preset as Output pins, so except if the pin was utilized as an Input in a similar sketch, there is no motivation to utilize the pinMode order to set the pin as an Output. Should a circumstance emerge where it is important to reset a Digital pin to Output from Input utilize the order:

pinMode(pinNumber, OUTPUT);

where pinNumber is the Digital pin number set as Output. To impart a Digital Output sign utilize the

order:

digitalWrite(pinNumber, esteem);

where pinNumber is the Digital pin that is yielding the sign and worth is the sign. While yielding a Digital sign worth can be either HIGH (On) or LOW (Off). analogWrite(pinNumber, esteem);

where pinNumber is a Digital Pin with PWM abilities and worth is a number between 0 (0%) an255 (100%).

For more data on PWM see the PWM worksheets or S.I.K. circuit 12. Yield can be shipped off a wide range of gadgets, however it is dependent upon the client tosort out which sort of Output signal is required, connect the equipment and afterward type the right code to appropriately utilize these signs.

1.7 BASIC INTRODUCTION OF SOFTWARE

While boot loading is a Atmega8 chip with Arduino 0010, there is an order (- i800) that makes bootloader defer 10 minutes. Thus, in the event that you need to utilize bootloader, use order line rather than IDE, eliminating "– i800" order and adding "– F" order, or use Arduino 0007 IDE. To transfer draws Arduino 0010 turns out great.

1.7.1 ARDUNIO UNO:

Download Arduino Integrated Design Environment (IDE) here (Most late form: 1.6.5): https://www.arduino.cc/en/Main/Software.

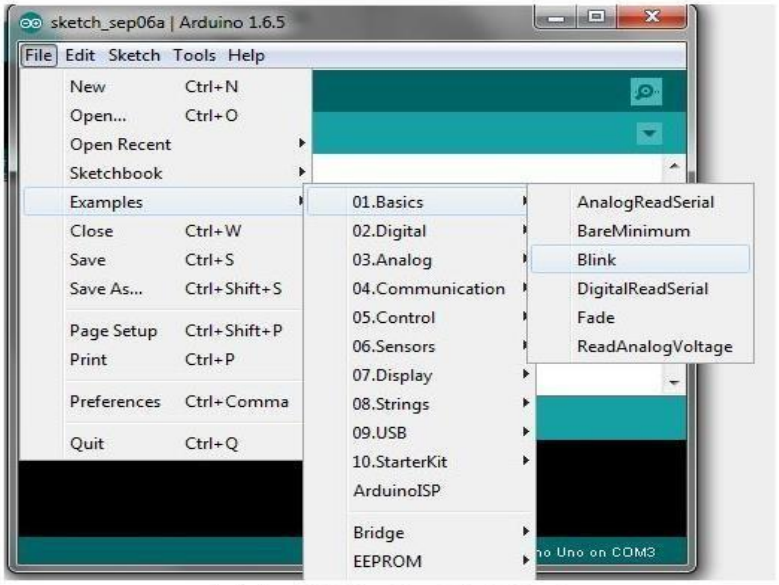
This is the Arduino IDE whenever it's been opened. It opens into a clear sketch where you can begin programming right away. To begin with, we ought to arrange the board and port settings to permit us to transfer code. Interface your Arduino board to the PC through the USB link

1.7.2 UPLOADING BLINK:

One common procedure to check whether the board you're using is correctly founded is to upload the “Blink” sketch. This sketch is included with all Arduino IDE releases and might be accessed by the Filepull-down menu and visiting Examples, 01.Basics, then select Blink. Standard Arduino Boards include a surface-mounted LED labeled “L” or “LED” next to the “RX” and “TX” LEDs, that's connected to digital pin 13.

This sketch will blink the LED at an everyday interval, and is a straightforward thanks to confirm if your board is ready up properly and you were successful in uploading code. Open the “Blink” sketch and press the “Upload” button within the upper-left corner to upload “Blink” to the board.

1. Download and introduce Arduino IDE (https://www.arduino.cc/en/Main/Software)
2. Plug in your Arduino Board
3. Select the correct board in the IDE (Tools>Boards>Arduino Uno
4. Select the correct COM port (Tools>Port>COMx (Arduino Uno))
5. Open the "Blink" sketch (File>Examples>Basics>01.Blink)



Arduino IDE: Loading Blink Sketch

Fig 1-Setup Page

6. Press the Upload catch to transfer the program to the board
7. Affirm that your board is functio functioning true to form by noticing LED

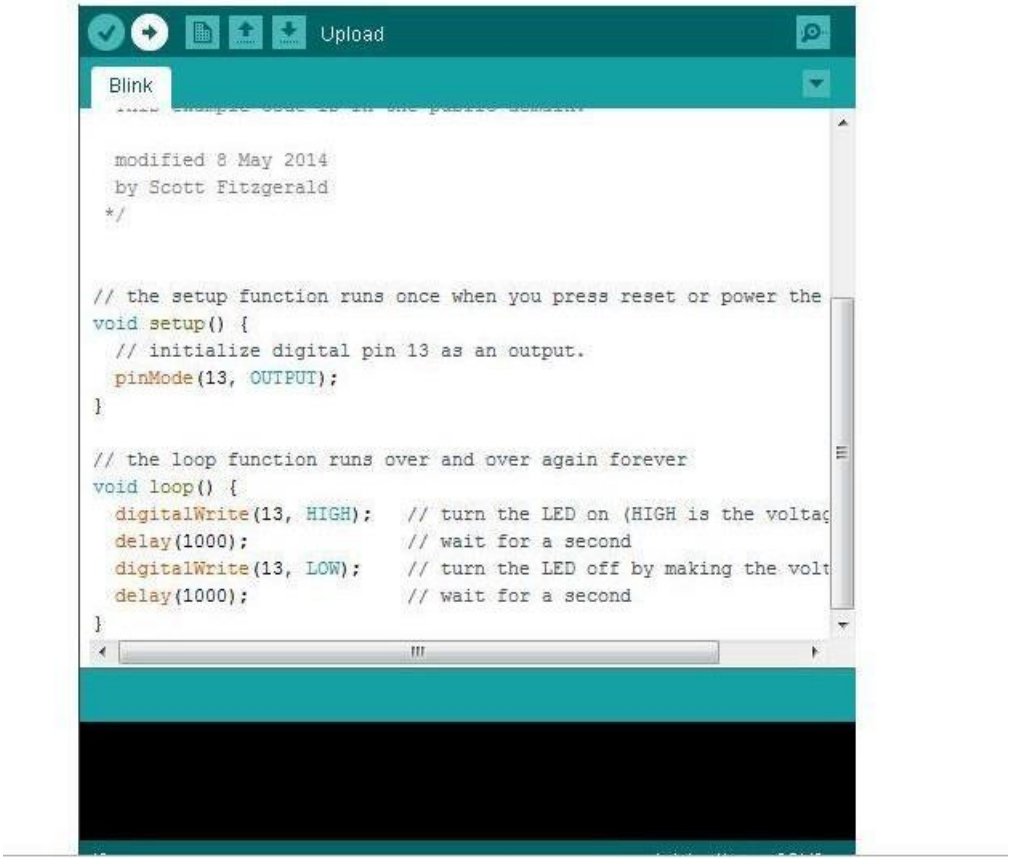


Fig 2- Code Uploading Page

Arduino has bunches of network backing and documentation. Your smartest option when running into unforeseen issues is to look through online for help. You should have the option to discover a discussion where somebody had a similar issue you are having, and somebody encouraged them fix it. In the event that you don't discover results, take a stab at altering your pursuit, or post on the Arduino discussions.

