# LIBRARY MANAGEMENT SYSTEM

A dissertation submitted in partial fulfilment of the requirement for the award of the degree of

**BACHELOR OF SCIENCE IN PHYSICS**


**By**

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2. **Abinaya. C 2020P02**
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Under the Guidance of

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**FATIMA COLLEGE (Autonomous)**
Re-Accredited with A++ by NAAC (Cycle – IV)
Mary Land, Madurai - 625 018.

**APRIL, 2023**

## CERTIFICATE

This is to certify that the project work **'LIBRARY MANAGEMENT SYSTEM'** done by Abarna. J (2020P01), Abinaya. C (2020P0), Abisha. S (2020P03), Aileen Matharasi. A (2020P04), Ancitta. D (2020P05) under the guidance of Ms. R. Alphonsa Fernando, Associate Professor, Research Centre of Physics, Fatima College( Autonomous), Madurai.

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## DECLARATION

We hereby declare that the dissertation titled " **LIBRARY MANAGEMENT SYSTEM"**, submitted to Fatima College (Autonomous), Madurai -625018 to the award of degree of **Bachelor of Science in Physics** is a record of original project work carried out under the supervision of **Ms. R. Alphonsa Fernando, Associate Professor, Research Centre of Physics, Fatima College (Autonomous), Madurai** and has not submitted for any degree or diploma in Madurai Kamaraj University or any Institution.

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**Place :** Madurai

**Date :** 05/04/2023

**PROBLEM STATEMENT:**

The problem that occurs before having digital library management system are

1. The missing of books occurs due to the improper arrangement by human environment.
2. It consumes a lot of time for identifying a particular book.
3. The hardware disc such as barcode, scanners are not sufficient in number.
4. There is difficulty in searching the books.
5. It requires a man power to supervise a large number of books.
6. Missing of books occur due to the lack of staffs.
7. Barcodes can only store identification number.

**SOLUTION:**

1. It helps to search the books in easiest way as well as in the proper manner.
2. It helps to find a particular book in a short of time.
   (For Eg: A particular book can be found in the range of 40m among 1 lakh books within 5 minutes.)
3. This system makes library functions automatic, making the task of the librarian easy.
4. Easy to identify the unorganized book.
5. It gives reliable search facilities for the users.
6. RFID tag can store the stack number, author names,book titles, book version and many other important details.
7. The maintance cost is low compared to the other management systems like barcodes, scanners.
8. This system is a user- friendly and the process is very fast.
9. This is simple and easy to operate.

**INTRODUCTION:**

***LIBRARIES are a cornerstone of the community dedicated to serving the information needs of everyone***

As such, they collect and make available a wide variety of information resources representing the range of human thought and experience.

The library management system project is based on relevant technologies which is an attempt to automate the existing library. This project enables the user to find a desired book and to arrange the books in a easiest way. Thus, this system reduces manual work to a great extent allows smooth flow of library activities.

In our college, we are facing some issues in finding desired book and improper arrangement of books. By introducing RFID library management system we can easily solve these issues and make our library management system to a updated version of digital library system.

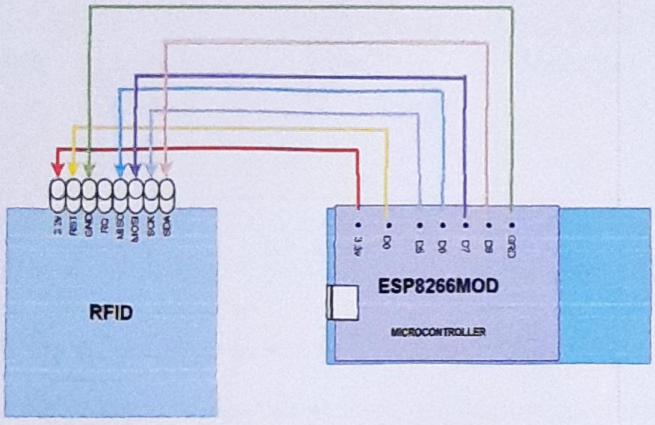
**Radio-frequency identification:**

- Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects.
- RFID refers to a wireless system comprised of two components: **tags and readers**.
- An RFID system consists of a tiny radio transponder, a radio receiver and transmitter.
- When triggered by an electromagnetic interrogation pulse from a nearby RFID reader device, the tag transmits digital data, usually an identifying inventory number, back to the reader.
- This number can be used to track inventory goods.

**DESIGN:**

Radio frequency identification system uses tags attached to the objects to be identified.

Two-way radio transmitter-receivers called **readers** send a signal to the tag and read its response.




**Readers:**

It uses radio ways to transmit signals that activate the tag.Once activated the tag sends a wave back to the antenna , where it is translated into the data.

**Types of RFID reader based on range of frequencies:**

| Band | Regulations | Range | Data speed | Remarks |
|---|---|---|---|---|
| **Low frequency: 120–150 kHz** | Unregulated | 10 cm | low | Animal identification, factory data collection |
| **High frequency : 13.56 MHz** | Radio spectrum (ISM band) | 1 m | Low to moderate | Smart cards, ISO-non-compliant memory cards, |

| Band | Regulations | Range | Data speed | Remarks |
|---|---|---|---|---|
| | | | | ISO-compatible microprocessor cards |
| **Ultra high frequency: 433 MHz** | Long range devices | 1–100 m | Moderate | Underground Miner Tracking with active tags |

**Tags:**

- The tag information is stored in a non-volatile memory.
- The RFID tag includes either fixed or programmable logic for processing the transmission and sensor data, respectively.
- RFID tags can be passive, active or battery-assisted passive. An active tag has an on-board battery and periodically transmits its ID signal.
- A passive tag is cheaper and smaller because it has no battery; instead, the tag uses the radio energy transmitted by the reader.
- The RFID tag receives the message and then responds with its identification and other information.
- This is the unique tag serial number, or product-related information such as a stock number, lot or batch number, production date, or other specific information.
- Since tags have individual serial numbers, the RFID system design can discriminate among several tags that might be within the range of the RFID reader and read them simultaneously.

**There are 3 types of RFID tags:**

1. Active RFID
2. Passive RFID
3. Semi- Passive RFID

**Passive RFID** system use tags with no internal power source and instead are powered by the electromagnetic energy transmitted from an RFID reader. Passive RFID tags are used for applications such as access control, file tracking, race timing, supply chain management, smart labels, and more. The lower price point per tag makes employing passive RFID systems economical for many industries.

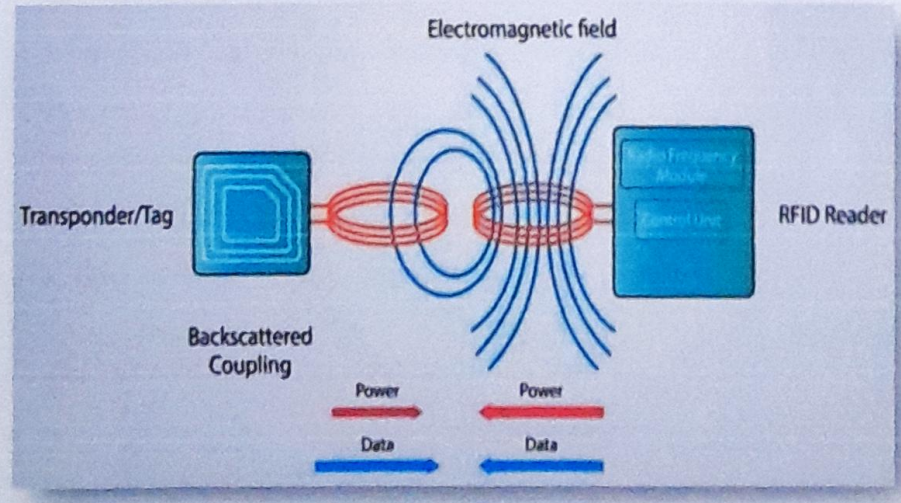
**Active RFID**systems use battery-powered RFID tags that continuously broadcast their own signal. Active RFID tags are commonly used as "beacons" to accurately track the real-time location of assets or in high-speed environments such as tolling. Active tags provide a much longer read range than passive tags, but they are also much more expensive.

**What are the other purposes of using RFID tags?**

Asset tracking, inventory visibility, and control, location tracking, patient tracking & monitoring, providing valuable data, Fast transaction in payment, avoiding distributing counterfeit medicines. These are a few of the purposes of using RFID tags.

**Software:**

RFID technology uses specific software depends on service providers. This software controls the RFID reader, initiate scan and retrieve information from



the tags and stores the information to a local computer or send to the cloud storage.RFID tags can be erased and re-used using control software.

**WORKING PRICIPLE:**

- ✓ RFID depends on the frequency of operation for low frequency and high frequency operation based on the inductive coupling (near field coupling).
- ✓ RFID technology works based on the principle of inductive coupling which include a source antenna and receiver antenna. Each RDID tag will have a microchip which contains a unique identification number, model, manufacturing date, expiry date, access information etc....
- ✓ RFID reading is a process of accessing information of a tag using a reader. When the user initiates a scanning, the tags are placed near the RFID reader or vice versa.
- ✓ RFID reader sends radio frequency signals using it's antenna, small coils embedded on the RFID tag pick up the signal from the reader and activate the tag (in passive tags) by powering it.
- ✓ Once the tag is activated, it starts to transmit data back to the reader using the same antenna coil using inductive coupling (backscatter coupling) method.

**Low frequency and high frequency (Inductive coupling):**

RFID reader continuously sends radio waves at a particular frequency. The radio waves which issend by the reader is of three purposes.

- It includes enough power into tag
- It provides synchronization clock tag to passive tag
- Acts as a carrier for return data from tag

The low and high frequency operation the RFID reader and tag are very close to each other. So working principle is based on the inductive coupling just like transformer action. The field which is generated by RFID reader is used

to couple with the antenna of a RFID tag, because of the mutual coupling voltage will get induced across the coil of the RFID tag. Some portion of voltage is rectified uses a power supply for the controller and memory elements.

RFID reader sending radio waves of a particular frequency so that voltage will be induced across the coil at a particular frequency. This induced voltage is used to synchronizing the clock of the controller. Suppose if we connect load across the coil, the current will start flowing through the connected load. If we change the impedance of load, simultaneously the current flowing through load will also change (Ohms Law), suppose if we switch ON/OFF load current will also ON/OFF. The switching of current the rate of change of current also generates the voltage in as RFID reader. The switching ON/OFF the load is known as the load modulation.

**Advantages of RFID technology:**

- Cost effective solution compared to other technologies
- Does not require direct line of sight to operate
- RFID readers can read hundreds of tags simultaneously within seconds
- RFID tags can be rewritten and easily reused
- Data from tags can be encrypted for enhanced security
- Tags can store more information than just basic product information (serial number, lot number manufacturing date, expiry, and website URL etc...)
- RFID systems can be integrated with other existing systems
- RFID technology is easily scalable and easy to implement

**Limitations of RFID technology:**

- Signals from the RFID reader can be blocked by metal surface, liquids and thick materials.
- Higher implementation cost compared to barcode scanners

- Accuracy is affected due to signal quality (any obstruction could cause error in data)
- Implementation is more complex than barcode system.
- Privacy and security vulnerabilities often argued with increased use of tags (especially personal information).

**PROGRAMMING CODE:**

```
#include <SPI.h>
#include <MFRC522.h>
#define SS_PIN D8
#define RST_PIN D0
MFRC522 rfid(SS_PIN, RST_PIN); // Instance of the class
MFRC522::MIFARE_Key key;
// Init array that will store new NUID
byte nuidPICC[4];
void setup() {
  Serial.begin(115200);
 SPI.begin(); // Init SPI bus
 rfid.PCD_Init(); // Init MFRC522
 Serial.println();
 Serial.print(F("Reader :"));
 rfid.PCD_DumpVersionToSerial();
 for (byte i = 0; i < 6; i++) {
    key.keyByte[i] = 0xFF;
 }
 Serial.println();
 Serial.println(F("This code scan the MIFARE Classic NUID."));
 Serial.print(F("Using the following key:"));
 printHex(key.keyByte, MFRC522::MF_KEY_SIZE);
}
void loop() {
 // Reset the loop if no new card present on the sensor/reader. This saves the entire process
when idle.
 if ( ! rfid.PICC_IsNewCardPresent())
    return;
 // Verify if the NUID has been readed
 if ( ! rfid.PICC_ReadCardSerial())
    return;
 Serial.print(F("PICC type: "));
 MFRC522::PICC_Type piccType = rfid.PICC_GetType(rfid.uid.sak);
 Serial.println(rfid.PICC_GetTypeName(piccType));
 // Check is the PICC of Classic MIFARE type
 if (piccType != MFRC522::PICC_TYPE_MIFARE_MINI &&
      piccType != MFRC522::PICC_TYPE_MIFARE_1K &&
```

```
    piccType != MFRC522::PICC_TYPE_MIFARE_4K) {
  Serial.println(F("Your tag is not of type MIFARE Classic."));
  return;
}
if (rfid.uid.uidByte[0] != nuidPICC[0] ||
    rfid.uid.uidByte[1] != nuidPICC[1] ||
    rfid.uid.uidByte[2] != nuidPICC[2] ||
    rfid.uid.uidByte[3] != nuidPICC[3] ) {
  Serial.println(F("A new card has been detected."));
  // Store NUID into nuidPICC array
  for (byte i = 0; i < 4; i++) {
    nuidPICC[i] = rfid.uid.uidByte[i];
  }
  Serial.println(F("The NUID tag is:"));
  Serial.print(F("In hex: "));
  printHex(rfid.uid.uidByte, rfid.uid.size);
  Serial.println();
  Serial.print(F("In dec: "));
  printDec(rfid.uid.uidByte, rfid.uid.size);
  Serial.println();

 //if (tag == "2422495525") {
  //Serial.println("Access Granted!");
  //Serial.println("Access Granted!");
}
else Serial.println(F("Card read previously."));
Serial.println(F("THERMO DYNAMICS"));
// Halt PICC
rfid.PICC_HaltA();
// Stop encryption on PCD
rfid.PCD_StopCrypto1();
}
/**
  Helper routine to dump a byte array as hex values to Serial.
*/
void printHex(byte *buffer, byte bufferSize) {
 for (byte i = 0; i < bufferSize; i++) {
   Serial.print(buffer[i] < 0x10 ? " 0" : " ");
   Serial.print(buffer[i], HEX);
 }
}
/**
  Helper routine to dump a byte array as dec values to Serial.
*/
void printDec(byte *buffer, byte bufferSize) {
 for (byte i = 0; i < bufferSize; i++) {
   Serial.print(buffer[i] < 0x10 ? " 0" : " ");
   Serial.print(buffer[i], DEC);
 }
}
```

**Conclusion:**

As any other available technologies, RFID also not has it's downsides in terms of security and accuracy. With continuous development and use of complex modulation techniques will ensure a better solution in the future. Higher demand and more vendors in RFID technology will reduce the implementation charges to lower levels.

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# NOISE MONITORING SYSTEM - IN LIBRARY

A dissertation submitted in partial fulfillment of the requirement for the award of the degree of

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BY


1. Anusuya Mary R - 2020P06
2. Bershina P - 2020P07
3. Bhuvaneshwari V - 2020P08
4. Deva Dharshini T - 2020P10
5. Divain Penni J - 2020P11

Under the guidance of

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Assistant Professor,

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FATIMA COLLEGE (AUTONOMOUS), MADURAI (Affiliated to MADURAI KAMARAJ UNIVERSITY)

(RE-ACCREDITED WITH 'A++' GRADE BY NAAC) (74 Rank in Indian Ranking 2020 (NIRF) by MHRD)

Mary Land, MADURAI-625018

April 2023

# Certificate

This is to certify that the project work NOISE MONITORING SYSTEM - IN LIBRARY done by_Anusuya Mary R (2020P06), Bershina P (2020P08), Bhuvaneshwari V (2020P08), Deva Dharshini T (2020P10) and Divain Penni J (2020P11) under the guidance of Dr. M.V. Leena Chandra, Assistant Professor, Research center of Physics has been submitted as the external viva-voce on 03.04.2023 at Fatima College (Autonomous), Madurai.

External Examiner 5/4/23

Guide 3/4/23

Head of the Department

## DECLARATION

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Place: Madurai

Date: 03.04.2023

## ACKNOWLEDGEMENT

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I thank God for his substantial blessings and mercy at all stages of the completion of my project. Taking this opportunity, I thank my parents and friends for their sacrifices in supporting me.

I feel honored to place a warm salutation to the management of **FATIMA COLLEGE, MADURAI** which gave me the opportunity to have a strong base in physics and practical and theoretical knowledge.

I express my sincere thanks to **REV. DR. SR. CELINE SAHAYA MARY., Principal, Fatima College, Madurai** for giving me a comfortable environment.

I express my sincere thanks to **REV. DR. SR. FATIMA MARY vice principal** for her extensive support rendered to carry out this project successfully.

I owe my special thanks to **Dr. A. Sheela Vimala Rani, M.Sc., M.Phil., Ph.D, HOD, Research centre of Physics,** for her valuable guidance and encouragement.

I owe my special thanks to **Dr. M. V. Leena Chandra, M.Sc., M.Phil., NET., Ph.D. Research center of physics** for her valuable guidance and encouragement.

I like to thank all the staff members in the research centre of physics of Fatima College, for their valuable suggestions at different stages of this project work.

# NOISE MONITORING SYSTEM - IN LIBRARY

## Problem Statement:

In the modern age, libraries suffer from many problems but noise is the major problems in both public and academic libraries. In order to facilitate the different needs of library uses, the libraries have established zones for quite conversation and silent study. When necessary, library staff will remind library users of the noise policy. Library users being disturbed by noise are encouraged to ask library staff to intervene. Those users who do not comply with the noise policy after being warned will be asked to leave the library premise.

## Solution:

In order to reduce this problem in the libraries monitoring presence would detect noise levels. The monitoring systems measures the noise in decibel level, it reveals that quite study areas within the library are in fact quiet and noise levels often stay within the 45 to 50 db. If the decibel reaches the threshold level it enables the alarm and alert the people in warning of increase in noise.

## Introduction:

Noise is considered to be an environment pollutant and requires to develop adequate mitigating measures. The normal decibel level in library is 40db and the threshold is above 50 db. Therefore, systematic noise monitoring and analysis of noise level measurements are necessary to access the noise level in the terms of possible combination of noise source and influencing parameters.

## Hardware:

1. NodeMCU - ESP8266
2. Sound Sensor (KY037).
3. Buzzer.
4. Connecting wires
5. Wish board.

## NodeMCU - ESP8266:

NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

Sound sensor module also provides and analog output voltage which is directly proportional to the intensity of the ambient sound.

**Interface Definition:**

- AO: analog output sensor
- GND: ground
- VCC: Power supply input range: 3 to 5 Volts.
- DO: Digital Output (comparator output)

**Features of KY038 Sound Sensor Module:**

- Working voltage: DC 4 - 5 Volts
- Signal output indication.
- Single channel signal output.
- The output effective signal is low level.
- When there is sound, outputs low level and the signal light.
- Can be used for Acoustic control light, give sound and light alarm working with Photosensitive sensor, and sound control, sound detect.
- Circuit board output switch quantity.

**WORKING:**

The working of this Sound detector is very similar to sensor which is built out of LM393 IC. The link to other sensors which are similar to it are also included in the basic electronic section.

The inverting input of the one comparator is connected to the positive pin of the condenser microphone with a resistor of 150 Ω in series.

The non-inverting input of both the comparators is connected to the voltage divider of 100kΩ each between VCC & GND.

The output of the first comparator is connected to the digital output and inverting input of the second comparator. The output of 2nd is connected to the VCC of the indicator LED with 10kΩ in series.

The potentiometer is connected to the inverting input of the first comparator with VCC. Also, the analog input is connected to this pin also.

**SOUND SENSOR - KY037:**

The NodeMCU ESP8266 development board comes with the ESP-12E module containing the ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency.

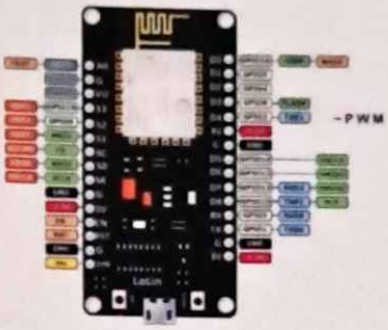
NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects. NodeMCU can be powered using a Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

The NodeMCU Development Board can be easily programmed with Arduino IDE since it is easy to use. Programming NodeMCU with the Arduino IDE will hardly take 5-10 minutes. All you need is the Arduino IDE, a USB cable and the NodeMCU board itself.

## 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.

## Pin Configuration:




| Pin Category | Name | Description |
|---|---|---|
| Power | Micro-USB, 3.3V, GND, Vin | Micro-USB: NodeMCU can be powered through the USB port<br>3.3V: Regulated 3.3V can be supplied to this pin to power the board<br>GND: Ground pins<br>Vin: External Power Supply |
| Control Pins | **EN, RST** | The pin and the button reset 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 board |
| SPI Pins | SD1, CMD, SD0, CLK | NodeMCU has four pins available for SPI communication. |
| UART Pins | TXD0, RXD0, TXD2, RXD2 | NodeMCU has two UART interfaces, UART0 (RXD0 & TXD0) and UART1 (RXD1 & TXD1). UART1 is used to upload the firmware/program.range is |

| | | |
|---|---|---|
| I2C Pins | | NodeMCU has I2C functionality support but due to the internal functionality of these pins, you have to find which pin is I2C. |

**Applications:**

- Prototyping of IoT devices.
- Low power battery operated applications.
- Network projects.
- Projects requiring multiple I/O interfaces with Wi-Fi and Bluetooth functionalities

**Types of sound sensors:**

- KY037
- KY038
- LM393
- Sen 12642:

**SOUND SENSOR - KY038:**

- This module is used to detect the noise, claps, hits etc. It allows to detect one sound has exceeded a set point.
- This sensor cannot recognise whisperings and low voice
- This module only suitable for Aurdino.
- Its small PCB size; (L*W) 3.2* = 1.7cm/1.26"*0. 67".

KY038 is a highly sensitive sound detection module with Analog as well as digital output. This is an arduino compatible module. Using this module you can even measure the intensity of ambient sound. Most of the digital sound sensor module just provides digital output i.e. if sound is present or not. But this

Sound sensor module also provides and analog output voltage which is directly proportional to the intensity of the ambient sound.

**Interface Definition:**

- AO: analog output sensor
- GND: ground
- VCC: Power supply input range: 3 to 5 Volts.
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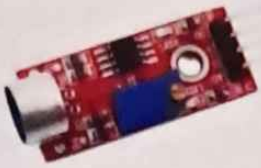
**SOUND SENSOR - KY037:**



- A0 – Analog Pin.
- G – Ground Pin.
- \+ –VCC.
- D0 – Digital Pin.
- LED 1 – Power LED.
- LED 2 – Output LED.
- W104 – Adjustable sensitivity.

It is a high sensitivity sound detection microphone module its frequency response range is 50Hz to 20K Hz.

**Advantages:**

This sensor module is so designed that changes output level to high when the ambient sound intensity passes a certain threshold.

It has higher sensitivity than KY038.

**Working:**

This sensor emits a signal if the front microphone of the sensor perceives a noise. This sensor emits a signal if the sensor detects a noise. The sensitivity of the sensor can be adjusted by the means of the controller.

**LM393:**

LM393 Sound Detection Sensor Module LM393 for Arduino detects whether sound has exceeded a threshold value. The sound is detected via microphone and fed into an LM393 op-amp.

The sound level set point is adjusted via an on board potentiometer. When the sound level exceeds the set point, an LED on the module is illuminated and the output is sent low.

**Pin configuration:**

- VCC - The Vcc pin powers the module, typically with +5V

- GND - Power Supply Ground
- DO - Digital Output Pin. Directly connected to digital pin of Microcontroller
- AO - Analog Output Pin. Directly connected to an analog pin of Microcontroller

**Specifications:**

- Operating Voltage: 3.3V to 5V D
- PCB Size: 3.4cm * 1.6cm
- Induction distance: 0.5 Meter
- Operating current: 4~5 mA
- Microphone Sensitivity (1kHz): 52 to 48 Db

**Advantages:**

- Easy to use with Microcontrollers or even with normal Digital/Analog IC
- Small, cheap and easily available

**Applications:**

- Hearing aids
- Telephones
- Tape recorders and karaoke
- Live and recorded audio engineering
- Radio and television broadcasting
- Speech recognition technology

**Sen 12642**:

Sen 12 sensor employs a microphone to provide input to buffer, peak detector and an amplifier. This sensor notices a sound, & processes an o/p voltage signal to a microcontroller. After that, it executes required processing.

This sensor is capable to determine noise level within DB's or decibels at 3 kHz 6 kHz frequencies approximately wherever the human ear is sensitive. In smartphones, there is an android application namely decibel meter used to measure the sound level.

## Specifications:

- Pin1 (VCC): 3.3V DC to 5V DC
- Pin2 (GND): This is aground pin
- Pin3 (DO): This is an output pin

## Government Norms:

| Area Code | Category of Area/ Zone | Limit in dB(A) Leq* | |
|---|---|---|---|
| | | Day Time | Night Time |
| A | Industrial Area | 75 | 70 |
| B | Commercial Area | 65 | 55 |
| C | Residential Area | 55 | 45 |
| D | Silence Zone | 50 | 40 |

Ambient Air Quality Standards in Respect of Noise is notified under Noise Pollution (Regulation and Control) Rules, 2000.

## Sound Sensor Module:

For many different projects, this can be used to build sound-reactive switches or to build a sound-reactive LED visualizer. This is why this sensor is popular among beginners as these are low power, low cost, rugged, and feature a wide sensing range that can be trimmed down to adjust the sensitivity.

This sensor has three pins, two of which are power pins leveled VCC and GND and the other two pins are analog and digital pins which are shown in the diagram above. It has an onboard power LED and a signal LED. The power LED turns on when power is applied to the board and the signal LED turns on when the circuit is triggered.

Op-amp that is responsible for converting the incoming analog signal to digital signal. We also have a sensitivity adjustment potentiometer; with that, we can adjust the sensitivity of the device. Last, we have the condenser microphone that is used to detect the sound. All these together make the total Sound Sensor Module.

## Working Principle:

The working principle of this sensor is related to human ears. Because human eye includes a diaphragm and the main function of this diaphragm is, it uses the vibrations and changes into signals. Whereas in this sensor, it uses a microphone and the main function of this is, it uses the vibrations and changes into current otherwise voltage.

Generally, it includes a diaphragm which is designed with magnets that are twisted with metal wire. When sound signals hit the diaphragm, then magnets within the sensor vibrates & simultaneously current can be stimulated from the coils.

## Advantages of a sound sensor:

Sound sensors can be used for security systems, often it works with speech recognition software where sound or speech is converted to text. This is a faster approach compared to typing using a keyboard.

## Range of the sound sensor

This sensor is capable of determining noise levels within 100 dBs or decibels at 3 kHz, 6 kHz frequencies range, approximately. Human ear is also sensitive to this sound at this range.

## Circuit Diagram for Sound Sensor Module

The schematic diagram for the Sound Sensor module is shown below. The schematic itself is very simple and needs a handful of generic components to build. If you don't have a prebuilt module on hand but still want to test your project, the schematic below will come in handy.

In the schematic, we have LM393 op-amp that is low power, low cost, low offset voltage op-amp that can be powered from a 3.3V or 5V supply. The analog output voltage of the device will depend on the supply voltage of the device. The main job of this op-amp is to convert the incoming analog signal from the sensor probe to a digital signal. There is also this 10K potentiometer that is used to set a reference voltage for the op-amp also this potentiometer is used to generate the reference voltage for the analog out function of the module.

If the input voltage of the sensor goes below the threshold voltage set by the potentiometer, the output of the op-amp goes low. Other than that we have two LEDs. The first one is a power LED and the other one is the trigger. The

power LED turns on when power is applied to the board and the trigger LED turns on when a certain set threshold is reached. This is how this basic circuit works.

## Specifications:

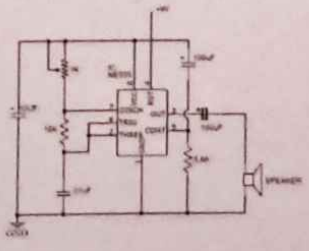
- The range of operating voltage is 3.⅗ V
- The operating current is 4~5 mA
- The voltage gain 26 dB ((V=6V, f=1kHz)
- The sensitivity of the microphone (1kHz) is 52 to 48 dB
- The impedance of the microphone is 2.2k Ohm
- The frequency of m microphone is16 to 20 kHz
- The signal to noise ratio is 54 dB

## Applications:

- Security system for Office or Home
- Spy Circuit
- Home Automation
- Robotics
- Smart Phones
- Ambient sound recognition
- Audio amplifier
- Sound level recognition

## Buzzer:

An electrical device that makes a buzzing noise, and this is used for signalling.



## Working:

Magnetic buzzer operates using electromagnetic principles. When power is applied, current runs through the coil of wire inside the buzzer, which produces a magnetic field. The flexible ferromagnetic disk is attracted to the

coil when the magnetic field is activated, then returns to rest when the magnetic field is off.

## Specifications:

- Operation voltage: 5V DC
- Frequency: 33000Hz
- Current: <15mA
- Colour: Black
- Operating temperature: - 20degree to 60degree
- Polarity: Positive pin marked on the surface
- Number of pins: 2

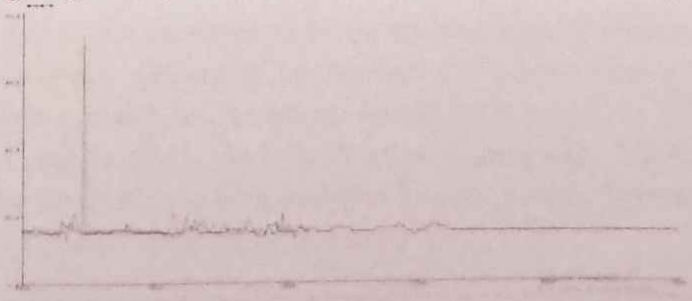
## Working of the module:

The purpose of this study was to determine the effectiveness of the noise sign on reducing noise levels in an academic library setting.

Sound sensor works similar to our ears. Our ears have a diaphragm which converts the detected vibration and converts it in the signal. Similarly, the sound sensor converts the vibration into the audio signal (voltage and current proportional) with the help of a microphone

The microphone has an inbuilt diaphragm, made up of magnets which are coiled by metal wire. Whenever sound wave hits the diaphragm, magnet vibrates and at the same time coil induces the current.

The following diagram represents the sound measured in the serial plotter



## Code for running this program:

```
const int MIC = 0; //the microphone amplifier output is connected to pin A0
int adc;
```

```
int dB, PdB; //the variable that will hold the value read from the microphone each time
void setup() {
 Serial.begin(9600); //sets the baud rate at 9600 so we can check the values the
microphone is obtaining on the Serial Monitor
 pinMode(2, OUTPUT);
}
void loop() {
 PdB = dB; //Store the previous of dB here
 adc = analogRead(MIC); //Read the ADC value from amplifer
 //Serial.println (adc);//Print ADC for initial calculation
 dB = (adc + 83.2073) / 11.003; //Convert ADC value to dB using Regression values
 if (PdB != dB)
  Serial.print("dB = ");
  //delay(100);
   Serial.println (dB);
  // delay(200);
  if (dB > 60)
  {
   digitalWrite(2, HIGH);   // turn the LED on (HIGH is the voltage level)
    delay(2000);                  // wait for a second
    digitalWrite(2, LOW);
    Serial.println ("silent please");
    delay(1000);
  }
  // delay(100);
 }
```

## Conclusion:

Noise is considered to be an environmental pollutant. Therefore, using a measuring instrument is needed to monitor noise level. The measurements are results in the buzzer sound when it reaches the maximum level. This is used to detect the noise level measuring also. And can keep the noise with in control this can be installed in hospitals, public libraries and in the place where we should maintain certain noise level.