CHAPTER-2

2.1 BLOCK DIAGRAM:

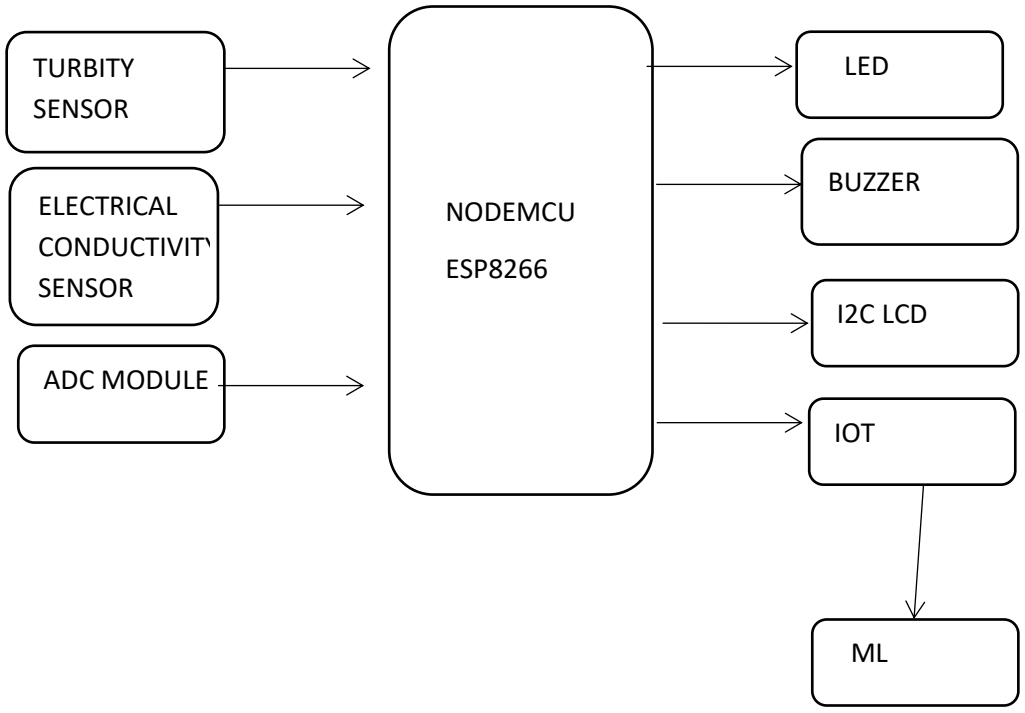


Fig 3 – Water quality check in large aquatic area using wireless sensor network

2.2 HARDWARE REQUIRED:

- NODEMCU ESP8266
- TURBITY SENSOR
- ELECTRICAL CONDUCTIVITY SENSOR
- I2C LCD
- ADC MODULE
- BUZZER
- LED

2.3 SOFTWARE REQUIRED:

- ARDUINO IDE SOFTWARE
- IOT

- EMBEDDED C PROGRAMMING LANGUAGE
- MACHINE LEARNING

HARDWARE COMPONENTS

2.4 NODEMCU ESP8266:

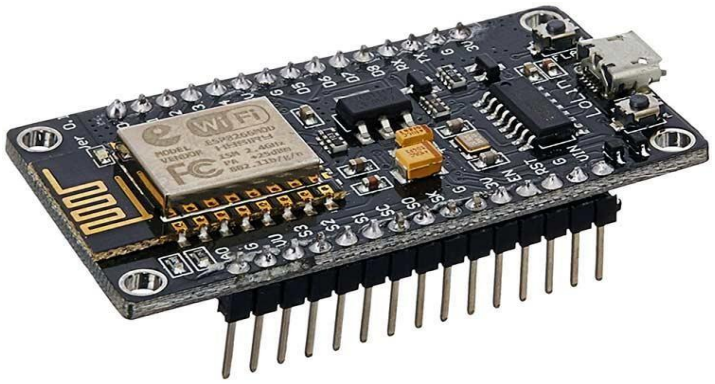


Fig 4 -NODEMCU

NodeMCU is an open-source firmware for which open-source prototyping board designs are available. The name “NodeMCU” combines “node” and “MCU” (micro-controller unit). The term “NodeMCU” strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. Nodemcu ESP8266 and Nodemcu ESP32 are becoming very popular and are almost used in more then 50% IoT based projects today. The firmware uses the Lua scripting language. The firmware is based on the eLua project and built on the Espressif Non-OS SDK for ESP8266.

It uses many open source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented. The prototyping hardware typically

used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna.

The choice of the DIP format allows for easy prototyping on breadboards. The design was initially was based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT application**.**

❖ NODEMCU DEVELOPMENT BOARD PINOUT CONFIGURATION:

Pin Catego	**Name**	**Description**
Power	Micro-USB, 3.3 GND, Vin	**Micro-USB:** NodeMCU can be powered through the USB por **3.3V:** Regulated 3.3V can be supplied to this pin to power the board **GND:** Ground pins **Vin:** External Power Supply
ControlPins	**EN, RST**	The pin and the button resets the microcontroller

Analog Pin	A0	Used to measure analog voltage in the range of 0-3.3V
GPIO Pins	GPIO1 to GPIO16	NodeMCU has 16 general purpose input-output pins on its boa
SPI Pins	SD1, CMD SD0, CLK	NodeMCU has four pins available for SPI communication.

Table 1 : NodeMCU Board Pinout Configurati

2.4.1 NODEMCU ESP8266 SPECIFICATIONS & FEATURES:

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
- PCB Antenna
- Small Sized module to fit smartly inside your IoT projects

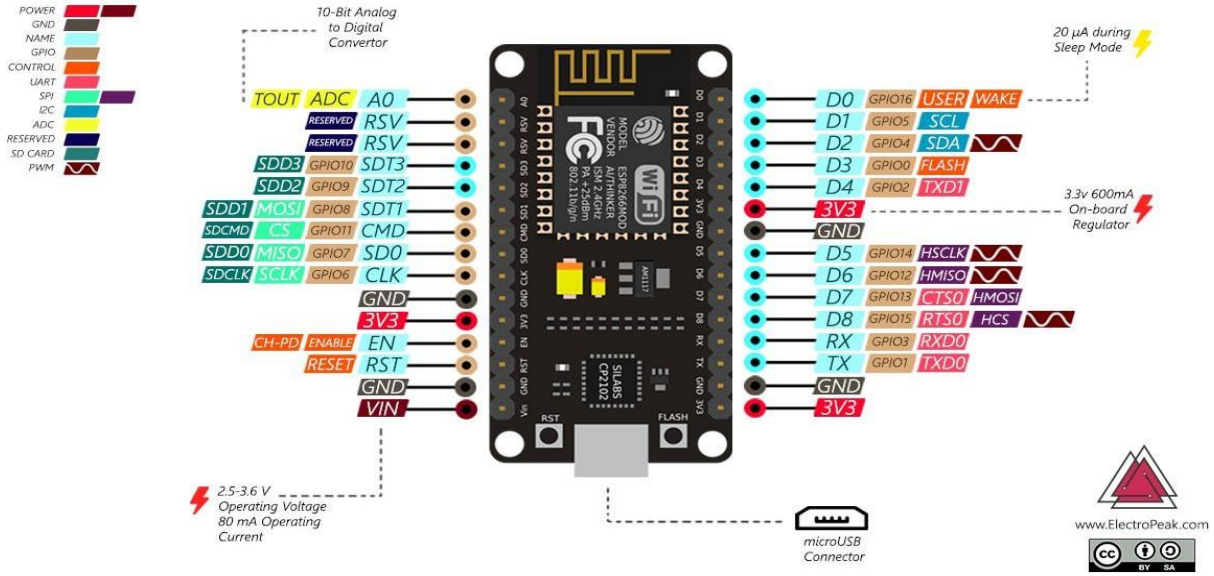


Fig 5- Pin Diagram

2.4.2 GENERAL PURPOSE INPUT/OUTPUT INTERFACE (GPIO):

ESP8266EX has 17 GPIO pins which can be assigned to various functions by programming the appropriate registers. Each GPIO can be configured with internal pull-up or pull-down, or set to high impedance, and when configured as an input, the data are stored in software registers; the input can also be set to edge-trigger or level trigger CPU interrupts. In short, the IO pads are bidirectional, non-inverting and tristate, which includes input and output buffer with tristate control inputs. These pins can be multiplexed with other functions such as I2C, I2S, UART, PWM, IR Remote Control, etc.

2.4.3 SECURE DIGITAL INPUT/OUTPUT INTERFACE (SDIO):

ESP8266EX has one Slave SDIO, the definitions of which are described below. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

Table 1-1: Pin Definitions of SDIOs

Pin Name	Pin Num	IO	Function Name
SDIO_CLK	21	IO6	SDIO_CLK
SDIO_DATA0	22	IO7	SDIO_DATA0
SDIO_DATA1	23	IO8	SDIO_DATA1
SDIO_DATA_2	18	IO9	SDIO_DATA_2
SDIO_DATA_3	19	IO10	SDIO_DATA_3
SDIO_CMD	20	IO11	SDIO_CMD

Table 2: Pin Definitions of SDIOs

2.4.4 SERIAL PERIPHERAL INTERFACE (SPI/HSPI):

ESP8266EX has 3 SPIs.

One general Slave/Master SPI

One Slave SDIO/SPI

One general Slave/Master HSPI

Functions of all these pins can be implemented via hardware. The pin definitions are described as below.

2.5 TURBITY SENSOR:

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates. The more total suspended solids in the water, the murkier it seems and the higher the turbidity. Turbidity is considered as a good measure of the quality of water.Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality.Fluids can contain suspended solid matter consisting of particles of many different sizes. While some suspended material will be large enough and heavy enough to settle rapidly to the bottom of the container if a liquid sample is left to stand (the settable solids), very small particles will settle only very slowly or not at all if the sample is regularly agitated or the particles are colloidal. These small solid particles cause the liquid to appear turbid.Turbidity (or haze) is also applied to transparent solids such as glass or plastic. Inplastic production, haze is defined as the percentage of light that is deflected more than 2.5° from the incoming light direction

Fig 6. **TURBIDITY SENSOR**

. The voltage ranges from 0 to 4.5 volts. Under digital mode the signal wire from the converter goes to the digital pin of the microcontroller the sensor sends out a 5v signal when turbidity reaches a threshold value. This value can be adjusted by the on board potentiometer on the A & D converter.

Working voltage	5V DC
Current	30mA (MAX)
Operating temperature	-30 ° C to 80 ° C
Compatible	Arduino, Raspberry Pi, AVR, PIC
Measuring Range	0 ~ 1000 NTU
Dimensions	5 x 5 x 5 cms
Weight	50 grams

2.6 ELECTRICAL CONDUCTIVITY SENSOR

Conductivity Sensor measures the conductivity of aqueous solutions in industrial and municipal process applications. It is designed to perform in the harshest of environments. All seals are dual O-ring using multiple sealing materials. It uses the same principle as regular conductors, based on purity of water conductivity level will vary. Pure H2O will not conduct any current but with increasing impurity level conductivity will also increase. This property is used for measuring contamination level of water.

Conductivity measurement is a versatile tool in process control. The measurement is simple and fast, and most advanced sensors require only a little maintenance. The measured conductivity reading can be used to make various assumptions on what is happening in the process. In some cases it is possible to develop a model to calculate the concentration of the liquid.

Concentration of pure liquids can be calculated when the conductivity and temperature is measured. The preset curves for various acids and bases are commercially available. For example, one can measure the

concentration of high purity hydrofluoric acid using conductivity-based concentration measurement [Zhejiang Quhua Fluorchemical, China Valmet Concentration 3300]. A benefit of conductivity- and temperature-based concentration measurement is the superior speed of inline measurement compared to an on-line analyzer.

Conductivity-based concentration measurement has limitations. The concentration-conductivity dependence of most acids and bases is not linear. Conductivity-based measurement cannot determine on which side of the peak the measurement is, and therefore the measurement is only possible on a linear section of the curve.[*citation needed*] Kraft pulp mills use conductivity-based concentration measurement to control alkali additions to various stages of the cook. Conductivity measurement will not determine the specific amount of alkali components, but it is a good indication on the amount of effective alkali (NaOH + ½ Na_2S as NaOH or Na_2O) or active alkali (NaOH + Na_2S as NaOH or Na_2O) in the cooking liquor. The composition of the liquor varies between different stages of the cook. Therefore, it is necessary to develop a specific curve for each measurement point or to use commercially available products.