# AUTOMATIC SMART IRRIGATION SYSTEM.

A dissertation submitted in partial fulfillment of the requirement for the award of the degree of

**BACHELOR OF SCIENCE IN PHYSICS**

BY


1. Doncy Punitha J - 2020P12
2. Jasmin Fatima G - 2020P15
3. Jeffrina J - 2020P16
4. Jeyashree B - 2020P17
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FATIMA COLLEGE (AUTONOMOUS), MADURAI

(Affiliated to MADURAI KAMARAJ UNIVERSITY)

(RE-ACCREDITED WITH 'A++' GRADE BY NAAC)

(74 Rank in Indian Ranking 2020 (NIRF) by MHRD)

Mary Land, MADURAI-625018

April 2023

## CERTIFICATE

This is to certify that the project work '<u>AUTOMATIC SMART IRRIGATION SYSTEM</u>' done by Doncy Punitha J (2020P12), Jasmin Fatima G (2020P15), Jeffrina J (2020P16), Jeyashree B (2020P17) and Kavitha P (2020P18) under the guidance of Dr.Sr. G. Jenita Rani, Assistant Professor, Research center of Physics has been submitted as the external viva-voce on 03.04.2023 at Fatima College (Autonomous), Madurai.

External Examiner 5/4/23

Guide 5/4/23

Head of the Department

## DECLARATION

We hereby declare that the dissertation titled "AUTOMATIC SMART IRRIGATION SYSTEM", submitted to Fatima College (Autonomous), Madurai -625018 to the award of degree of Bachelor of Science in Physics is a record of original project work carried out under the supervision of Dr.Sr.G.Jenita Rani, Assistant Professor, Research Centre of Physics, Fatima College (Autonomous), Madurai and has not submitted for any degree or diploma in Madurai Kamaraj University or any Institution.

Doncy Punitha J

(2020P12)

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Place: Madurai

Date: 03.04.2023

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**Abstract**

India's population has reached beyond 1.2 billion and the population rate is increasing day by day, so after 25-30 years there will be serious problem of food, such that the development of agriculture is necessary. Today, farmers incur the problem of water scarcity due to lack of rain. The main objective of this project is to provide an automatic irrigation system that saves time, money of the farmer. The traditional farm land irrigation techniques require manual intervention. With the automated technology of irrigation, the human intervention can be minimized. Whenever there is a change in humidity of the soil, the sensor senses the humidity change and irrigates the field automatically using a popular technology called the 'Internet of Things'. The project makes use of simple IoT technology and is economic making it feasible even in economically backward areas.

**Problem statement**

There are imperfections in every sector. We throw light on the problem of excess of water being used in irrigation. Farmers water their plant according to their convenience of time without the knowledge of knowing the amount of water needed for a crop per day.

Agriculture accounts for around 70% of all water withdrawals globally according to the world bank, and approximately, out of which 60% of water wasted largely due to the inefficient applications according to UN's Food and Agriculture Organization (FAO).

Research has shown that excess water can increase weed pressure and create the environment favorable to diseases. Crop growth and yield can also be impeded due to over irrigation which disturbs the oxygen balance of the root zone, drowns roots, reduces plant water uptake and make the plant to stress.

**Solution**

"With technology, we can achieve the unimaginable things."

IoT describes a world where just about anything can be connected and communicate in an intelligent fashion. In other words, with the Internet of Things, the physical world is becoming one big information system. IoT being one of blooming technologies in today's world has various real time applications which prove to be really useful. The scope of the technology is vast promising to be one of the technologies of recent times. With the water requirements in irrigation being large, there is a need for a smart irrigation system that can save about 80% of the water. This prototype aims at saving time and avoiding problems like constant vigilance. It also helps in water conservation by automatically providing water to the plants or gardens depending on their water requirements. It can also prove to be efficient in Agricultural fields, lawns and parks. As technology is advancing, there is always a chance of reducing risks and making work simpler. Embedded and micro controller systems provide solutions for many problems. This application precisely controls water system for gardens by using a sensor micro controller system. It is achieved by installing sensors in the field to monitor the soil moisture.

For the above problem we came up with the solution to overcome the water wastage and unnecessary usage of electrical current, without man power.

Here comes the AUTOMATIC SMART IRRIGATION SYSTEM. It helps to water our plants automatically by using drip irrigation method and with the help of the soil moisture sensor. It automatically senses the moisture level of the soil for each plant and helps us to proceed with the solution to provide the exact amount of water to the plant. By using the system, the plants can get rid of withering.

This IoT based intelligent irrigation system helps a farmer to take decision on water management in farm and there is no need to maintain irrigation time table .Irrigation time table can be fetch and map from

agriculture university or government web site as per soil and crop type. It gives maximum profit from minimum cost.

This can be the fruitful way of efficient usage of water which helps in correct growth of the crop.

**Introduction**

Nowadays we are living with sufficient technology all over the world. There is a need of application of technology in each and every field. There is a problem in wastage of water everywhere. But when we look into agriculture sectors there is overflow of water. Farmers are unaware of the required level of water for all the plants. They are watering plants with their conventional knowledge. If there is overflow of water there will be problem in plant rising, drying, withering and it can cause disease to plants. At last it leads to reduction of plant growth.

Hence In this project we present the automatic smart irrigation system by using PIC micro controller, this irrigation network is controlled by the processing unit which is nothing but the NODEMCU micro controller, in order to eradicate the flaws done by farmers.

We implemented the new dimension in the irrigation field with less utilization of humans, it is totally different from the conventional irrigation method used by Indian farmers which involves manual operation and control, in this electronic era farmers does not need to face the challenges creating by these conventional methods. They use drip irrigation method in which water is given to root of plants to save water and stop land infertility and nutrition count. In irrigation farmer have to keep time table for irrigation which changes as per crop, soil and weather. This irrigation system is one and only solution to water management and precision agriculture.

So we provide this automatic irrigation system which provides the amount of water given to different plants by using the data given by the government.

## Existing System

In most existing systems, the threshold value of moisture is not taken into consideration and the field is irrigated at random time intervals, leading to over- irrigation or under irrigation of field and this in turn affects the crop productivity. There are cases where the threshold value of moisture is fixed leading to another disadvantage. Different crops need different environment condition to grow and when the moisture content of the system is fixed, conditions may not be appropriate for the crop's growth and yield. A method is proposed to monitor the soil moisture and the irrigation is done only when the moisture content goes below the threshold value.

Refered in: http://www.agritech.tnau.ac.in/

**Water used and yield of crops in micro and conventional irrigation methods**

| Crop | Methods of irrigation | Water requirement (cm) | % water saving | Yield kg $ha^{-1}$ | % increase in yield | Water use efficiency (kg ha $mm^{-1}$) |
|---|---|---|---|---|---|---|
| Banana | Drip | 97.00 | 45.00 | 87500 | 52.00 | 90.20 |
| | Surface | 176.00 | - | 57500 | - | 32.67 |
| Sugarcane | Drip | 94.00 | 56.00 | 170000 | 33.00 | 180.85 |
| | Furrow | 215.00 | - | 128000 | - | 59.53 |
| Grapes | Drip | 27.80 | 48.00 | 32500 | 23.00 | 116.90 |
| | Surface | 53.20 | - | 26400 | - | 49.62 |
| Aerobic rice | Conventional aerobic rice | 74.30 | 38.10 | 4747 | - | 6.39 |
| | Surface drip | 61.90 | 48.40 | 5940 | 14.20 | 9.60 |
| | Sub-surface drip | 61.90 | 48.40 | 6227 | 19.80 | 9.74 |
| | Conventional transplanted | 120.00 | - | 5200 | - | 4.33 |
| Cotton | Drip | 28.00 | 66.27 | 3250 | 25.00 | 116.10 |
| | Furrow | 83.00 | - | 2600 | - | 31.33 |
| Beetroot | Drip | 17.70 | 79.34 | 887 | 55.34 | 50.11 |
| | Surface | 85.70 | - | 571 | - | 6.66 |
| Radish | Drip | 10.80 | 75.72 | 1186 | 13.49 | 109.80 |
| | Surface | 46.40 | - | 1045 | - | 22.52 |
| Papaya | Drip | 73.88 | 67.89 | 23490 | 69.47 | 0.32 |
| | Surface | 225.80 | - | 13860 | - | 0.06 |
| Mulberry | Drip | 20.00 | 60.00 | 71400 | 3.03 | 3570 |
| | Surface | 50.00 | - | 69300 | - | 1386 |
| Tomato | Drip | 18.40 | 39.00 | 48000 | 50.00 | 260.86 |
| | Surface | 30.00 | - | 32000 | - | 106.66 |

(WTC Annual Reports 1985-2003)

**Table 1.1**

| Column 1 | Column 2 | Column 3 | Column 4 | Column 5 |
|---|---|---|---|---|
| -30%<br><br>45%<br><br>4.2mm/day | -10%<br><br>65%<br><br>5.4mm/day | same as standard grass<br><br>75%<br><br>6mm/day | + 10%<br><br>85%<br><br>6.6mm/day | +20%<br><br>95%<br><br>7.2mm/day |
| citrus | cucumber | Carrots | barley | paddy rice |
| olives | radishes | crucifers (cabbage, cauliflower, broccoli, etc.) | beans | sugarcane |
| grapes | squash | Lettuce | maize | banana |
| | | Melons | flax | Nuts & fruit trees with cover crop |
| | | Onions | small grains | |
| | | Peanuts | cotton | |
| | | Peppers | tomato | |
| | | Spinach | eggplant | |
| | | Tea | lentils | |
| | | Grass | millet | |
| | | Cacao | oats | |
| | | Coffee | peas | |
| | | clean cultivated nuts & fruit trees e.g. apples | potatoes | |
| | | | safflower | |
| | | | sorghum | |
| | | | soybeans | |
| | | | sugarbeet | |
| | | | sunflower | |
| | | | tobacco | |
| | | | wheat | |

**Table 1.2**

Suppose in a certain area the standard grass crop needs 5.5 mm of water per day.

Then, in that same area, maize will need 10% more water. Ten percent of 5.5 mm = 10/100 × 5.5 = 0.55 mm. Thus maize would need 5.5 + 0.55 = 6.05 or rounded 6.1 mm of water per day.

Citrus: -30% (compared to grass); thus the water need of citrus is 6.0 - 30% = 6.0 -1.8 = 4.2 mm/day

Bananas: +20%; thus the water need of bananas is 6.0 + 20% = 6.0 + 1.2 = 7.2 mm/day

Onions: same as grass; thus the water need of onions is 6.0 mm/day

Cucumber: -10%; thus the water need of onions is 6.0 - 10% =6.0-0.6 =5.4 mm/day

Apples (clean): same as grass; thus the water need of clean cultivated apples is 6.0 mm/day

If the apples have a cover crop in between the trees, the water need would be 20% higher than grass and thus: 6.0 + 20% = 6.0+1.2 = 7.2 mm/day.

Millet: +10%; thus the water need of millet is 6.0 + 10% =6.0+0.6 = 6.6 mm/day

**https://www.fao.org/3/s2022e/s2022e02.htm#:~:text=The%20water%20need%20of%20a%20crop%20is%20usually%20expressed%20in,5**

Roses prefer 350 ml per day in most climates.This can increase slightly in hot climates but rose bushes are fairly drought tolerant. Soil rich in organic matter and well drained sandy loam soils are suitable for Rose cultivation. For good growth it requires PH of 6 to 7.5.

## Water requirement of Horticultural Crops

| Crop | Water Requirement (mm) |
|---|---|
| Tomato | 600-800 |
| Potato | 500-700 |
| Pea | 350-500 |
| Onion | 350-550 |
| Bean | 300-500 |
| Cabbage | 380-500 |
| Banana | 1200-2200 |
| Citrus | 900-1200 |
| Grapes | 500-1200 |
| Pineapple | 700-1000 |
| Coconut | 80-100 (lit/plant/day) |
| Mango | 30-40 (lit/plant/day) |
| Guava | 22-30 (lit/plant/day) |
| Banana | 8-12 (lit/plant/day) |

**Table 1.3**

**Components**

- Soil moisture sensor
- NODEMCU ESP8266
- Relay module
- DC pump
- Connecting wires.

Soil moisture sensor

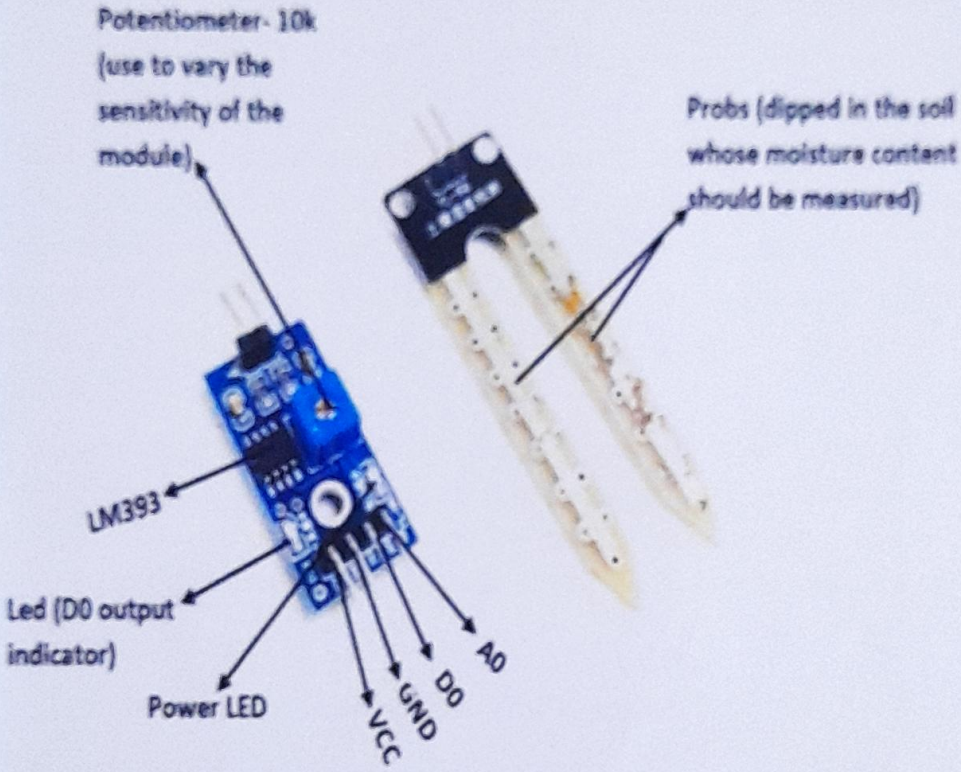



Fig 1.1

The moisture of the soil plays an essential role in the irrigation field as well as in gardens for plants. As nutrients in the soil provide the food to the plants for their growth. Supplying water to the plants is also essential to change the temperature of the plants. The temperature of the plant can be changed with water using the method like transpiration. And plant root systems are also developed better when rising within moist soil. Extreme soil moisture levels can guide to anaerobic situations that can encourage the plant's growth as well as soil pathogens.

The soil moisture sensor is one kind of sensor used to gauge the volumetric content of water within the soil. As the straight gravimetric

dimension of soil moisture needs eliminating, drying, as well as sample weighting. These sensors measure the volumetric water content not directly with the help of some other rules of soil like dielectric constant, electrical resistance, otherwise interaction with neutrons, and replacement of the moisture content.

The relation among the calculated property as well as moisture of soil should be adjusted & may change based on ecological factors like temperature, type of soil, otherwise electric conductivity. The microwave emission which is reflected can be influenced by the moisture of soil as well as mainly used in agriculture and remote sensing within hydrology.

These sensors normally used to check volumetric water content, and another group of sensors calculates a new property of moisture within soils named water potential. Generally, these sensors are named as soil water potential sensors which include gypsum blocks and tensiometer.