The high pressure and temperature of cooking process, combined with high concentration of alkali components, put a heavy strain on conductivity sensors that are installed in process. The scaling on the electrodes needs to be taken into account, otherwise the conductivity measurement drifts, requiring increased calibration and maintenance.

2.7.I2C LCD:

The I2C 1602 LCD module is a 2 line by 16character display interfaced to an I2C daughterboard. The I2C interface only requires 2 data connections, +5 VDC and GNDto operate Viewablearea Adjustable by potentiometer on I2c interface80mm x 36mm x 20 mm. Now, with only 3 pins from microcontroller, you can display message on this LCD. Compared to parallel LCD which required at least6 pins of I/O, this LCD offer more cost effective solution. The LCD display is four lines by 20 characters and provides basic text wrapping so that your text looks right on the display.

Fig 7- I2C LCD

Fig 8 - I2C LCD Display

2.7.1 I2C SERIAL INTERFACE ADAPTER:

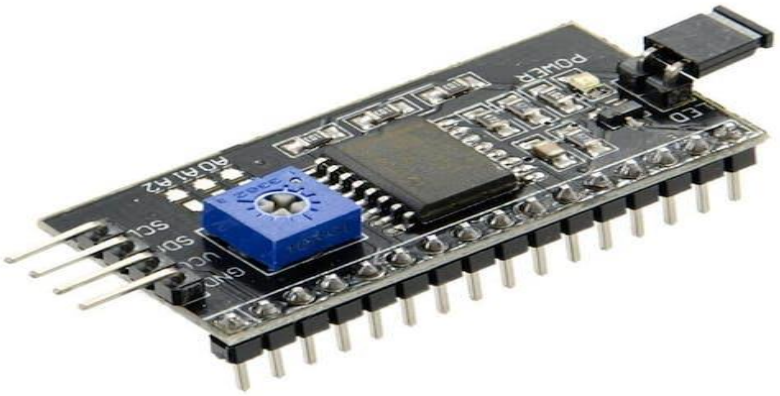


Fig 9- I2C Adapter

It is also known as I2C Module. It has total of 20 male pins. 16 pins are faced to rear side and 4 pins faced towards front side. The 16 pins for connect to 16x2 LCD and the 2 pins out of 4 pins are SDA and SCL. SDA is the serial data pin and SCL is the clock pin. The rest 2 pins for power supply (Vcc and ground).There is a POT on the I2C Module. We can control the contrast of the LCD display by rotating this POT. And there is a jumber fixed on the module. When we remove the jumber, the backlight of the LCD display will go OFF.

2.7.2 ADDRESS OF I2C LCD:

Before starting we need to know about addressing of I2C devices. Every device which can attached to MCU have an address. We need to know this address for communicate with that particular device.

You can see three solder pads on the I2C module. which is labeled as A0, A1 and A2. This is Address selectors. ie, each solder pads have one upper potion and a one lower potion. if, there is a connection between upper potion with lower connection it is called "**Connected**" otherwise it is called "**Not connected**". When A0, A1, A2 are in "Not Connected" condition (A0 = 0, A1 = 0, A2 = 0) the address would be 0x27. In default the A0, A1, A2 are in "Not connected" condition. And some time default address is 0x3F. There is no need to change the address of the I2C module when we use only one LCD. But when we use more than one LCD, need to change the address. Because

two or more different device can't communicate with the same address. For more address see the table given below.

2.7.3 INTERFACING 16×2 CHARACTER LCD MODULE WITH ARDUINO:

The Serial Monitor is a convenient way to view data from an Arduino, but what if you want to make your project portable and view sensor values without access to a computer? Liquid crystal displays (LCDs) are excellent for displaying a string of words or sensor data.

The Serial Monitor is a convenient way to view data from an Arduino, but what if you want to make your project portable and view sensor values without access to a computer? Liquid crystal displays (LCDs) are excellent for displaying a string of words or sensor data.Depending on the manufacturer, some LCDs include a current-limiting resistor for the backlight. It is located on the back of the LCD, close to pin 15. If your LCD does not contain this resistor or if you are unsure whether it does, you must add one between 5V and pin 15. It should be safe to use a 220 ohm resistor, although a value this high may make the backlight slightly dim. For better results, check the datasheet for the maximum backlight current and choose an appropriate resistor value.

2.7.4 ARDUINO EXAMPLE CODE:

```
// include the library code:
#include <LiquidCrystal.h>

// Creates an LCD object. Parameters: (rs, enable, d4, d5, d6, d7)
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

void setup()
{
        // set up the LCD's number of columns and rows:
        lcd.begin(16, 2);

        // Clears the LCD screen
        lcd.clear();
}
```

```
void loop()
{
        // Print a message to the LCD.
        lcd.print(" Hello world!");

        // set the cursor to column 0, line 1
        // (note: line 1 is the second row, since counting begins with 0):
        lcd.setCursor(0, 1);
        // Print a message to the LCD.
        lcd.print(" LCD Tutorial");
}
```

2.7.5 APPLICATIONS:

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

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

2.7.6 FEATURE:

- 5V powered 4 x 20
- SPI communication
- Minimum 3 Pins interface to microcontroller
- Compatible with all types of microcontrollers
- Suitable for hobbyists and experts

2.8.ADC MODULE:

Fig 10.**ADC MODULE**

The MCP3008 10-bit Analog-to-Digital Converter (ADC) combines high performance and low power consumption in a small package, making it ideal for embedded control applications. The MCP3008 features a successive approximation register (SAR) architecture and an industry-standard SPI serial interface, allowing 10-bit ADC capability to be added to any PIC® microcontroller.

Fig.11. adc pins

The MCP3008 features 200k samples/second, 8 input channels, low power consumption (5nA typical standby, 425µA typical active), and is available in 16-pin PDIP and SOIC packages. Applications for the MCP3008 include data acquisition, instrumentation and measurement, multi-channel data loggers, industrial PCs, motor control, robotics, industrial automation, smart sensors, portable instrumentation and home medical appliances.

2.9 BUZZER:

There are many ways to communicate between the user and a product. One of the best ways is audio communication using a buzzer IC. So during the design process, understanding some technologies with configurations is very helpful. So, this article discusses an overview of an audio signaling device like a beeper or a buzzer and its working with applications.

2.9.1 WHAT IS A BUZZER?

An audio signaling device like a beeper or buzzer may be electromechanical or piezoelectric or

mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.

Fig 12 -Buzzer Pin Configuration

The pin configuration of the buzzer is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal.

2.8.2 ELECTROMECHANICAL:

This buzzer was launched in the year 1831 by an American Scientist namely Joseph Henry but, this was used in doorbells until they were eliminated in 1930 in support of musical bells, which had a smooth tone.

2.9.3 PIEZOELECTRIC:

These buzzers were invented by manufacturers of Japanese & fixed into a broad range of devices during the period of 1970s – 1980s. So, this development primarily came due to cooperative efforts through the manufacturing companies of Japanese. In the year 1951, they recognized the Application Research Committee of Barium Titanate that allows the corporations to be cooperative competitively & bring about numerous piezoelectric

Fig.13 - Piezoelectric Buzzer

2.9.4 SPECIFICATIONS:

The specifications of the buzzer include the following.

- Color is black
- The frequency range is 3,300Hz
- Operating Temperature ranges from – 20° C to +60°C
- Operating voltage ranges from 3V to 24V DC
- The sound pressure level is 85dBA or 10cm
- The supply current is below 15Ma

2.9.5 WORKING PRINCIPLE:

The working principle of a buzzer depends on the theory that, once the voltage is given across a piezoelectric material, then a pressure difference is produced. A piezo type includes piezo crystals among two conductors. Once a potential disparity is given across these crystals then they thrust one conductor & drag the additional conductor through their internal property. So this continuous action will produce a sharp sound signal.

2.9.6 MOUNTING CONFIGURATIONS:

The mounting configurations of buzzers include the following.

- Panel Mount
- Wire Leads
- Screw Terminals
- Through Hole
- Spring Contact
- Surface Mount

2.9.7 BUZZER CIRCUIT DIAGRAM:

The circuit diagram of the water level indicator using the buzzer is shown below. This circuit is used to sense or detect the water level within the tank or washing machine or pool, etc. This circuit is very simple to design using few components such as a transistor, buzzer, 300K variable resistor, and power supply or 9V battery.

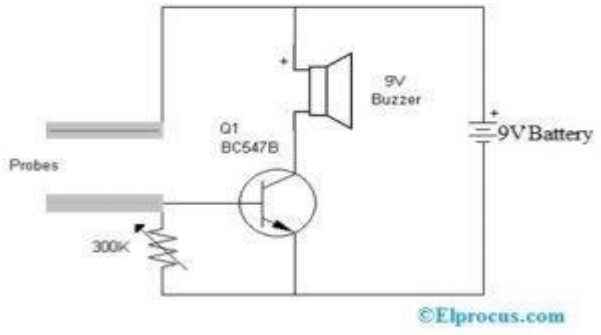


Fig 19-Water Level Indicator Buzzer

Once the two probes of the circuit are placed in the tank, it detects the level of water. Once the water level exceeds the fixed level, then it generates a beep sound through a buzzer connected to the circuit. This circuit uses a BC547B NPN transistor however we can also use any general-purpose transistor instead of using 2N3904/2N2222. This water level sensor circuitworking is very simple and the transistor used within the circuit works as a switch. Once the two probes notice the water level within the tank, then the transistor turns ON & the voltage begins flowing throughout the transistor to trigger the buzzer.

2.9.8 ADVANTAGES:

The advantages of a buzzer include the following.

- Simply Compatible
- Frequency Response is Good
- Size is small
- Energy Consumption is less
- The Range of Voltage usage is Large
- Sound Pressure is high

2.8.9 DISADVANTAGES:

- Controlling is a little hard
- Generates Annoying Sound
- Training is necessary to know how to repair the condition without just turning off.

2.9.10 APPLICATIONS:

The applications of the buzzer include the following.

- Communication Devices
- Electronics used in Automobiles

- Alarm Circuits
- Portable Devices
- Security Systems
- Timers
- Household Appliances
- Electronic Metronomes
- Sporting Events
- Annunciator

2.10 LED

A **light-emitting diode** (**LED**) is a semiconductor device that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.[5] White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.[6]

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared (IR) light.[7] Infrared LEDs are used in remote-control circuits, such as those used with a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red. Early LEDs were often used as indicator lamps, replacing small incandescent bulbs, and in seven-segment displays. Later developments produced LEDs available in visible, ultraviolet (UV), and infrared wavelengths, with high, low, or intermediate light output, for instance white LEDs suitable for room and outdoor area lighting. LEDs have also given rise to new types of displays and sensors, while their high switching rates are useful in advanced communications technology with applications as diverse as aviation lighting, fairy lights, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, lighted wallpaper, horticultural grow lights, and medical devices.[8]

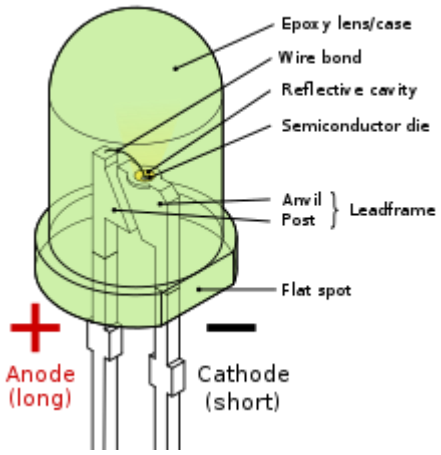


Fig.14**.LED**

LEDs have many advantages over incandescent light sources, including lower power consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. In exchange for these generally favorable attributes, disadvantages of LEDs include electrical limitations to low voltage and generally to DC (not AC) power, inability to provide steady illumination from a pulsing DC or an AC electrical supply source, and lesser maximum operating temperature and storage temperature. In contrast to LEDs, incandescent lamps can be made to intrinsically run at virtually any supply voltage, can utilize either AC or DC current interchangeably, and will provide steady illumination when powered by AC or pulsing DC even at a frequency as low as 50 Hz. LEDs usually need electronic support components to function, while an incandescent bulb can and usually does operate directly from an unregulated DC or AC power source

SOFTWARE DESCRIPTION

2.11.ARDUINO :

Arduino is an open source, computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that

can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL),[1] permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (*shields*) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

The Arduino project started in 2003 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy,[2]aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

A program for Arduino may be written in any programming language for a compiler that produces binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio.

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platformapplication written in the programming language Java.

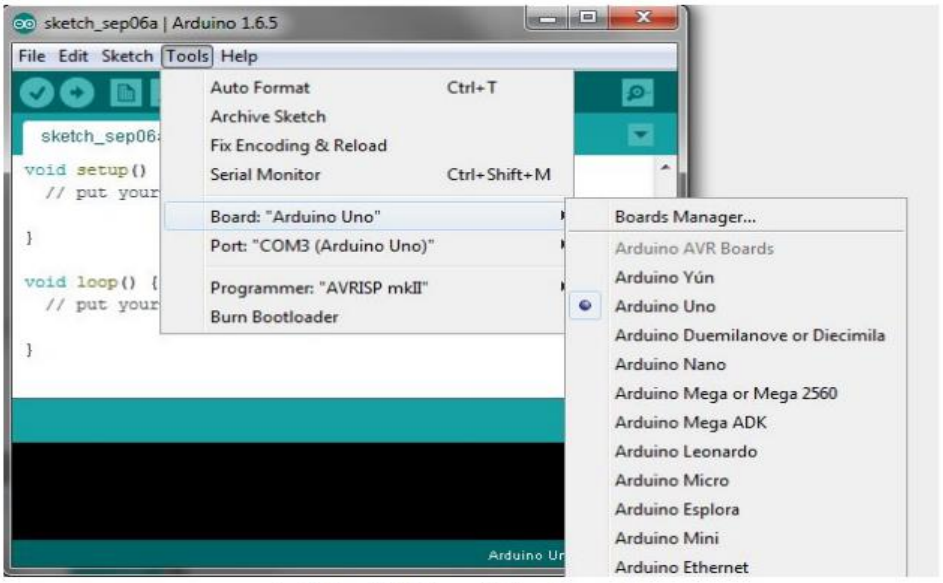
It originated from the IDE for the languages *Processing* and *Wiring*. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple *one-click* mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

A program written with the IDE for Arduino is called a *sketch*.[42] Sketches are saved on the development computer as text files with the file extension *.ino*. Arduino Software (IDE) pre-1.0 saved sketches with the extension *.pde*.

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

Fig 15- Arudino IDE Compile

You have to tell the Arduino IDE what board you are uploading to. Select the Tools pull down menu and go to Board. This list is populated by default with the currently available Arduino Boards that are developed by Arduino. If you are using an Uno or an Uno-Compatible Clone (ex. Funduino , Sain Smart, IEIK, etc.), select Arduino Uno. If you are using another board/clone, select that board.



Arduino IDE: Board Setup Procedure

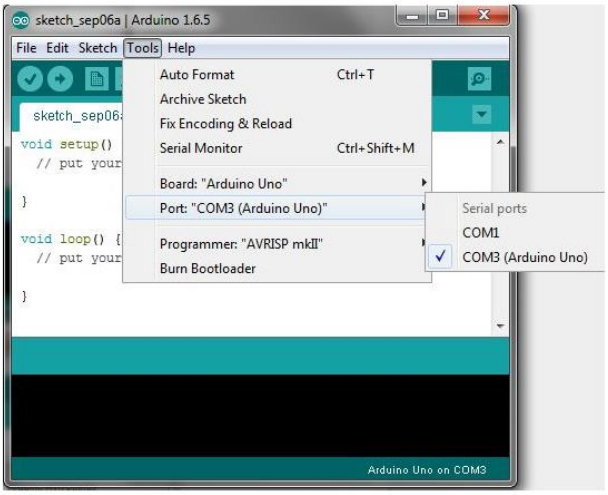
Fig 16-Board setup procedure

2.11.1 COM PORT SETUP:

If you downloaded the Arduino IDE before plugging in your Arduino board, whenyou plugged in the board, the USB drivers should have installed automatically. The most recent Arduino IDE should recognize connected boards and label them with which COM port they are using. Select the Tools pulldown menu and then Port.Here it should list all open COM ports, and if there is a recognized Arduino Board, it will also give it's name. Select the Arduino board that you have connected to the PC. If the setup was successful, in the bottom right of the Arduino IDE, you should see the board type and COM number of the board you plan to program. Note: the Arduino Uno occupies the next available COM port; it will not always be COM3.

At this point, your board should be set up for programming, and you can begin writing and uploading code.

If you are using an Uno or an Uno-Compatible Clone (ex. Funduino , Sain Smart, IEIK, etc.), select Arduino Uno. If you are using another board/clone, select that board.



Arduino IDE: COM Port Setup

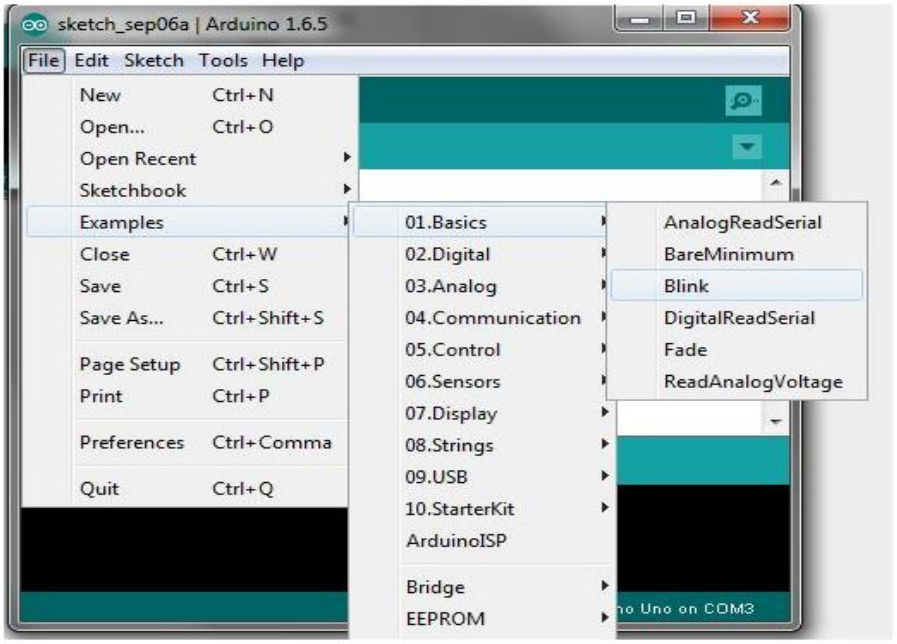
Fig 17- COM Port Setup

At this point, your board should be set up for programming, and you can begin writing and uploading code.

2.11.2 UPLOADING BLINK:

One common procedure to test whether the board you are using is properly set up is to upload the “Blink” sketch. This sketch is included with all Arduino IDE releases and can be accessed by the Filepull-down menu and going to Examples, 01.Basics, and then select Blink. Standard Arduino Boards include a surface-mounted LED labeled “L” or “LED” next to the “RX” and “TX” LEDs, that is connected to digital pin 13. This sketch will blink the LED at a regular interval, and is an easy way to confirm if your board is set up properly and you were successful in uploading code. Open the “Blink” sketch and press the “Upload” button in the upper-left corner to upload “Blink” to the board.