Pin Configuration:

The FC-28 soil moisture sensor includes 4-pins

- VCC pin is used for power
- A0 pin is an analog output
- D0 pin is a digital output
- GND pin is a Ground

This module also includes a potentiometer that will fix the threshold value, & the value can be evaluated by the comparator-LM393. The LED will turn on/off based on the threshold value.

Working Principle:

This sensor mainly utilizes capacitance to gauge the water content of the soil (dielectric permittivity). The working of this sensor can be done by inserting this sensor into the earth and the status of the water content in the soil can be reported in the form of a percent.

This sensor makes it perfect to execute experiments within science courses like environmental science, agricultural science, biology, soil science, botany, and horticulture.

Specifications:

The specification of this sensor includes the following.

- The required voltage for working is 5V
- The required current for working is <20mA
- Type of interface is analog
- The required working temperature of this sensor is 10°C~30°C

Applications:

The applications of moisture sensor include the following.

- Agriculture
- Landscape irrigation
- Research
- Simple sensors for gardeners

This is all about the soil moisture sensor. From the above information, finally, we can conclude that this sensor is used to gauge the soil's volumetric water content, which makes it perfect to make experiments in the science field like agricultural science, soil science, horticulture, environmental science, biology, and botany.

**NODEMCU ESP8266**

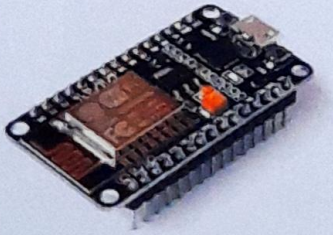


**Fig 1.2**

The ESP8266 is a low-cost Wi-Fi microchip, with built-in TCP/IP networking software, and microcontroller capability, produced by Espressif Systems in Shanghai, China. While the ESP8266 is often used as a 'dumb' Serial-to-WiFi bridge, it's a very powerful microcontroller on its own. In this chapter, we'll look at the non-Wi-Fi specific functions of the ESP8266.

DIGITAL I/O: Just like a normal Arduino, the ESP8266 has digital input/output pins (I/O or GPIO, General Purpose Input/Output pins). As the name implies, they can be used as digital inputs to read a digital voltage, or as digital outputs to output either 0V (sink current) or 3.3V (source current).

VOLTAGE AND CURRENT RESTRICTIONS: The ESP8266 is a 3.3V microcontroller, so its I/O operates at 3.3V as well. The pins are not 5V tolerant, applying more than 3.6V on any pin will kill the chip. The maximum current that can be drawn from a single GPIO pin is 12mA.

USABLE PINS: The ESP8266 has 17 GPIO pins (0-16), however, you can only use 11 of them, because 6 pins (GPIO 6 - 11) are used to connect the flash memory chip. This is the small 8-legged chip right next to the ESP8266. If you try to use one of these pins, you might crash your program.

GPIO 1 and 3 are used as TX and RX of the hardware Serial port (UART), so in most cases, you can't use them as normal I/O while sending/receiving serial data.

The pinout is as follows for the common ESP-01 module:

- GND, Ground (0 V)
- GPIO 2, General-purpose input/output No. 2
- GPIO 0, General-purpose input/output No. 0
- RX, Receive data in, also GPIO3
- VCC, Voltage (+3.3 V; can handle up to 3.6 V)

- RST, Reset
- CH_PD, Chip power-down
- TX, Transmit data out, also GPIO1

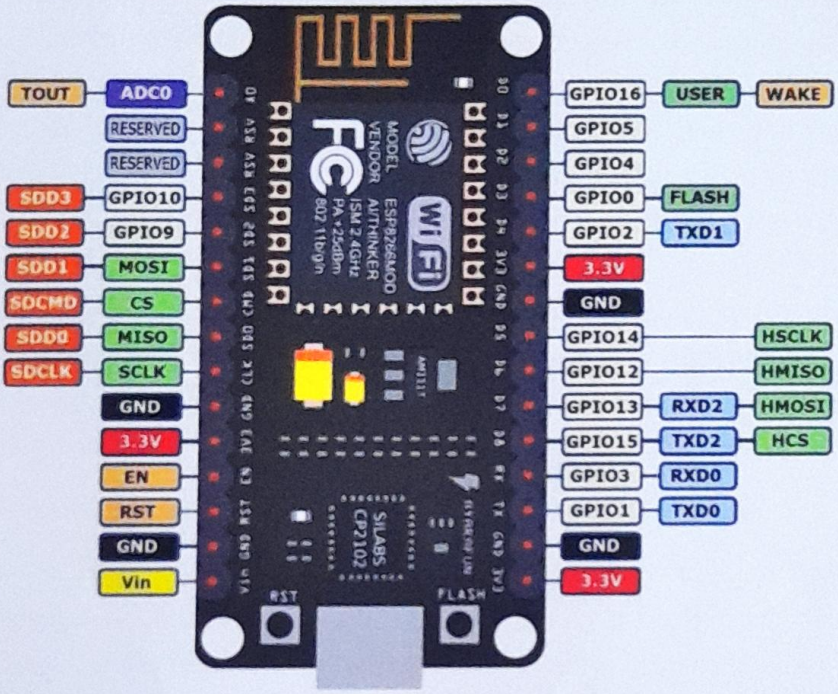



Fig 1.3

**Relay**

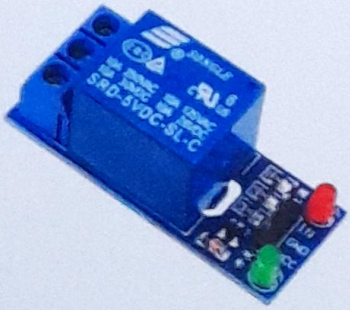



Fig 1.4

It works on the principle of an electromagnetic attraction. When the circuit of the relay senses the fault current, it energizes the electromagnetic field which produces the temporary magnetic field. This magnetic field moves the relay armature for opening or closing the connections. The small power relay has only one contacts, and the high power relay has two contacts for opening the switch. The inner section of the relay is shown in the figure below. It has an iron core which is wound by a control coil. The power supply is given to the coil through the contacts of the load and the control switch. The current flows through the coil produces the magnetic field around it. Due to this magnetic field, the upper arm of the magnet attracts the lower arm. Hence close the circuit, which makes the current flow through the load. If the contact is already closed, then it moves oppositely and hence open the contacts.

Construction of Relay:

The relay operates both electrically and mechanically. It consists electromagnetic and sets of contacts which perform the operation of the switching. The construction of relay is mainly classified into four groups. They are the contacts, bearings, electromechanical design, terminations and housing.

Contacts – The contacts are the most important part of the relay that affects the reliability. The good contact gives limited contact resistance and reduced contact wear. The selection of the contact material depends upon the several factors like nature of the current to be interrupted, the magnitude of the current to be interrupted, frequency and voltage of operation.

Bearing – The bearing may be a single ball, multi-ball, pivot-ball and jewel bearing. The single ball bearing is used for high sensitivity and low friction. The multi-ball bearing provides low friction and greater resistance to shock.

Electromechanical design – The electromechanical design includes the design of the magnetic circuit and the mechanical attachment of core, yoke and armature. The reluctance of the magnetic path is kept minimum for making the circuit more efficient. The electromagnet is made up of soft iron, and the coil current is usually restricted to 5A and the coil voltage to 220V.

Terminations and Housing – The assembly of an armature with the magnet and the base is made with the help of spring. The spring is insulated from the armature by moulded blocks which provide dimensional stability. The fixed contacts are usually spot welded on the terminal link.

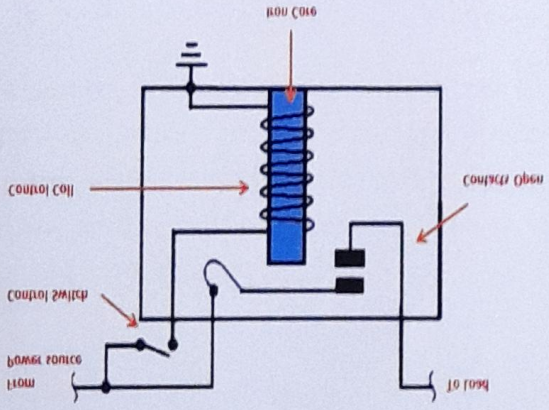



**Fig 1.5**

**DC pump**

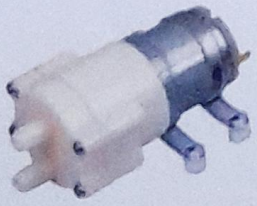


**Fig 1.6**

DC powered pumps use direct current from motor, battery, or solar power to move fluid in a variety of ways. Motorized pumps typically operate on 6, 12, 24, or 32 volts of DC power. Solar-powered DC pumps use photovoltaic (PV) panels with solar cells that produce direct current when exposed to sunlight.

Types:

DC powered pump from Xylem Flow Control DC pumps come in many different design types, each with its own method of operation, advantages, and preferred applications. For more information on these different types of pumps, visit the Pump Types information page on Engineering360.

Specifications:

As with most pumps, the primary specifications to consider when discerning DC powered pump performance are flowrate, pump head, pressure, horsepower, and operating temperature. For an explanation of these specifications and pump performance curves, visit the Pump Flow information page on Engineering360.

Features:

DC powered pumps can also be distinguished based on the features they provide, such as adjustable speed, run-dry capability, and corrosion resistance. Engineering360's Pump Features page provides a full list and explanation of these different pump features.

Advantage:

The main advantage of DC (direct current) pumps over AC (alternating current) pumps is that they can operate directly from a battery, making them more convenient and portable. They are easier to operate and control, since AC systems typically require a controller to manage speed. DC pumps also tend to be more efficient. However, AC pumps usually are designed for higher speeds and larger bursts of power. They also have a longer working lifespan than DC pumps.

It can be hooked to a battery, portable, simpler speed control and operation, more energy efficient.

**Drip irrigation**

Drip irrigation or trickle irrigation is a type of micro-irrigation system that has the potential to save water and nutrients by allowing water to drip slowly to the roots of plants, either from above the soil surface or buried below the surface. The goal is to place water directly into the root zone and minimize evaporation. Drip irrigation systems distribute water through a network of valves, pipes, tubing, and emitters. Depending on how well designed, installed, maintained, and operated.

There are four main types of drip irrigation: soaker hoses (also sometimes known as porous soaker lines), emitter systems, drip tapes, and micro-misting systems. Each system has different features and benefits depending on your needs

Advantages of Drip Irrigation:

- Maximum use of available water.
- No water being available to weeds.
- Maximum crop yield.
- High efficiency in the use of fertilizers.
- Less weed growth and restricts population of potential hosts.
- Low labour and relatively low operation cost.
- No soil erosion.

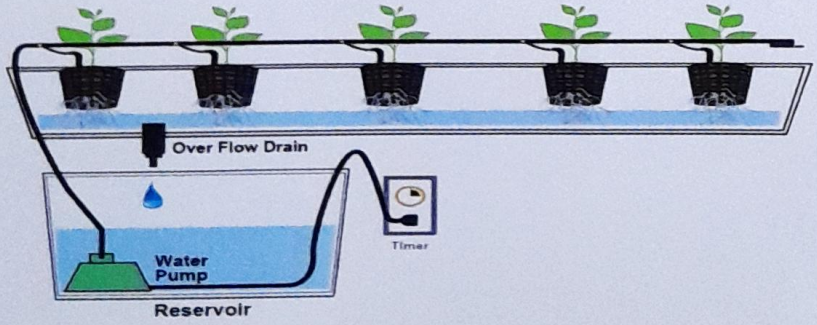
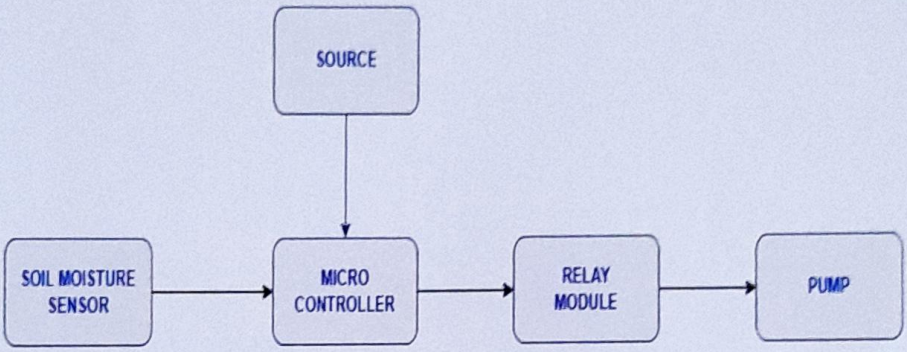
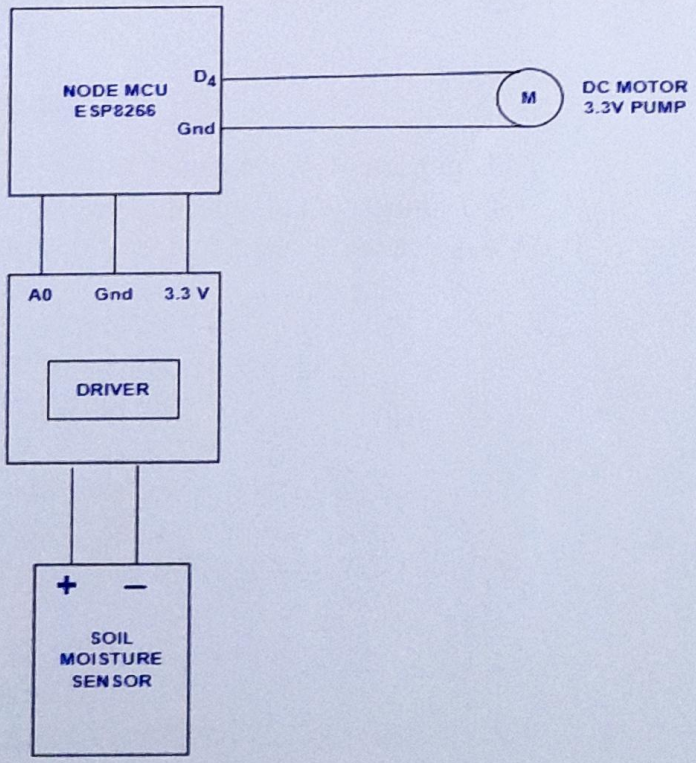


Fig 1.7

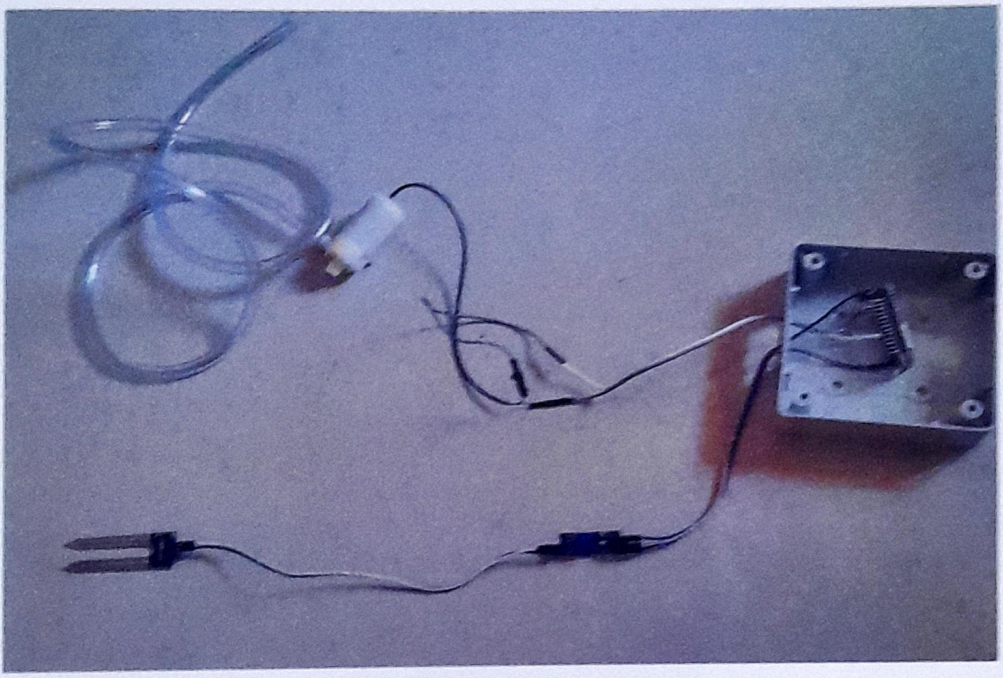
## Block Diagram




## Circuit Diagram



**Model**



**Program code**

```
int WET= 16; // Wet Indicator at Digital pin D0
int DRY= 2;  // Dry Indicator at Digital pin D4
int sense_Pin = 0; // sensor input at Analog pin A0
int value = 0;
#include <ESP8266WiFi.h>
#include <NTPClient.h>
#include <WiFiUdp.h>
int LED1 = 2;
// Replace with your network credentials
const char *ssid     = "max";
const char *password = "Temple@123";

// Define NTP Client to get time
WiFiUDP ntpUDP;
NTPClient timeClient(ntpUDP, "pool.ntp.org");
```

```
//Week Days
String weekDays[7]={"Sunday", "Monday", "Tuesday",
"Wednesday", "Thursday", "Friday", "Saturday"};

//Month names
String months[12]={"January", "February", "March", "April", "May",
"June", "July", "August", "September", "October", "November",
"December"};

void setup() {
  Serial.begin(9600);
  pinMode(WET, OUTPUT);
  pinMode(DRY, OUTPUT);
  delay(2000);
 //Serial.begin(115200);
 pinMode(LED1, OUTPUT);
 // Connect to Wi-Fi
 Serial.print("Connecting to ");
 Serial.println(ssid);
 WiFi.begin(ssid, password);
 while (WiFi.status() != WL_CONNECTED) {
  delay(500);
  Serial.print(".");

  // Initialize a NTPClient to get time
 timeClient.begin();
 // Set offset time in seconds to adjust for your timezone, for
example:
 // GMT +1 = 3600
 // GMT +8 = 28800
 // GMT -1 = -3600
 // GMT 0 = 0
 timeClient.setTimeOffset(19800);  //IST is UTC+5:30 Hrs
}
}
void loop() {
```

```
//
// String currentMonthName = months[currentMonth-1];
// Serial.print("Month name: ");
// Serial.println(currentMonthName);
//
// int currentYear = ptm->tm_year+1900;
// Serial.print("Year: ");
// Serial.println(currentYear);
//
// //Print complete date:
// String currentDate = String(currentYear) + "-" +
String(currentMonth) + "-" + String(monthDay);
// Serial.print("Current date: ");
// Serial.println(currentDate);

if (currentHour == 1)
{
 digitalWrite(LED1, HIGH);
 Serial.println("TESTING");
 Serial.println(currentHour);
 delay(1000);
 }
else
{
 digitalWrite(LED1, LOW);
 delay(1000);
 }
 Serial.println("");

 delay(2000);

 Serial.print("MOISTURE LEVEL : ");
 value= analogRead(sense_Pin);
 //value= value/10;
 Serial.println(value);

     if(value<50)
```

```
    {
      digitalWrite(WET, HIGH);
    }
    else
    {
      digitalWrite(DRY,HIGH);
    }

    delay(1000);

    digitalWrite(WET,LOW);

    digitalWrite(DRY, LOW);
}
```

**Future scope**

Our project can be improvised by adding a Webscaper which can predict the weather and water the plants or crops accordingly. If rain is forecasted, less water is let out for the plants.

Also, a GSM module can be included so that the user can control the system via smart phone. A water meter can be installed to estimate the amount of water used for irrigation and thus giving a cost estimation. A solenoid valve can be used for varying the volume of water flow. Furthermore, Wireless sensors can also be used.

Monitoring of other growth or soil parameter can also be included just by connecting the sensors and modifying the source code of the project. This integration can also reduce the number of other hardware components used in the system thereby reducing the total cost of the system.

The system will continuously send the data on the cloud. These data can also be accessed using Bluetooth on Android App. If there is no internet present, the farmer can control the system through the App.

## Conclusion

The smart irrigation system implemented is cost effective for optimizing water resources for agricultural production. The proposed system can be used to switch on/off the water sprinkler depending on the required level of water to be irrigated for a particular plant per day at regular intervals of time and the level of soil moisture level as per the source code, thereby making the process simpler to use. Through this project it can be concluded that there can be considerable development in irrigation with those of IOT and automation. Thus this system is a solution to the problems faced in the existing process of irrigation.

# WATER MANAGEMENT SYSTEM

A dissertation submitted in partial fulfilment of the requirement for the award of the degree of

**BACHELOR OF SCIENCE IN PHYSICS**

by


| | |
|---|---|
| **2020P19** | **KEERTHANA.C** |
| **2020P20** | **KIRUTHIKA.R** |
| **2020P22** | **LAVANYA.P** |
| **2020P23** | **NANDHINI DEVI.V** |
| **2020P24** | **NANDHINI.K** |

Under the guidance of

**Dr. R. JOTHI MANI,**

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Assistant Professor,

Research Centre of physics,

Fatima College (Autonomous), Madurai.



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(RE-ACCREDITED WITH 'A++'GRADE BY NAAC)

(74th Rank in India Ranking 2020(NIRF) by MHRD)

Mary Land, MADURAI-625018

**APRIL 2023**

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## CERTIFICATE

This is to certify that the project work **'WATER MANAGEMENT SYSTEM'** done by Keerthana.C – 2020P19, Kiruthika.R – 2020P20, Lavanya.P – 2020P22, Nandhini Devi.V – 2020P23, Nandhini.K – 2020P24 under the guidance of Dr. R. JOTHI MANI, M.Sc., M.Ed., M.Phil., Ph.D., SET,PGDCA, Assistant Professor, Research Centre of physics has been submitted for external viva-voce on 03/04/2023 at Fatima College (Autonomous), Madurai.

**External Examiner** 5/4/23

**Guide** 5/4/23

**Head of the department**

## DECLARATION

We hereby declare that the dissertation titled '**WATER MANAGEMENT SYSTEM**', submitted to Fatima College (Autonomous), Madurai -625018 to the award of degree of **Bachelor of Science in Physics** is a record of original project work carried out under the supervision of **Dr. R. JOTHI MANI, M.Sc., M.Ed., M.Phil., Ph.D., SET.,PGDCA., Assistant Professor, Research Centre of physics Fatima College (Autonomous), Madurai** and has not submitted for any degree or diploma in Madurai Kamaraj University or any Institution.

Keerthana C.

**KEERTHANA.C - 2020P19**

R. Kiruthika

**KIRUTHIKA.R - 2020P20**

Lavanya P.

**LAVANYA.P - 2020P22**

Nandhini Devi.V.

**NANDHINI DEVI.V - 2020P23**

Nandhini.k

**NANDHINI.K - 2020P24**

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I thank god for his substantial blessings and mercy at all stages of the completion of my project. Taking this opportunity, I thank my parents and friends for their sacrifices in supporting me.

I feel honoured to place a warm salutation to the management of **FATIMA COLLEGE, MADURAI** which gave me the opportunity to have a strong base in physics and practical and theoretical knowledge.

I express my sincere thanks to **REV.DR.SR. CELINE SAHAYA MARY., Principal, Fatima College, Madurai** for giving me a comfortable environment.

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# ABSTRACT

According to the World Resources Institute, drought will affect up to 40 per cent of the planet already by 2020. In India, water demand is expected to exceed available water resources by up to 50 per cent by 2030. Most of the water (over 90 per cent) we use is "virtual water" meaning that it is water used all over the world to produce the food and products we buy. Buying food and products from companies with responsible water management makes a difference. If you have ever visited large-scale manufacturing companies, the first thing you will notice is that they are all automated. Soft Drink Industries and Chemical industries have to constantly measure and quantify the liquid that they are handling during this automation process, and the most common sensor used to measure the flow of a liquid is a Flow Sensor. By using a flow sensor with a microcontroller like ESP8266, we can calculate the flow rate, check the volume of liquid that has passed through a pipe, and control it as required. Apart from manufacturing industries, flow sensors can also be found in the agriculture sector, food processing, water management, mining industry, water recycling, coffee machines etc. Further, a water flow sensor will be a good addition to projects like Automatic water dispensers and smart irrigation systems where we need to monitor and control the flow of liquids. In this project, we are going to build a water flow sensor using ESP8266. We will interface the water flow sensor with ESP8266 and program it to display the volume of water, which has passed through the valve. For this particular project, we are going to use the YF-S201 water flow sensor, which uses a hall effect to sense the flow rate of the liquid.

# 1. INTRODUCTION

*"There will be no water by 2040 if we keep doing what we're doing today".* - **Professor Benjamin Sovacool, Aarhus University, Denmark**.In our day-to-day life water scarcity and ineffective water management is one of the life-threatening issues we face. For example, in our college, there is a separate record of data for electricity usage in every block. So, they monitor the usage of electricity whenever needed. But, they are unaware of the record of water usage and the quantity of water needed for each respective block. Unlike the electricity usage record, the water usage record remains unknown. To overcome this problem, the water flow sensor (YFS201) was going to be assigned. We can measure the flow rate and volume of water. By uploading this data to the IoT cloud there with the help of programming rules and respective code we automate this process and monitor this water usage data in our IoT-enabled microcontroller. The measurement of water usage quantity of each respective block in our college will be presented for public opinion. It is also very useful for effective water management in our college.

## 2. SYSTEM ANALYSIS

### 2.1 EXISTING SYSTEM:

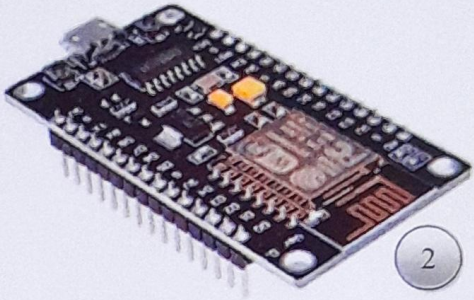
- Huge industrial plants and commercial and residential buildings require a large quantity of water supply. The public water supply system is used to meet this requirement.
- Large-scale manufacturing companies like soft drink industries, dairy industries and chemical industries. Constant monitoring of the quantity of the liquid is needed.
- Employing humans to monitor the quantity of the liquid may produce some operator errors and calculation errors.

### 2.2 PROPOSED SYSTEM:

- The water flow sensors play an essential role in the automation of the manufacturing units to minimize operator and calculation errors.
- In commercials and residential buildings by using this sensor we can measure the quantity of water needed for each respective block. So, that we can allocate water for effective water management.
- It provides confidential knowledge about water usage; we can use and save for the future and fellow people.

## 3. COMPONENTS REQUIRED

1



2

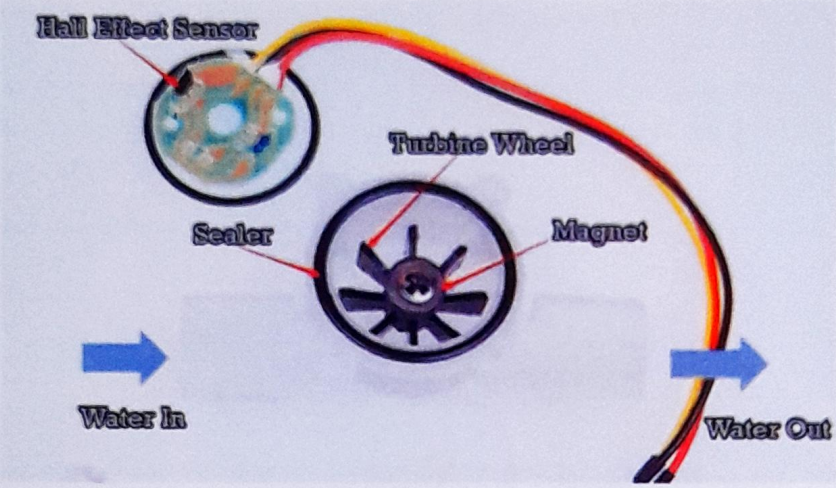
ARDUINO

IoT CLOUD

3

1) YF-S201-Hall effect water flow sensor
2) Node MCU ESP8266
3) Arduino IoT cloud

## 4. WATER FLOW SENSOR




4.1 Parts of Hall Effect water flow sensor

The sensor comes with three wires:

1. Red (5-24VDC power)

2. Black (ground)

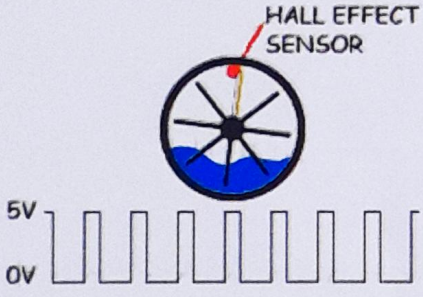
3. Yellow (Hall Effect pulse output)

**ADVANTAGES:**

- Unobstructed flow passage without projecting parts
- No moving parts
- No additional pressure drop
- Essentially flow profile insensitive, only short inlet and outlet sections required
- Unaffected by changes in temperature, density, viscosity, concentration and electrical conductivity
- Unaffected by contamination and deposits

## 4.1 PRINCIPLE OF WATER FLOW HALL EFFECT SENSOR:

The main components are the Hall Effect sensor, turbine wheel, and magnet. The water flows in through the inlet and out through the outlet. The water current drove the wheel to turn, and the magnet on the wheel turned with it.

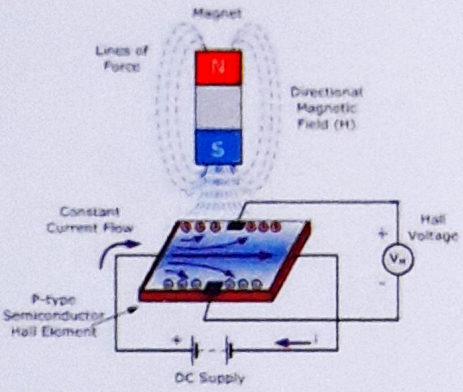



4.1.1 Output of Hall Effect sensor

Magnetic field rotation triggers the Hall sensor, which outputs high and low level square waves ( pulse ).For every round of the wheel, the volume of water flowing through is a certain amount, as is the number of square waves output. Therefore, we can calculate the flow of water by counting the number of square waves (pulse).

## 4.2 HALL EFFECT SENSOR:

Hall Effect Sensors consist basically of a thin piece of rectangular p-type semiconductor material such as gallium arsenide (GaAs), indium antimonide (InSb) or indium arsenide (InAs) passing a continuous current through itself.

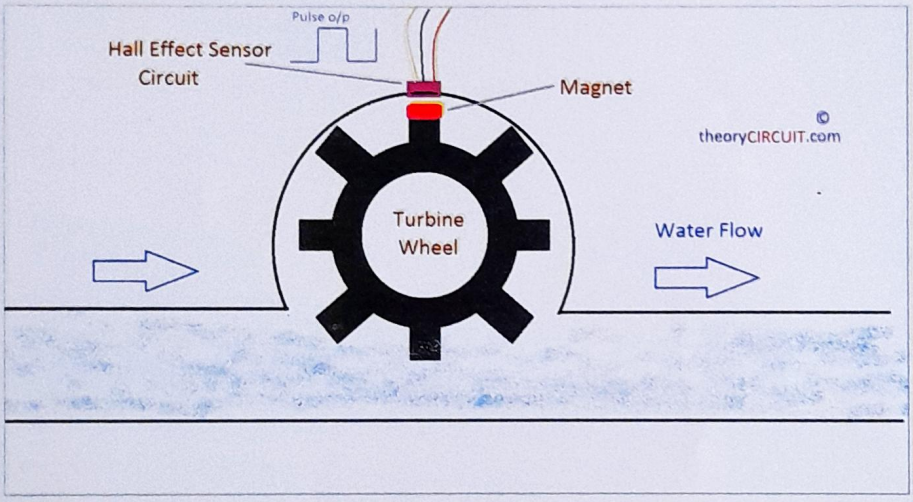



4.2.1 How Hall Effect sensor works.

When the device is placed within a magnetic field, the magnetic flux lines exert a force on the semiconductor material which deflects the charge carriers, electrons and holes, to either side of the semiconductor slab. This movement of charge carriers is a result of the magnetic force they experience passing through the semiconductor material. As these electrons and holes move side wards a potential difference is produced between the two sides of the semiconductor material by the buildup of these charge carriers. Then the movement of electrons through the semiconductor material is affected by the presence of an external magnetic field which is at right angles to it and this effect is greater in a flat rectangular shaped material. The effect of generating a measurable voltage by using a magnetic field is called the Hall Effect.