Upload Button: 



Arduino IDE: Loading Blink Sketch

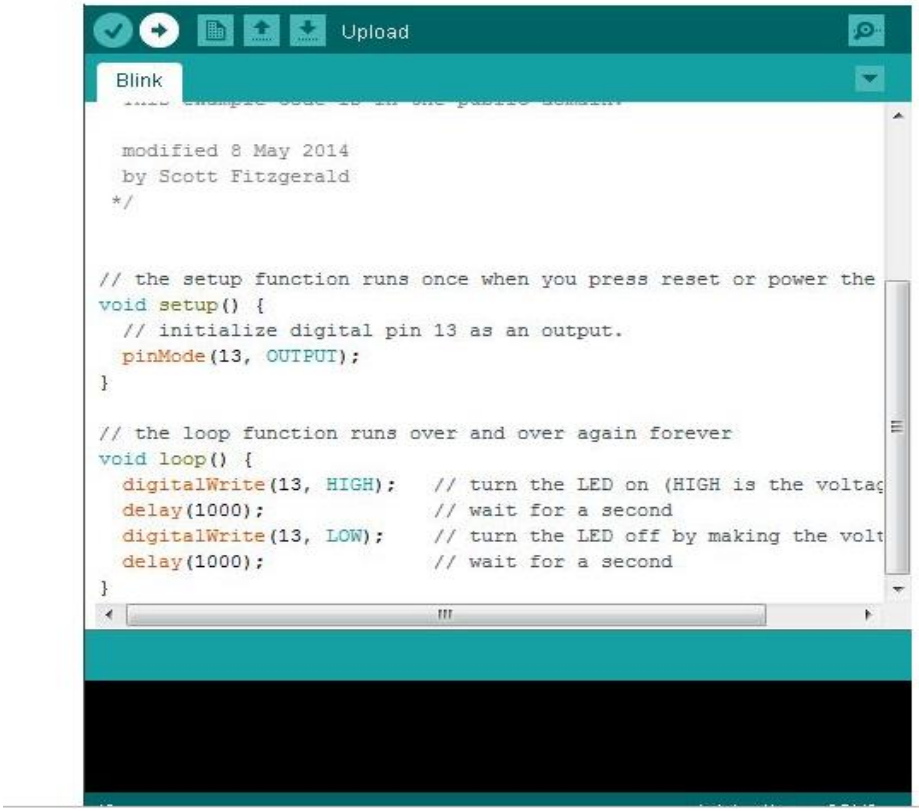


Fig 18-Loding Blink Sketch & Code uploading

1.Download and install Arduino IDE (https://www.arduino.cc/en/Main/Software)

2. Plug in your Arduino Board

3. Select the proper board in the IDE (Tools>Boards>Arduino Uno)

4. Select the proper COM port (Tools>Port>COMx (Arduino Uno))

5. Open the "Blink" sketch (File>Examples>Basics>01.Blink)

6. Press the Upload button to upload the program to the board

7. Confirm that your board is working as expected by observing LED

- Arduino has lots of community support and documentation. Your best bet when running into unexpected problems is to search online for help. You should be able to find a forum where someone had the same problem you are having, and someone helped them fix it. If you don't find results, try modifying your search, or post on the Arduino forums.

- My board isn't listed under devices and is not recognized by IDE: ○ Most likely, this means that the ATMega328p chip is not programmed with the Arduino firmware. If you have a separate working Uno available, you can program the unprogrammed chip using this guide and a few jumper cables: https://www.arduino.cc/en/Tutorial/ArduinoISP ○ If you don't have a separate Arduino available, let me know and I can use an Atmel Programmer to upload the firmware. ○ There may be hardware damage if you had the board plugged into USB and external power at the same time. You may have to replace the chip if this is the case.

- Error Message: avrdude: stk500_recv(): programmer is not responding ○ Double-check that you are using the correct COM port. ○ Make sure that your Arduino Board is plugged into the computer.

- The IDE says "Uploading…" after pressing the upload button, but nothing is happening. ○ Double-check that you have the correct board selected in the Tools menu. ○ Depending on the size of your program, it may take a few seconds to upload. If you feel like it is taking too long, it may be encountering an error and you can try unplugging and plugging in the Arduino board.

2.12 IOT(INTERNET OF THINGS):

2.12.1 THINK SPEAK:

Internet of Things (IoT) describes an emerging trend where a large number of embedded devices (things) are connected to the Internet. These connected devices communicatewith people and other things and often provide sensor data to cloud storage and cloud computingresources where the data is processed and analyzed to gain important insights. Cheap cloud computing power and increased device connectivity is enabling this trend. IoT solutions are built for many vertical applications such as environmental monitoring and control, health monitoring, vehicle fleet monitoring, industrial monitoring and control, and home automation.At a high level, many IoT systems can be described using the diagram below.

On the left, we have the smart devices (the "things" in IoT) that live at the edge of the network. These devices collect data and include things like wearable devices, wireless temperatures sensors, heart rate monitors, and hydraulic pressure sensors, and machines on thefactory floor. In the middle, we have the cloud where data from many sources is aggregated andanalyzed in real time, often by an IoT analytics platform designed for this purpose. The right side of the diagram depicts the algorithm development associated with the IoT application.

Here an engineer or data scientist tries to gain insight into the collected data by performing historical analysis on the data. In this case, the data is pulled from the IoT platforminto a desktop software environment to enable the engineer or scientist to prototype algorithmsthat may eventually execute in the cloud or on the smart device itself. An IoT system includes all these elements. ThingSpeak fits in the cloud part of the diagram and provides a platform toquickly collect and analyze data from internet connected sensors.

2.12.2 THINK SPEAK (IOT):

Thing Speak is IoT Cloud platform where you can send sensor data to the cloud. You can also analyze and visualize your data with MATLAB or other software, including making your own applications. The Thing Speak service is operated by Math Works. In order to sign up for Thing Speak, you must create a new Math Works Account or log in to your existing Math Works Account Thing Speak is free for

small non-commercial projects.

Thing Speak includes a Web Service (REST API) that lets you collect and store sensordata in the cloud and develop Internet of Things applications. It works with Arduino, RaspberryPi and MATLAB (premade libraries and APIs exists) But it should work with all kind of Programming Languages, since it uses a REST API and HTTP. Thing Speak 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, social network and otherAPIs. We will consider each of these features in detail below.

The core element of Thing Speak is a 'Thing Speak Channel'. A channel stores the data thatwe send to Thing Speak 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 orfrom an embedded device.
- 3 location fields - Can be used to store the latitude, longitude and the elevation. These arevery useful for tracking a moving device.
- 1 status field - A short message to describe the data stored in the channel.

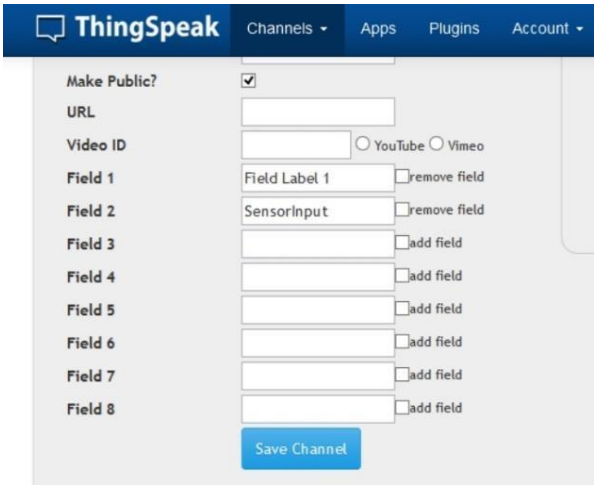


Fig19 - Input Entering Window

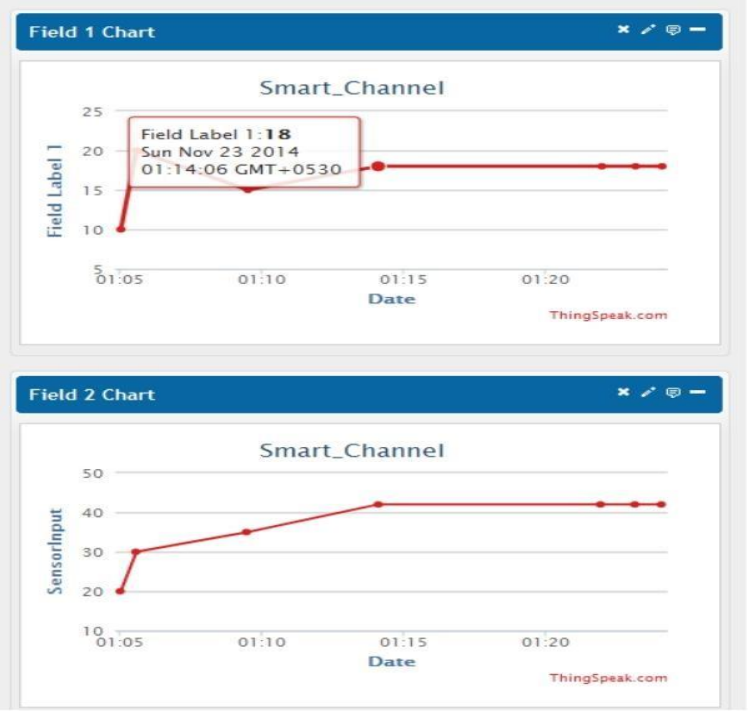


Fig.20 - Output Showing Window

2.12.3 THING SPEAK KEY FEATURES:

ThingSpeak allows you to aggregate, visualize and analyze live data streams in the cloud.

Some of the key capabilities of ThingSpeak include the ability to:

- Easily configure devices to send data to ThingSpeak using popular IoT protocols.
- Visualize your sensor data in real-time.
- Aggregate data on-demand from third-party sources.
- Use the power of MATLAB to make sense of your IoT data.
- Run your IoT analytics automatically based on schedules or events.
- Prototype and build IoT systems without setting up servers or developing websoftware.
- Automatically act on your data and communicate using third-party services likeTwilio® or Twitter®.