## 4.3 WORKING:

The Water Flow Sensor for Flow Rate & Volume Measurement using Arduino works on the principle of the **Hall Effect**. According to the Hall Effect, a voltage difference is induced in a conductor transverse to the electric current and the magnetic field perpendicular to it.




4.3.1 Working of Hall Effect water flow sensor

The Hall Effect is utilized in the flow meter using a small fan/propeller-shaped rotor, which is placed in the path of the liquid flowing. The liquid pushes against the fins of the rotor, causing it to rotate. The shaft of the rotor is connected to a Hall Effect sensor. It is an arrangement of a current flowing coil and a magnet connected to the shaft of the rotor, thus a voltage/pulse is induced as this rotor rotates. In this flow meter, for every litre of liquid passing through it per minute, it outputs about 4.5 pulses. This is due to the changing magnetic field caused by the magnet attached to the rotor shaft. We measure the number of pulses using an Arduino and then by counting the pulses from the output of the sensor, you can easily calculate the water flow rate. Each pulse is approximately 2.25 millilitres. Calculate the flow rate in litres per hour (L/hr) and total volume in Litre.

## 4.4 FORMULA FOR THE CALCULATION OF WATER FLOW SENSOR:

Every litre of water that flows, the Hall Sensor outputs 450 pulses.

450 pulse for 1 litre.

For each pulse = 1/450 litre water flowing through.

The total volume of liquid flowing through the water flow sensor at a certain time t(s)

V (L) = N* 1/450(L)

Where,

V-Total Volume of Liquid

N- Number of pulses detected

The total volume of fluid flowing through the water flow sensor is equal to the water flow rate (Q) multiplied by time t(s).

V_total (L) = Q (L/s)*t(s)

N* 1/450 = Q (L/s)*t(s) N/t = 450 * Q (L/s)

N/t happen to be frequency f,

f = 450*Q (L/s)

Q (L/s) = f/450

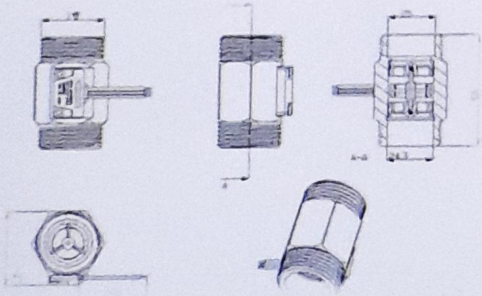
Q (L/min) = f*60/450

= f/7.5 Q (L/hr)

= f*60*60/450

= f*60 /7.5

## 4.5 YF-B1 HALL EFFECT WATER FLOW METER / SENSOR



FEATURES:

**Model:** YF-B1
**End Shape:** 2x male end
**Working Voltage:** 5V ~ 15V
**Working Current:** 15mA (at 5V)
**Flow Rate Range:** 1L/min ~ 25L/min
**Frequency:** F=11*Q(Q=L/MIN)
**Load Capacity:** ≤10mA (DC 5V)
**Liquid Temperature:** ≤120°C
**Water Pressure:** ≤1.75MPa
**Material:** Copper
**Operating Temperature:** ≤80°C
**Storage Temperature:** -25°C ~ + 80°C
**Operating Humidity:** 35% ~ 90%RH
**Storage Humidity:** 25% ~ 95%RH

**DESCRIPTION:**

This water flow sensor is mainly composed of a copper body, a water flow rotor assembly and a Hall sensor. The magnetic rotor rotates and the rotation speed changes with the flow rate, and the Hall sensor outputs corresponding pulses.

## 4.6 WATER FLOW SENSOR YF-B4

**FEATURES:**

**Model:** YF-B4
**End Shape:** Male in, female out.
**Working Voltage:** 5V ~ 15V
**Working Current:** 15mA (at 5V)
**Flow Rate Range:** 1L/min ~ 25L/min
**Frequency:** F=11*Q(Q=L/MIN)
**Load Capacity:** ≤10mA (DC 5V)
**Liquid Temperature:** ≤120ºC
**Water Pressure:** ≤1.75MPa
**Material:** Copper
**Operating Temperature:** ≤80°C
**Storage Temperature:** -25°C ~ + 80°C
**Operating Humidity:** 35% ~ 90%RH
**Storage Humidity:** 25% ~ 95%RH

**DESCRIPTION:**

This water flow sensor is like YF B1 models both shares same data like; it is composed of a copper body, a water flow rotor assembly and a Hall sensor. If there is a need to measure both water flow and water temperature, like water heaters, or dishwashers. Then this water flow hall effect sensor is right option for that.

YF-B1 ~ YF-B7 belongs to the Large-diameter type. The YF-Bx serials are commonly used in industry, agriculture, and animal husbandry, and therefore require the use of copper pipes that are more resistant to pressure and better resistant to corrosion.

## 4.7 WATER FLOW SENSOR - YF-S402

**FEATURES:**

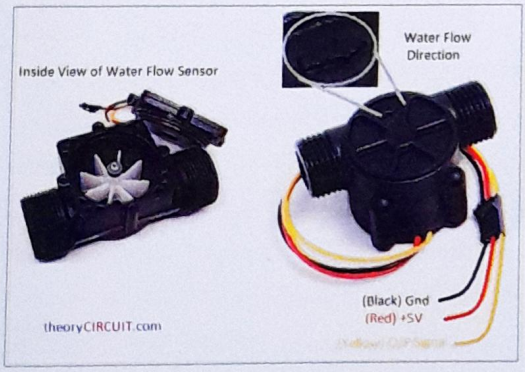
**Model:** YF-S402
**Working Voltage:** 5V ~ 24V
**Working Current:** 15mA (at 5V)
**Flow Rate Range:** 1L/min ~ 5L/min
**Frequency:** F=73*Q± 2% (Q=L/MIN)
**Load Capacity:** ≤10mA (DC 5V)
**Liquid Temperature:** ≤120°C
**Water Pressure:** 0.35MPa
**Material:** plastic
**Operating Temperature:** ≤80°C
**Storage Temperature:** -25°C ~ + 80°C
**Operating Humidity:** 35% ~ 90%RH
**Storage Humidity:** 25% ~ 95%RH

**DESCRIPTION:**

This water flow sensor composed of a plastic body, a water flow rotor assembly and a Hall sensor, which is basically a small turbine whose output signal is a series of digital pulses. The frequency of the pulses is proportional to the flow rate of the liquid passing through the sensor. That digital signal, whose frequency is in the range between 0Hz and 100Hz, can be read directly through one of the digital input/output pins of a microcontroller.

YF-S402 is suitable for smaller diameter household appliances such as water dispensers, coffee makers.

## 4.8 YF-S201-HALL EFFECT WATER FLOW SENSOR




**FEATURES:**

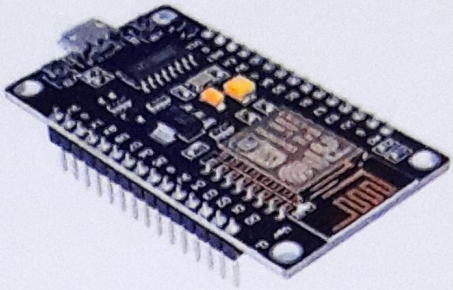
**Model:** YF-S201
**Working Voltage:** 5V ~ 18V
**Working Current:** 15mA (at 5V)
**Flow Rate Range:** 1L/min ~ 30L/min
**Frequency:** F=7.5*Q (Q=L/MIN)
**Load Capacity:** ≤10mA (DC 5V)
**Liquid Temperature:** ≤120°C
**Water Pressure:** ≤1.75MPa
**Material:** plastic
**Operating Temperature:** ≤80°C
**Storage Temperature:** -25°C ~ + 80°C
**Operating Humidity:** 35% ~ 90%RH
**Storage Humidity:** 25% ~ 95%RH

**DESCRIPTION:**

Water flow sensor to measure the water flow rate. The water flow rate is the volume of fluid that passes per unit time. YF-S201 is a water flow measurement sensor with high-grade quality sealing property. It works on the Hall Effect principle and with a flow rate range of 1~30L/min. The module has three pins: Power, Ground, and the Analog output. YF-S201 consumes very little current and can work with an allowing pressure of ≤1.75MPa. YF-S201 is suitable for card dispensers, water vending machines. In this project this yf-s201-hall effect water flow sensor is employed.

## 5. CONTROLLER

**NodeMCU ESP8266**



### 5.1 FEATURES:

The ESP8266 is a low-cost Wi-Fi microchip, with built-in TCP/IP networking software, and microcontroller capability. The **NodeMCU ESP8266** development board comes with the ESP-12E module containing the ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

NodeMCU can be powered using a Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

**FEATURES AND SPECIFICATIONS OF NodeMCU ESP8266**

**Developer :** ESP8266 Opensource Community

**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

**Flash Memory:** 4 MB

**SRAM:** 64 KB

**Clock Speed**: 80 MHz

. **Type** : Single-board microcontroller

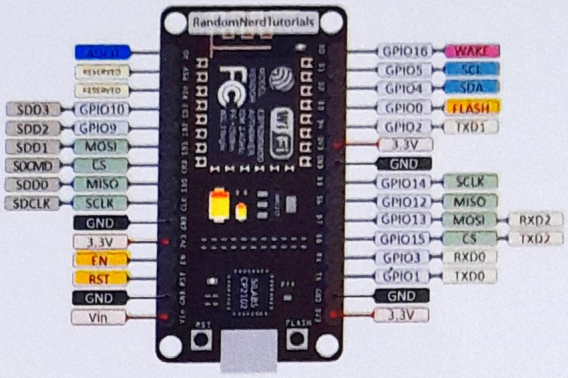
. **CPU** : ESP8266 (LX106)

. **Memory:**128kBytes

. **Storage**:4MBytes

. **Power :**USB

**5.2 PIN CONFIGURATION:**




Power pins (3.3 V).

Ground pins (GND).

Analog pins (A0).

Digital pins (D0 – D8, SD2, SD3, RX, and TX – GPIO XX)

Most ESP8266 NodeMCU boards have one input voltage pin (Vin), three power pins (3.3v), four ground pins (GND), one analog pin (A0), and several digital pins (GPIO XX).

| **Pin** | **Code** | **Arduino alias** |
|---|---|---|
| A0 | A0 | A0 |
| D0 | GPIO 16 | 16 |
| D1 | GPIO 5 | 5 |
| D2 | GPIO 4 | 4 |
| D3 | GPIO 0 | 0 |
| D4 | GPIO 2 | 2 |
| D5 | GPIO 14 | 14 |
| D6 | GPIO 12 | 12 |
| D7 | GPIO 13 | 13 |
| D8 | GPIO 15 | 15 |
| SD2 | GPIO 9 | 9 |
| SD3 | GPIO 10 | 10 |
| RX | GPIO 3 | 3 |
| TX | GPIO 1 | 1 |

**Advantages of ESP8266** over other competitors like Arduino is the embedded wireless technology that is web friendly with no use of shields or any peripherals, as is required for Arduinos. The price and size are the USP of the module with the added advantage of good speed and processing power.

The NodeMCU (Node MicroController Unit) 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. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

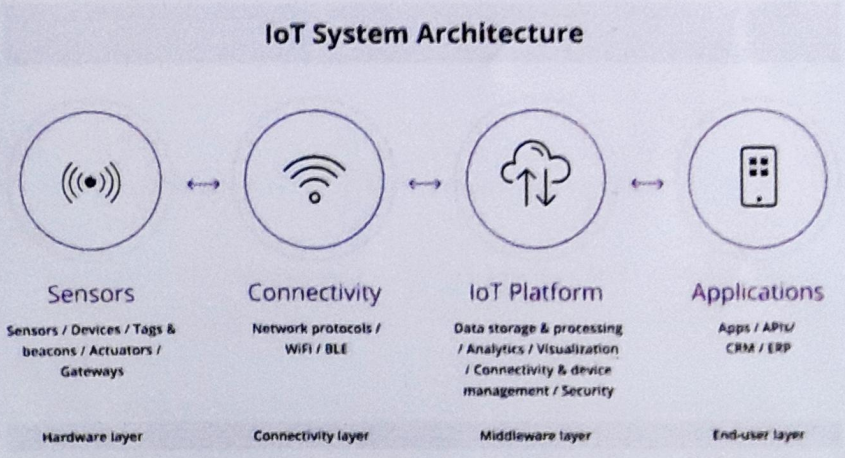
### 5.3 APPLICATIONS:

- Prototyping of IoT devices
- Low power battery operated applications
- Network projects
- Projects requiring multiple I/O interface with Wi-Fi and Bluetooth functionalities.
- Home and business automation
- Robotics
- Smart security, such as remote access and monitoring of sensors
- Locate device via Wi-Fi
- Wearable electronics
- Security tags
- Smart cameras

## 6. PLATFORM SUPPORTED:

### IoT CLOUD

- An IoT cloud is a massive network that supports IoT devices and applications. This includes the underlying infrastructure, servers and storage, needed for real-time operations and processing. An IoT cloud also includes the services and standards necessary for connecting, managing, and securing different IoT devices.
- IoT clouds offer an efficient, flexible, and scalable model for delivering the infrastructure and services needed to power IoT devices and applications for businesses with limited resources. IoT clouds offer on-demand and cost-efficient
- We can connect smart devices in minutes. Choose from a wide range of compatible devices to connect; we will take care of the necessary code.
- Control projects from anywhere in the world
- Control your project from any device, share it with others, automate it, or control with voice.




Here Arduino IoT cloud is employed.

### 6.1 ARDUINO IoT CLOUD:

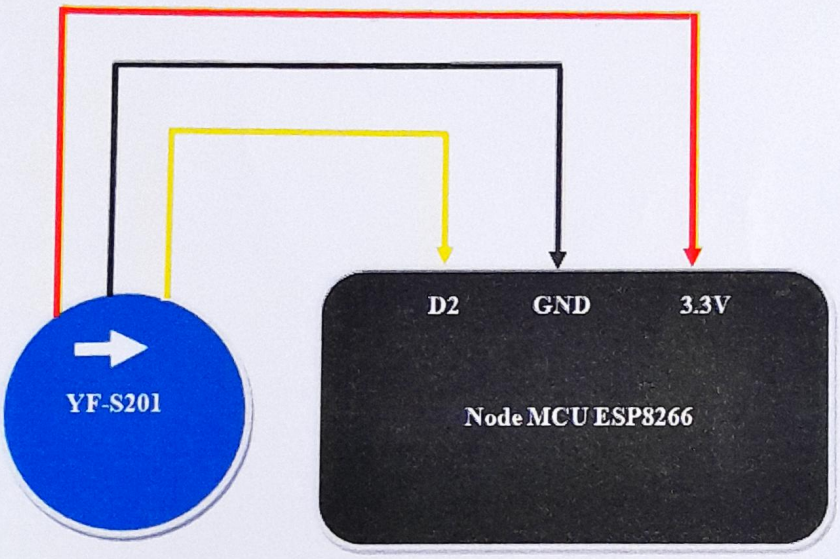

The Arduino IoT Cloud is a platform that allows **anyone** to create IoT projects, with a user friendly interface, and an all in one solution for **configuration, writing code, uploading** and **visualization.**

**FEATURES:**

- **Data Monitoring** - learn how to easily monitor your Arduino's sensor values through a dashboard.
- **Variable Synchronisation** - variable synchronisation allows you to sync variables across devices, enabling communication between devices with minimal coding.
- **Scheduler** - schedule jobs to go on/off for a specific amount of time (seconds, minutes, hours).
- **Over-The-Air (OTA) Uploads** - upload code to devices not connected to your computer.
- **Webhooks** - integrate your project with another service, such as IFTTT.
- **Amazon Alexa Support** - make your project voice controlled with the Amazon Alexa integration.
- **Dashboard Sharing** - share your data with other people around the world.

## 7. PROJECT IMPLEMENTATION:

### 7.1 BLOCK DIAGRAM:

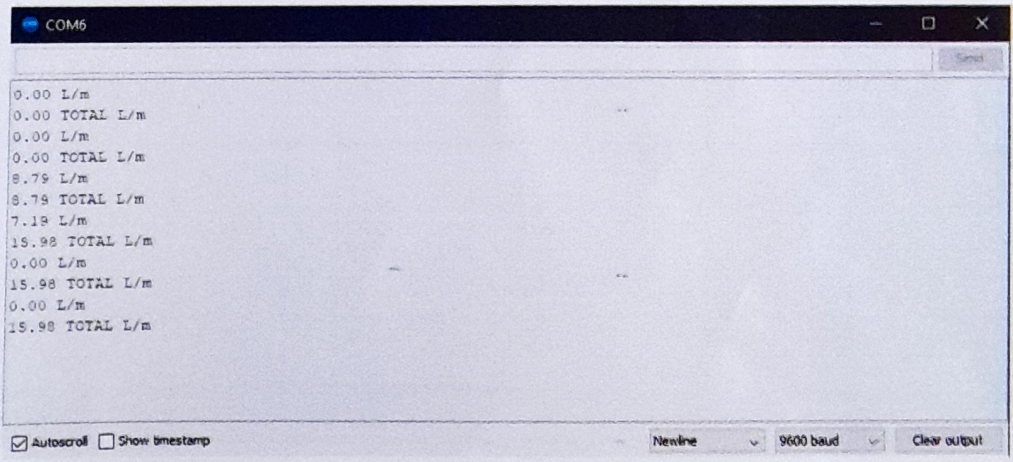


## 7.2 CODING:

```
int sensorPin = D2;

volatile long pulse;

unsigned long lastTime;

float volume;

float Tvolume;

void setup() {

pinMode(sensorPin, INPUT);

Serial.begin(9600);

attachInterrupt(digitalPinToInterrupt(sensorPin), increase, RISING);

}

void loop() {

volume = 2.663 * pulse / 1000 * 30;

if (millis() - lastTime > 2000) {

pulse = 0;

lastTime = millis();

}

Serial.print(volume);
```

```
  Serial.println(" L/m");
  Tvolume=Tvolume+volume;
  Serial.print(Tvolume);
  Serial.println(" TOTAL L/m");
  delay(2000);
}
ICACHE_RAM_ATTR void increase() {
  pulse++;
}
```

**7.3 SAMPLE OUTPUT:**



## 8. CONCLUSION:

We conclude that by using the water flow sensor interfaced with EPS8266 we can have the data on water consumed and with that data we can optimize water usage. We can monitor the water used and we can do various actions by developing the program. This small step to optimization in water usage will bring a drastic change in future.

Somewhere in this world, people experience water demand. We can save water for our fellows and our future by keeping eye on water usage.

*"Water is life's matter and matrix, mother and medium.*

*There is no life without water."*

***– Albert Szent-Gyorgyi, M.D. Discoverer of Vitamin C***

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# WATER QUALITY MONITORING SYSTEM

A dissertation submitted in partial fulfillment of the requirement for the award of the degree of

BACHELOR OF SCIENCE IN PHYSICS


By:

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| G . NITHYA SHREE | 2020P25 |
| M. RITHIKA | 2020P26 |
| R. ROSHAL | 2020P27 |
| T. ROSHINI | 2020P28 |
| S. SAFREEN ASHIMA | 2020P29 |

Under the guidance of

Dr. I. JANET SHERLY, M.Sc., M.Phil., Ph.D.,

Assistant Professor,

Research Center of Physics,

Fatima College (Autonomous), Madurai.




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Re-Accredited with A++ by NAAC (Cycle – IV)

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## CERTIFICATE

This is to certify that the project work WATER QUALITY MONITORING SYSTEM done by S. Safreen Ashima (2020P29), Roshini. T( 2020P28),Rithika.M (2020P26), R.Roshal ( 2020P27), G. Nithya shree (2020P25) under the guidance of Ms. I JANET SHERLY, M.Sc, M.Phil, Ph.D Assistant Professor, Research Center of physics has been submitted for external viva-voce on 05/04/2023 at Fatima College(Autonomous), Madurai.

5/4/23
EXTERNAL EXAMINER

13/04/23
GUIDE

HEAD OF THE DEPARTMENT

## DECLARATION

We hereby declare that the dissertation titled 'WATER QUALITY MONITORING SYSTEM', submitted to Fatima College (Autonomous), Madurai -625018 to the award of degree of Bachelor of Science in Physics is a record of original project work carried out under the supervision of Dr. I. JANET SHERLY, Assistant Professor, Research Center of Physics, Fatima College (Autonomous), Madurai and has not submitted for any degree or diploma in Madurai Kamaraj University or any Institution.

| | |
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| S. SAFREEN ASHIMA | 2020P29 |

PLACE : MADURAI
DATE : 05.04.2023

## ACKNOWLEDGEMENT

I am grateful to mention the people whose constant inspiration, guidance and blessings made my project a successful one.

I thank god for his substantial blessings and mercy at all stages of the completion of my project. Taking this opportunity, I thank my parents and friends for their sacrifices in supporting me.

I feel honoured to place a warm salutation to the management of FATIMA COLLEGE, MADURAI which gave me the opportunity to have a strong base in physics and practical and theoretical knowledge.

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I owe my special thanks to Dr. A. SHEELA VIMALA RANI , M.Sc., M.Phil., Ph.D., HOD, Research centre of Physics, for her valuable guidance and encouragement.

I owe my special thank to Dr. I. JANET SHERLY, M.Sc., M.Phil., Ph.D., Research centre physics for her valuable guidance and encouragement.

I like to thank all the staff members in the research centre of physics of Fatima college, for their valuable suggestions at different stages of this project work.

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| 3 | PROPOSED COMPONENTS | 8 |
| 4 | PRINCIPLE AND WORKING | 9 |
| 5 | PROGRAM CODING | 18 |
| 6 | CONCULSION | 21 |

## PROBLEM STATEMENT

- Pollution of water is one the main threats in recent times as drinking water is getting contaminated and polluted
- The polluted water can cause various disease to human such as cholera , typhoid, dysentery and elephantiasis .
- Due to the vast increase in global industrial outputs, rural to urban drift and the over utilization of and sea resources the quality of water available to people has deteriorated greatly.
- The high use of fertilizers in farms and also other chemicals in sectors can reduce the water quality globally.
- The life of the echo system also affected by harmful water.

## SOLUTION STATEMENT

- In order to ensure the safe supply of the drinking water the quality of the water need to be monitored in real time.
- Smart solution for monitoring of water pollution are getting more and more significant these days with helps of sensors .
- With the help of turbidity sensor the water quality can be measured.
- The turbidity sensor is used to detect the intensity of light passing through the scattering of particles.

# INTRODUCTION

- Water plays a vital role in the creation of human being and other natural phenomena. About 80% of diseases in the developing countries are caused by the consumption of polluted water.
- As we all know water is not only used for drinking purposes. It has other uses too such as agriculture, economic aspects, industrial sites, fishing and other constructive activities. The quality of water is mainly affected by physical, chemical and biological aspects.
- In the past, water quality has been measured by taking the water samples and sending them to the laboratories and examines them which is very costly ,time consuming, and involves more human resources .This process will not provide real time data.
- Now a days, Smart solutions for monitoring of water pollution are getting more and more significant with the help of sensors. This helps to find the water quality in real times and if water pollution is detected in an early stage .Suitable measures can be taken and critical situation can be avoided.
- The water quality monitoring system can be introduced in schools and colleges and also in rural and urban areas to check the water quality.
- In this water quality monitoring system we are using turbitidy .

# PROPOSED SYSTEM

## COMPONENTS

Fig.1. Jumper wire

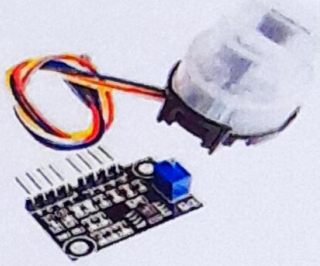

Fig.2. Turbidity senor

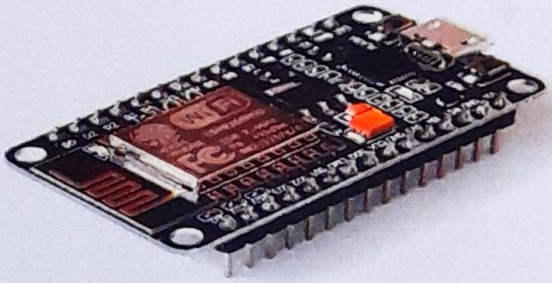

Fig.3. ESP8266 wifi module

# TURBIDITY SENSOR

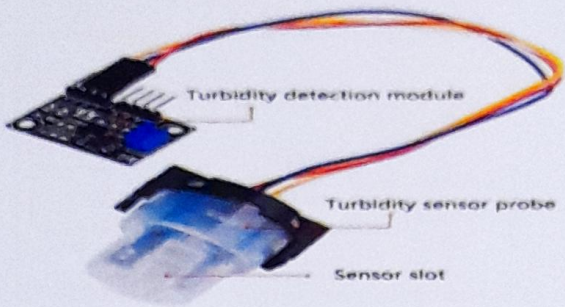


Fig.4. Turbidity sensor

## PRINCIPLE

When a light is passed through a sample of water, the amount of light transmitted through the sample is dependent on the amount of soil in water. As the soil level increase the amount of transmitted light decreases.

## WORKING

A turbidity probe works by sending a light beam into the water to be tested. This light will then scattered by any suspended particles. A light detector is placed at a 90 degree angle to the light source and detect the amount of light that is reflected back as it. Turbidity sensor emit infrared light imperceptible to human vision, capable of detecting particles that are suspended in water, measuring the light transmittance and the dispersion rate, which changes according to the Amount of TSS (Total Suspended Solids), increasing the turbidity of the liquid whenever levels increase. The turbidity unit is measured in NTU "Nephelometric

Turbidity Units" which is global standard. The larger the turbidity is, the cloudy of the sample is. Turbidity sensor connects to the microcontroller through an analog to digital converter through this A to D converter.

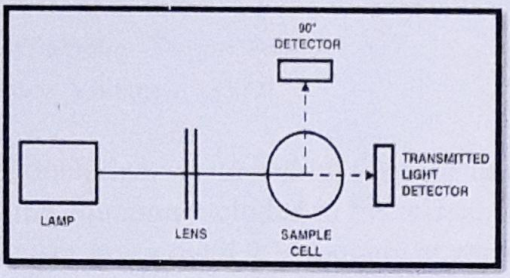


**Fig.5. Block diagram of turbidity sensor**

Turbidity sensor consists

- Transmitter
- Receiver

Transmitter consists of light source and driver circuit. In the receiver end, there is a light detector like photodiode or an LDR

## Turbidity Sensor Voltage into NTU:

The voltage range you can see is from 0 to 4.5 and the NTU values from 0 to 3500, now all you need is to map the 0 to 4.5 voltage range to 0 to 3500 which is the easiest way. Or you can use the 2nd method which is a bit hard and we are going to implement this.

At the bottom of the graph, you can see this formula

$$\mathbf{Y = -1120.4x^2 + 5742.3x - 4352.9} \quad \text{... [ 1 ]}$$

Where x is the voltage, and I already explained how to measure the Turbidity sensor voltage

float voltage = sensorValue * (5.0 / 1024.0); ... [ 2 ]
this line of code gives you the voltage

LET SAY

Turbidity_Sensor_Voltage = Y

Then we can use the following formula to convert the **turbidity sensor Voltage** value into **NTU** value. In the Arduino code we will simply write

ntu = -1120.4*square(Turbidity_Sensor_Voltage)* + *5742.3*Turbidity_Sensor_Voltage – 4352.9 ... [ 3 ]

From this graph I concluded, while coding for your microcontroller-based project that the equation included in the relationship graph is only applicable if the sensor gives out 4.2 V roughly at zero turbidity (clear water), and it's only true within the range of 2.5 V to 4.2 V (3,000 to 0 turbidity).
Clear water with NTU less than 0.5 give us a voltage around Voltage

NTU: 500 Voltage: 3.27V

NTU: 50 Voltage: 4.10V

NTU: 0.5 Voltage: 4.21V

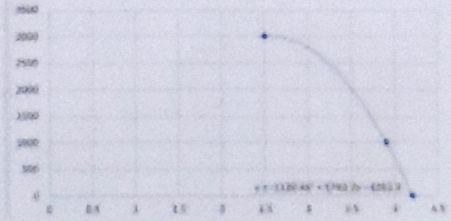

Fig.6. The relationship between turbidity and voltage

## DATA SHEET

| | |
|---|---|
| OPERATING VOLTAGE | 5VDC |
| OPERATING CURRENT | 40MA |
| RESPONSE TIME | 500MS |
| INSULATION RESISTANCE | 100M |
| OUTPUT METHOD | ANALOG |
| ANALOG OUTPUT | 0-5V |
| DIGITAL OUTPUT | HIGH/ LOW LEVEL SIGNAL |

Turbidity Sensor Applications

- Washing machines
- Dishwashers
- Industrial site control
- Environmental sewage collection
- Water quality monitoring using IoT
- Oil quality monitoring

## ESP8266 WIFI module

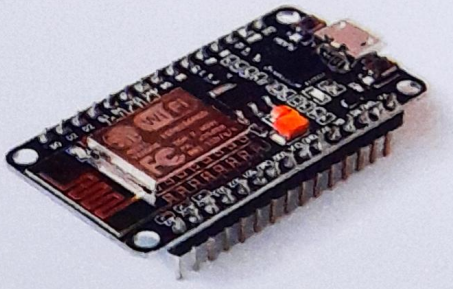

**Fig.7. ESP8266 wifi module**

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices. It is referred to as a standalone wireless transceiver, available at a very low price. It is used to enable the internet connection to various applications of embedded systems.