2.13 EMBEDDED C:

2.13.1 BASICS OF EMBEDDED C:

Embedded C is one of the most popular and most commonly used Programming Languages in the development of Embedded Systems. So, in this article, we will see some of the Basics of Embedded C Program and the Programming Structure of Embedded C. EmbeddedC is perhaps the most popular languages among Embedded Programmers for programming Embedded Systems.

There are many popular programming languages like Assembly, BASIC, C++, Python etc. that are often used for developing Embedded Systems but Embedded C remains popular due to its efficiency, less development time and portability. Before digging in to the basics of Embedded C Program, we will first take a look at what an Embedded System is and the importance of Programming Language in Embedded Systems.

2.13.2.PROGRAMMING EMBEDDED SYSTEMS:

As mentioned earlier, Embedded Systems consists of both Hardware and Software.If weconsider a simple Embedded System, the main Hardware Module is the Processor. The Processor is the heart of the Embedded System and it can be anything like a Microprocessor, Microcontroller, DSP, CPLD (Complex Programmable Logic Device) or an FPGA (Field Programmable Gated Array).All these devices have one thing in common: they are programmable i.e.,

we can write a program (which is the software part of the Embedded System) to definehow the device actually works. Embedded Software or Program allow Hardware to monitor external events (Inputs/ Sensors) and control external devices (Outputs) accordingly. During this process, the program for an Embedded System may have to directly manipulate the internalarchitecture of the Embedded Hardware (usually the processor) such as Timers, Serial Communications Interface, Interrupt Handling, and I/O Ports etc.

From the above statement, it is clear that the Software part of an Embedded System is equally important as the Hardware part. There is no point in having advanced Hardware Components with poorly written programs (Software). There are many programming languagesthat are used for Embedded Systems like Assembly (low-level Programming Language), C, C++, JAVA (high-level programming languages), Visual Basic, JAVA Script (Application level Programming Languages), etc.

2.13.2 FACTORS FOR SELECTING THE PROGRAMMING LANGUAGE:

The following are few factors that are to be considered while selecting the ProgrammingLanguage for the development of Embedded Systems.

Size: The memory that the program occupies is very important as Embedded Processors like Microcontrollers have a very limited amount of ROM (Program Memory).

Speed: Theprograms mustbeveryfasti.e., theymustrun as fast as possible. The hardware should not be slowed down due to a slow running software.

2.13.3 GLOBAL DECLARATION SECTION:

This part of the code is the part where the global variables are declared. Also, the user-defined functions are declared in this part of the code. They can be accessed from anywhere.

Every C programs need to have the main function. So does an embedded C program. Each main function contains 2 parts. A declaration part and an Execution part. The declaration part is the part where all the variables are declared. The execution part begins with the curly brackets and ends with the curly close bracket. Both the declaration and execution part are inside the curly braces.

```
Void main(void)//main function
{
 P1 = 0x00;
 While(1)
  {
   P1 = 0xFF
  Delay(1000);
  P1 = 0x00;
  delay(1000);
```

```
  }
}
```

- **Global Declaration Section:**

This part of the code is the part where the global variables are declared. Also, the user-defined functions are declared in this part of the code. They can be accessed from anywhere.

- **Local Declaration Section:**

These variables are declared in the respective functions and cannot be used outside the main function.

- **Main Function Section:**

Every C programs need to have the main function. So does an embedded C program. Each main function contains 2 parts. A declaration part and an Execution part. The declaration part is the part where all the variables are declared. The execution part begins with the curly brackets and ends with the curly close bracket. Both the declaration and execution part are inside the curly braces.

2.14.MACHINE LEARNING

Machine learning (ML) is a branch of artificial intelligence (AI) that enables computers to "self-learn" from training data and improve over time, without being explicitly programmed. Machine learning algorithms are able to detect patterns in data and learn from them, in order to make their own predictions. In short, machine learning algorithms and models learn through experience.

In traditional programming, a computer engineer writes a series of directions that instruct a computer how to transform input data into a desired output. Instructions are mostly based on an IF-THEN structure: when certain conditions are met, the program executes a specific action.

Machine learning, on the other hand, is an automated process that enables machines to solve problems with little or no human input, and take actions based on past observations.

While artificial intelligence and machine learning are often used interchangeably, they are two different concepts. AI is the broader concept – machines making decisions, learning new skills, and solving problems in a similar way to humans – whereas machine learning is a subset of AI that enables intelligent systems to autonomously learn new things from data.

Instead of programming machine learning algorithms to perform tasks, you can feed them examples of labeled data (known as training data), which helps them make calculations, process data, and identify patterns automatically.

2.14.1 RANDOM FOREST ALGORITHM

Random forest is a classification and regression algorithm .It is used to solve classification as well as regression problems.It is mainly used for classification problems.Forest is made up of lots of trees and more trees means more robus forest.Random forest algorithm creates decision trees on data samples.It gets the prediction from each of them and finally selects the best solution by means of voting.It is better than the single decision tree because it redduces overfitting by averaging the result.

Random forest algorithm can be understood from the following steps:

Step 1: First , start with the selection of random samples from the given dataset.

Step 2: Next , the algorithm will construct a decision tree for every sample.

Step 3: In this step , voting will be performed for every predicted result.

Step 4: At last , select the most voted prediction result as the final prediction result.

First , start with importing necessary python packages.

```
import numpy as np
import matplotlib.pyplot as plt
```

import pandas as pd

Download the iris dataset from the weblink.

path = "https://archive.ics.uci.edu/ml/machine-learning-databases/iris/iris.data"

Next , we need to assign column names to the dataset.

headernames = ['sepal-length', 'sepal-width', 'petal-length', 'petal-width', 'Class']

Next , we need to read dataset to pandas dataframe

dataset = pd.read_csv(path, names=headernames)

dataset.head()

Data preprocessing will be done with the help of following script lines:

X = dataset.iloc[:, :-1].values

y = dataset.iloc[:, 4].values

Next , we will divide the data into train and test split.

The following code will split the dataset into 70% training dataset and 30% testing dataset.

from sklearn.model_selection import train_test_split X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.30)

Next , train the model with RandomForestClassifier class of sklearn.from sklearn.ensemble importRandomForestClassifier

classifier = RandomForestClassifier(n_estimators=50) classifier.fit(X_train, y_train)

At last , we need to make predictions. It can be done with the help of following script:

y_pred = classifier.predict(X_test)

Next print the result as follows:

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score result = confusion_matrix(y_test, y_pred)

```
print("Confusion Matrix:")

print(result)

result1 = classification_report(y_test, y_pred)

print("Classification Report:",)

print (result1) result2 = accuracy_score(y_test,y_pred)

print("Accuracy:",result2)

Confusion Matrix:

[ [14 0 0]

[ 0 18 1]

[ 0 0 12] ]
```

2,15.1.1ADVANTAGES

- It overcomes the problem of overfitting by combining the results of different decision trees.
- Random forest works well for a large range of data items.
- This algorithm has less variance than single decision tree.
- They are very flexible and possess very high accuracy.
- Scaling is not required in Random Forest Algorithm.
- It provides good accuracy even after providing data without scaling.
- Random Forest Algorithms are very complex.
- Random forests construction are much harder and time consuming.
- Lot of computational resources are required in order to implement Random Forest Algorithm.
- It is less intuitive in case when large amount of decision trees.

- Prediction time is more when we use Random Forest Algorithm when compared to other algorithms.

CHAPTER-3

3.1 FUTURE SCOPE:

- Increase the parameters by addition of multiple sensors.
- Detecting the more parameters for most secure purpose .
- By interfacing relay we controls the supply of water.
- In future we use more IOT concept in this project .

3.2 ADVANTAGES:

- Benefits currently identifying traffic pollution aside from decreasing exhalation rise off vapour.
- Preserving some certain unit of fuel worth keeping appear an extensive difference between civilization and commercial.
- Observing traffic jams beside IoT set up benefits keep granting the better resourceful city.
- Automated money transactions keep redeeming while customers are directed towards bulky amounts.
- The large number of papers misused might last replaced by computerized bills rather printed paper bills.
- After all paper slips are skipped in the presently planned ideology and never use of any attendant for collecting slips

3.3 DISADVANTAGES:

- Drivers who rely on public transportation may not have the ability to use this app because they don’t own a car or drive their own vehicle.
- These systems also require a lot of maintenance because many sensors need to be replaced often due to wear and tear or vandalism.

3.4 APPLICATIONS:

- Parking is an application of IoT technology for helping drivers find the best parking spots based on their location, budget and time period.
- Smart Parking helps drivers find a parking spot near them by using a mobile app.
- The mobile app determines if there are any vacant spots available for parkingby using the data communicated by the nearest parking lot.
- If the nearest parking lot is full, the app checks alternate lots and suggests a parking space to the driver. It can also help the driver navigate to the suggested parking space.
- The driver can reserve the parking space till he navigates to it. Smart parking system can also allow users to pay for parking spots using the app.
- The user can also be notified when the time slot that he has paid for is going to elapse so that he can take appropriate action.

CHAPTER-4

4.1 SOURCE CODE:

```
#define SW_VERSION " ThinkSpeak.com" // SW version will appears at innitial LCD Display
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);
#include <ESP8266WiFi.h>
#include <WiFiClientSecure.h>
#include <MCP3008.h>
uint32_t tsLastReport = 0;
void onBeatDetected()
{
   ;
}
const char* MY_SSID = "c";
const char* MY_PWD = "123456789";

WiFiClient client;

const char* TS_SERVER = "api.thingspeak.com";
```

```
String TS_API_KEY = "XVP885T53M6XFIXX";


const int xPin = A0;
#define CS_PIN    D8
#define CLOCK_PIN D5
#define MOSI_PIN  D7
#define MISO_PIN  D6
int buzzer=D3;
int led=D4;
int turbidity;
int water;
//WiFiClientSecure client;


MCP3008 adc(CLOCK_PIN, MOSI_PIN, MISO_PIN, CS_PIN);


/*
   Connecting WiFi
 **/
void connectWifi()
{
  Serial.print("Connecting to " + *MY_SSID);
  WiFi.begin(MY_SSID, MY_PWD);
  while (WiFi.status() != WL_CONNECTED)
```

```
 {
   delay(1000);
   Serial.print(".");
 }
 Serial.println("");
 Serial.println("WiFi Connected");
 Serial.println("");
   lcd.begin();
 // Turn on the blacklight and print a message.
 lcd.backlight();
 lcd.print("WELCOME");
}
/*
  Sending Data to Thinkspeak Channel
 **/
void sendDataTS(void)
{
 int x = adc.readADC(1);
 Serial.print("ec sensor val :");
 Serial.println(x);
 lcd.clear();
 lcd.print("ec sensor: ");
 lcd.print(x);
```

```
delay(3000);
if(x>400){
  digitalWrite(D4,HIGH);
  delay(1000);
   digitalWrite(D3,HIGH);
  delay(1000);
}
else{
  digitalWrite(D4,LOW);
  delay(1000);
  digitalWrite(D4,LOW);
  delay(1000);
}
int y = adc.readADC(0);
delay(100);
Serial.print("turbidity value : ");
Serial.println(y);
lcd.clear();
lcd.print("turbidity: ");
lcd.print(y);
delay(3000);
if(y>=255){
  digitalWrite(D4,HIGH);
```

```
  delay(1000);
}
else{
  digitalWrite(D4,LOW);
  delay(1000);
}
if (client.connect(TS_SERVER, 80))
{
  String postStr = TS_API_KEY;
  postStr += "&field1=";
  postStr += String(x);
   postStr += "&field2=";
  postStr += String(y);
  postStr += "\r\n\r\n";

  client.print("POST /update HTTP/1.1\n");
  client.print("Host: api.thingspeak.com\n");
  client.print("Connection: close\n");
  client.print("X-THINGSPEAKAPIKEY: " + TS_API_KEY + "\n");
  client.print("Content-Type: application/x-www-form-urlencoded\n");
  client.print("Content-Length: ");
  client.print(postStr.length());
  client.print("\n\n");
```

```
    client.print(postStr);
    delay(1000);
  }
  client.stop();
}
void setup()
{
  pinMode(D3,OUTPUT);
  pinMode(D4,OUTPUT);
  Serial.begin(9600);
  delay(10);
  connectWifi();

}
void loop()
{
  sendDataTS();
  delay(10);
}
```

4.2 RESULT:

4.2.1 OUTPUT:

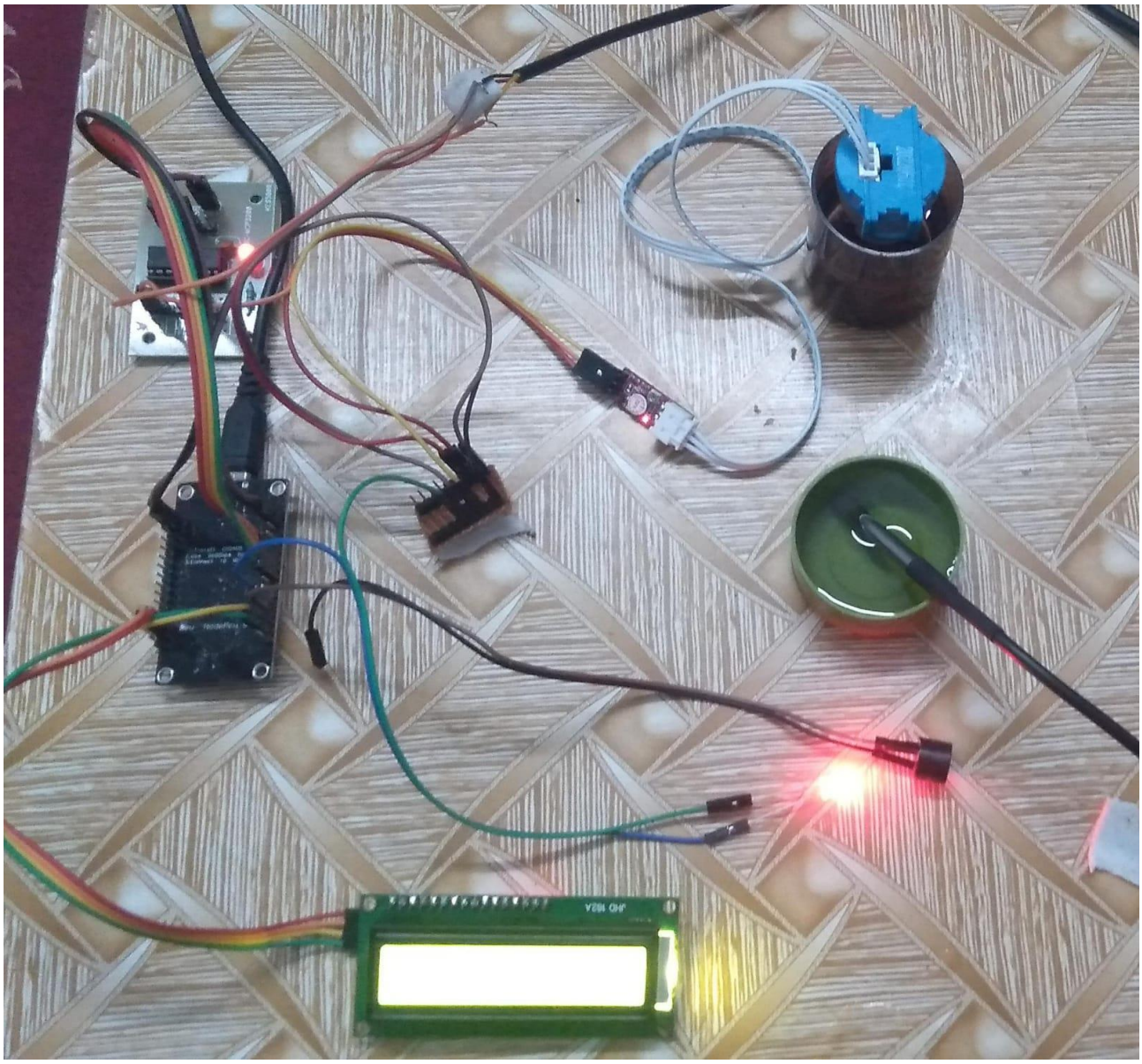


Fig.21 – water quality check

lcd output

Fig.22 – Turbidity value

Fig .23 – Electrical conductivity value

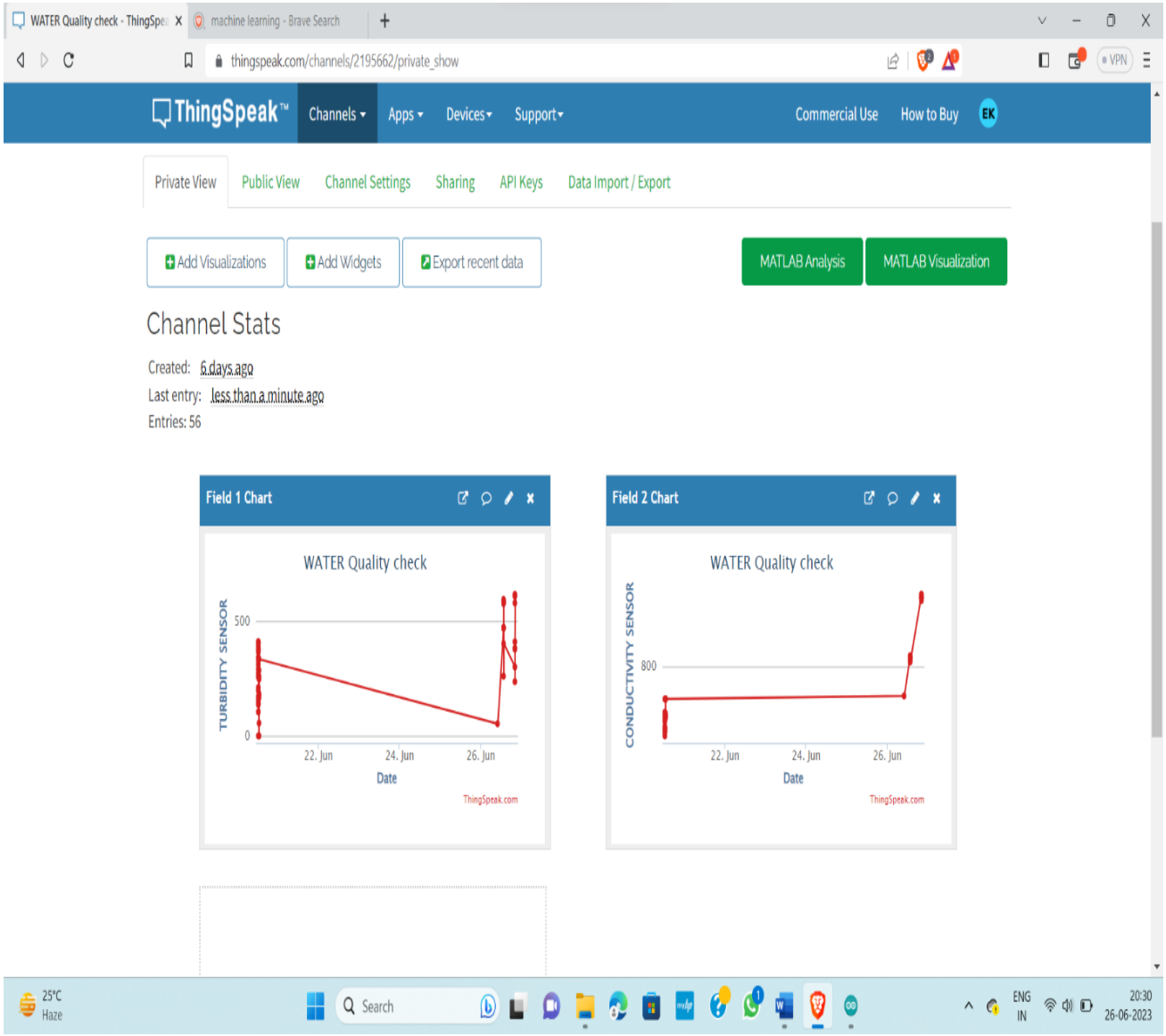
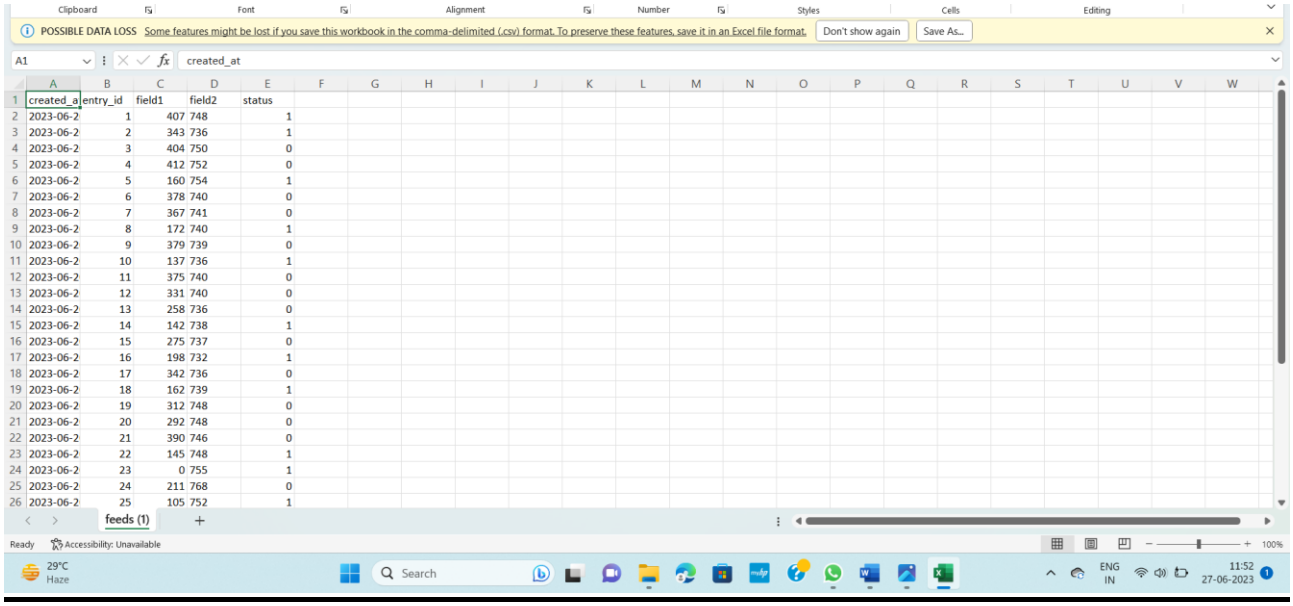
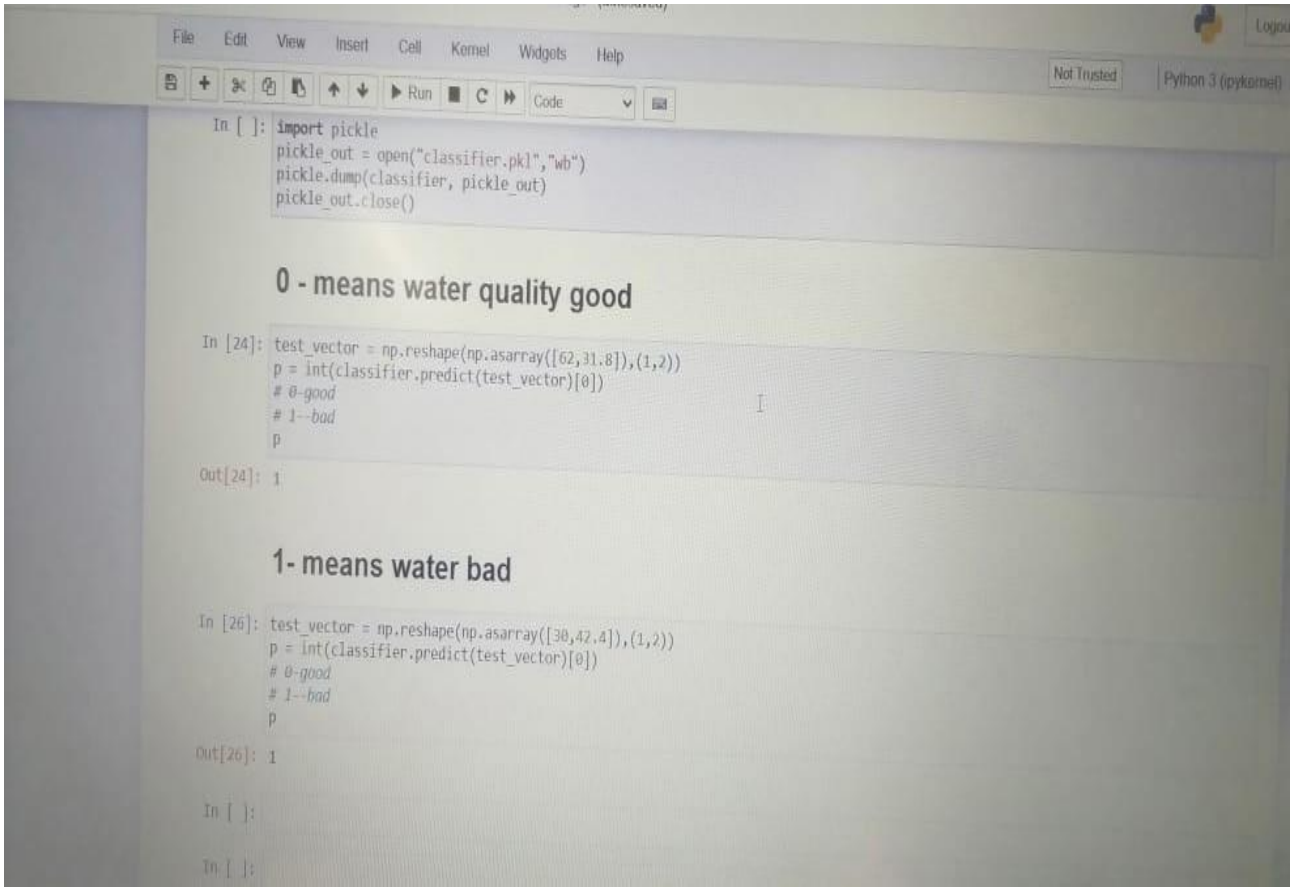


Fig.24 - IOT graphs



created_at	entry_id	field1	field2	status
2023-06-2	1	407	748	1
2023-06-2	2	343	736	1
2023-06-2	3	404	750	0
2023-06-2	4	412	752	0
2023-06-2	5	160	754	1
2023-06-2	6	378	740	0
2023-06-2	7	367	741	0
2023-06-2	8	172	740	1
2023-06-2	9	379	739	0
2023-06-2	10	137	736	1
2023-06-2	11	375	740	0
2023-06-2	12	331	740	0
2023-06-2	13	258	736	0
2023-06-2	14	142	738	1
2023-06-2	15	275	737	0
2023-06-2	16	198	732	1
2023-06-2	17	342	736	0
2023-06-2	18	162	739	1
2023-06-2	19	312	748	0
2023-06-2	20	292	748	0
2023-06-2	21	390	746	0
2023-06-2	22	145	748	1
2023-06-2	23	0	755	1
2023-06-2	24	211	768	0
2023-06-2	25	105	752	1

Fig.25. EXEL DATA



```
In [ ]: import pickle
        pickle_out = open("classifier.pkl","wb")
        pickle.dump(classifier, pickle_out)
        pickle_out.close()
```

0 - means water quality good

```
In [24]: test_vector = np.reshape(np.asarray([62,31.8]),(1,2))
         p = int(classifier.predict(test_vector)[0])
         # 0-good
         # 1--bad
         p
Out[24]: 1
```

1- means water bad

```
In [26]: test_vector = np.reshape(np.asarray([30,42.4]),(1,2))
         p = int(classifier.predict(test_vector)[0])
         # 0-good
         # 1--bad
         p
Out[26]: 1
```

Fig.26 prediction using ML

CHAPTER-5

5.1 CONCLUSION:

Based on study of existing water quality monitoring system and scenario of water we can define that proposed system is more suitable to monitor and analysis of water quality parameters in real time. The smart water quality meter is automatic and does not require human interface, thereby reducing the errors, a sensor node with a electrical conductivity and turbidity sensors was designed and connected to nodemcu board. The proposed system having wireless sensor networking using Wi-Fi module, which makes sensor.network is simple low cost and reliable and more efficient. The electrical conductivity sensor made use of a glass electrode and yielded acceptable results. The Turbidity sensor based light transmission and reception yields acceptable result The microcontroller is used as heart of this module, which process the received signal from different sensors then transmitted the measurements wirelessly to the cloud via the wireless Wi-Fi modules. A wireless node was implemented using ESP8266 Wi-Fi modules configured for peer-to-peer communication. IoT in recent computing paradigms consist of sensor or objects. The objects surround us to connect to a network. And exchange information to advances in semiconductor and communication technology lead to development of tiny computing devices and the object get smaller as embedded system; they become a sensor as actuators system. They are deployed in on sample water and generate numerous data. The network connected to server in the cloud through gateway, thus a lot of data is delivered to the sever and server gathers data from the objects and then analyze it for intelligent services.

.

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