## ESP8266-01 Features

- Low cost, compact and powerful Wi-Fi Module
- Power Supply: +3.3V only
- Current Consumption: 100mA
- I/O Voltage: 3.6V (max)
- I/O source current: 12mA (max)
- Built-in low power 32-bit MCU @ 80MHz
- 512kB Flash Memory
- Can be used as Station or Access Point or both combined
- Supports Deep sleep (<10uA)
- Supports serial communication hence compatible with many development platform like Arduino

# PIN DIAGRAM

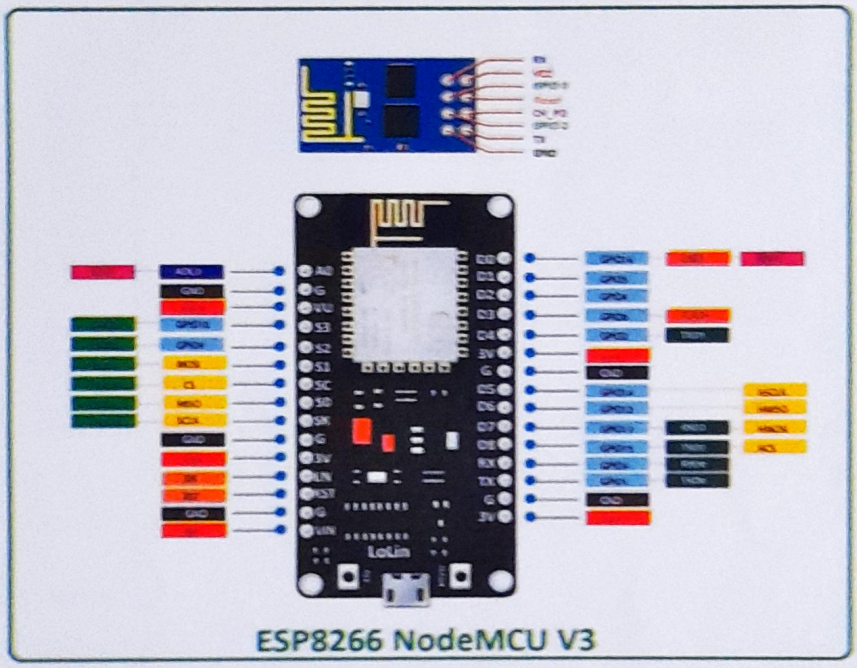


Fig.8. ESP8266 pin diagram

## ARDUINO IOT CLOUD

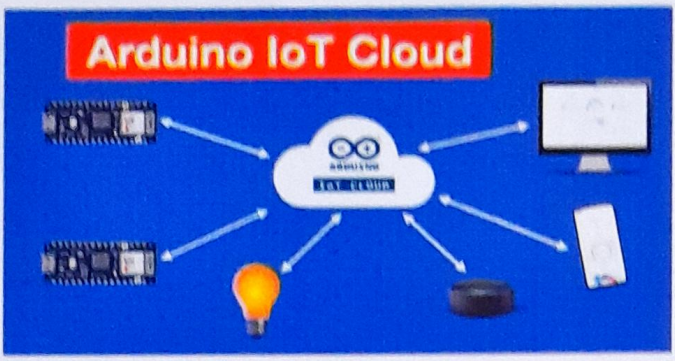


Fig.9. Arduino

The Arduino IoT Cloud is a platform that allows anyone to create IoT projects, with a user friendly interface, and an all in one solution for configuration, writing code, uploading and visualization

### Features

**Data Monitoring** - learn how to easily monitor your Arduino's sensor values through a dashboard.

- **Variable Synchronisation**- variable synchronisation allows you to sync variables across devices, enabling communication between devices with minimal coding.
- **Scheduler**- schedule jobs to go on/off for a specific amount of time (seconds, minutes, hours).
- **Over-The-Air (OTA) Uploads** - upload code to devices not connected to your computer.
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- **Dashboard Sharing** - share your data with other people around the world

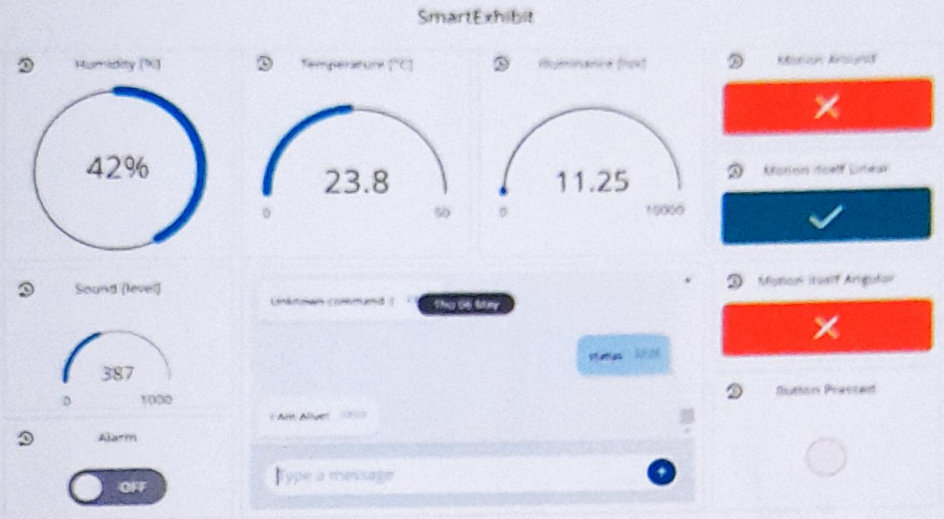


Fig.10. smart exhibit

## Application of water quality monitoring system

Technology can be used to monitor rivers, lakes, watercourses, wells and boreholes ensuring that the water is suitable for human or animal consumption. This system uses different sensors for monitoring the water quality by determining turbidity it also maintains a continuously healthy water supply.

## FUTURE SCOPE

The future scope of this project is **monitoring environmental conditions, drinking water quality, treatment and disinfection of waste water** etc. This system could be implemented in various industrial

process. Environmental water quality monitoring aims to provide the data required for safeguarding the environment against adverse biological effects from multiple chemical contamination arising from anthropogenic diffuse emissions and point sources.

## Circuit diagram

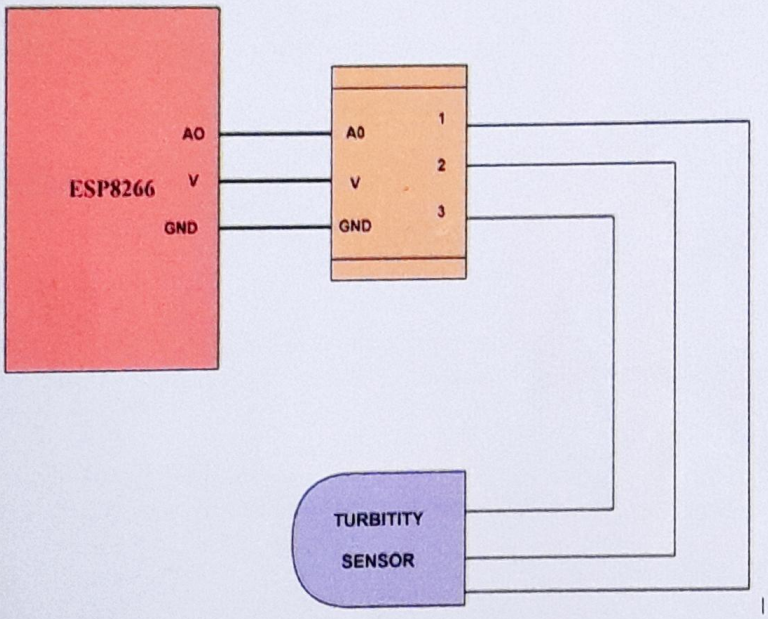


**Fig.11. Circuit diagram of water quality monitoring system**

## PROGRAM CODING

```
#define TdsSensorPin A1
#define VREF 5.0 // analog reference voltage(Volt) of the ADC
#define SCOUNT 30 // sum of sample point
int analogBuffer[SCOUNT]; // store the analog value in the array, read from ADC
int analogBufferTemp[SCOUNT];
int analogBufferIndex = 0,copyIndex = 0;
float averageVoltage = 0,tdsValue = 0,temperature = 25;
void setup()
{
Serial.begin(115200);
pinMode(TdsSensorPin,INPUT);
}
void loop()
{
static unsigned long analogSampleTimepoint = millis();
if(millis()-analogSampleTimepoint > 40U) //every 40 milliseconds,read the analog
value from the ADC
{
analogSampleTimepoint = millis();
analogBuffer[analogBufferIndex] = analogRead(TdsSensorPin); //read the analog
value and store into the buffer
analogBufferIndex++;
if(analogBufferIndex == SCOUNT)
analogBufferIndex = 0;
}
static unsigned long printTimepoint = millis();
if(millis()-printTimepoint > 800U)
{
printTimepoint = millis();
for(copyIndex=0;copyIndex<SCOUNT;copyIndex++)
analogBufferTemp[copyIndex]= analogBuffer[copyIndex];
```

```
averageVoltage = getMedianNum(analogBufferTemp,SCOUNT) * (float)VREF/
1024.0; // read the analog value more stable by the median filtering algorithm, and
convert to voltage value
float compensationCoefficient=1.0+0.02*(temperature-25.0); //temperature
compensation formula: fFinalResult(25^C) =
fFinalResult(current)/(1.0+0.02*(fTP-25.0));
float compensationVolatge=averageVoltage/compensationCoefficient;
//temperature compensation
tdsValue=(133.42*compensationVolatge*compensationVolatge*compensationVol
atge - 255.86*compensationVolatge*compensationVolatge +
857.39*compensationVolatge)*0.5; //convert voltage value to tds value
//Serial.print("voltage:");
//Serial.print(averageVoltage,2);
//Serial.print("V ");
Serial.print("TDS Value:");
Serial.print(tdsValue,0);
Serial.println("ppm");
}
}
int getMedianNum(int bArray[], int iFilterLen)
{
int bTab[iFilterLen];
for (byte i = 0; i<iFilterLen; i++)
bTab[i] = bArray[i];
int i, j, bTemp;
for (j = 0; j < iFilterLen - 1; j++)
{
for (i = 0; i < iFilterLen - j - 1; i++)
{
if (bTab[i] > bTab[i + 1])
{
bTemp = bTab[i];
bTab[i] = bTab[i + 1];
bTab[i + 1] = bTemp;
}
}
}
if ((iFilterLen & 1) > 0)
bTemp = bTab[(iFilterLen - 1) / 2];
else
```

```
bTemp = (bTab[iFilterLen / 2] + bTab[iFilterLen / 2 - 1]) / 2;
return bTemp;
}
```

## CONCLUSION

Monitoring of Turbidity of Water makes use of water detection sensor with unique advantage and existing GSM network. The system can monitor water quality automatically, and it is low in cost and does not require people on duty. So the water quality testing is likely to be more economical, convenient and fast. The system has good flexibility. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters To implement this need to deploy the sensor devices in the environment for collecting the data and analysis. By deploying sensor devices in the environment, we can bring the environment into real life i.e. it can interact with other objects through the network. Then the collected data and analysis results will be available to the end user through the Wi-Fi.

# VIBRATION ANALYSIS IN INDUSTRIES

A dissertation submitted in partial fulfillment of the
requirement for the award of the degree of
**BACHELOR OF SCIENCE IN PHYSICS**

**by**


**1. Salima Sulthana .M (2020P30)**

**2. Shalinipriya .J (2020P31)**

**3. Sweetlin Sherly .C (2020P32)**

**4. Sylvia Joan .J (2020P33)**

**5. Thiyathra Risen .R (2020P34)**

**Under the Guidance of**
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**Assistant Professor ,**
**Research Centre of physics.**
**Fatima College (Autonomous), Madurai.**



**FATIMA COLLEGE (AUTONOMOUS), MADURAI**

(Affiliated to MADURAI KAMARAJ UNIVERSITY)

(RE-ACCREDITED WITH 'A++'GRADE BY NAAC)

(74th Rank in India Ranking 2020 (NIRF) by MHRD)

Mary Land, MADURAI-625018

**APRIL 23**

## CERTIFICATE

**This is to certify that the project work 'VIBRATION ANALYSIS IN INDUSTRIES' done by Salima Sulthana .M (2020P30), Shalinipriya .J (2020P31), Sweetlin Sherly .C (2020P32), Sylvia Joan .J (2020P33), Thiyathra Risen .R(20202P34) under the guidance of Ms. J. R. Sofia, M.Sc., NET., (Ph.D.,)Assistant Professor, Research Centre of Physics has been submitted for external viva-voce on 05.04.2023 at Fatima College (Autonomous), Madurai.**

**External Examiner**

**Guide**

**Head of the Department**

## DECLARATION

We hereby declare that the dissertation titled "VIBRATION ANALYSIS IN INDUSTRIES", submitted to Fatima College (Autonomous), Madurai -625018 to the award of degree of Bachelor of Science in Physics is a record of original project work carried out under the supervision of Ms. J. R. Sofia, M.Sc., NET., (Ph.D.,) Assistant Professor, Research Centre of Physics, Fatima College (Autonomous), Madurai and has not submitted for any degree or diploma in Madurai Kamaraj University or any Institution.

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**Salima Sulthana .M**

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**(Reg No : 2020P34)**

**Place : Madurai**

**Date : 03.04.2023**

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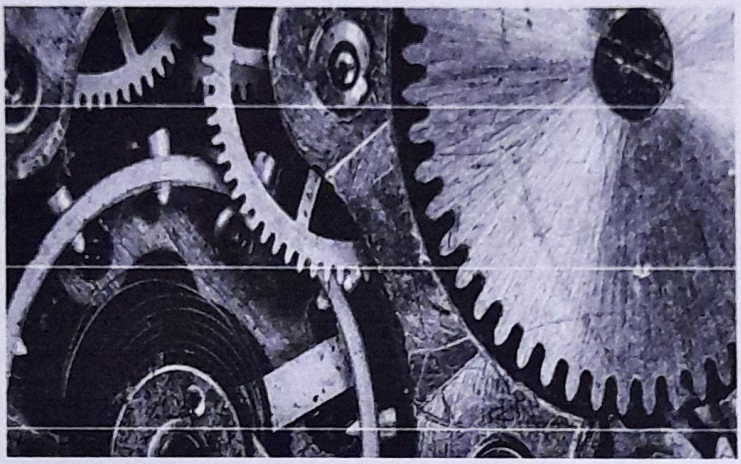
# ABSTRACT



Industries make use of a large number of motors and other instruments which consists of gears, bearings and shafts. As the gears rotate the shaft continuously producing torque, there exists a frictional force between the components. This friction leads to the wear and tear of the components of the machinery which includes: Gear tooth breakage, bearing and shaft damageetc. These defects are detected later only when the machine fails.Vibration analysis helps to overcome the problems which includes gear tooth damage, bearing and shaft damage. The characteristic vibration of the faulty machinery is detected using a vibration sensor. The analysis of these vibrations helps us to troubleshoot the problem and eventually solve it. We now build a vibration analyzer by interfacing SW-420 ,AMICA Node MCU ESP8266 development board and arduino IoT cloud. The normal conditions of vibration are specified in the code. When deviation occurs from the normal conditions of vibration, the sensor automatically alerts us.

# 1. INTRODUCTION

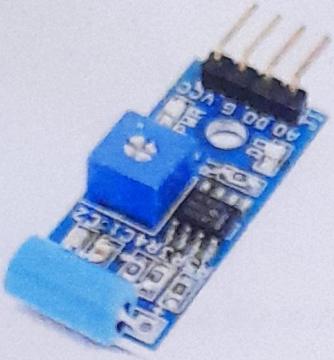
Gears, shafts, and bearings are the backbone of equipment used in the field of Mechanical Power Transmission. They are the primary components in transmission machinery, drivetrains, and gear boxes. Transmission machinery and drivetrains deliver power from engines to the wheels of a variety of vehicles ranging from automobiles to earth moving equipment like excavators, backhoes, bulldozers and dump trucks .Gear boxes of a variety of sizes and types power a variety of machines and equipment that are found in our factories and homes. Among the multitudinous machinery that make use of gear systems, we consider a DC Gear Motor. Many battery-operated devices rely on DC motors for power. Because of their high shaft speed(typically 1500-6000 RPM under load). Since many applications require a controllable shaft speed output, many DC motors are paired with mechanical gearboxes. This helps to reduce the motor's shaft speed, and increase the torque output of the motor. Without such gearboxes, the shaft speed of DC motors often exceeds the requirements of most applications. In most cases, torque is increased by the ratio of the gear reduction, minus any losses in the gearbox.

Vibration Analysis, applied in an industrial or maintenance environment aims to reduce maintenance costs and equipment downtime by detecting equipment faults. Vibration Analysis is a key component of a Condition Monitoring program, and is often referred to as Predictive Maintenance

Most commonly Vibration analysis is used to detect faults in rotating equipment (Fans, Motors, Pumps, and Gearboxes etc.) such as Unbalance, Misalignment, rolling element bearing faults and resonance conditions. Simply, the goal of vibration analysis is to avoid equipment failure which causes great loss in production and it is also comparatively costlier to repair the damaged machinery. So we can use vibration analysis alongside other technologies to get the earliest warning at early stages of failure.

A failure in such gear system is not easily recognizable and is only detected when the motor fails to function properly. In order to overcome faults like, cracked gear tooth, bent shaft, pitting of race and balls of bearing, etc. we make use of a Vibration sensors which are ideal both for monitoring applications, getting instant notification when faults occur and more in-depth analysis that vibration experts can do with trended vibration data, often to diagnose complex vibration patterns or mysterious faults

## 2.1 COMPONENTS USED

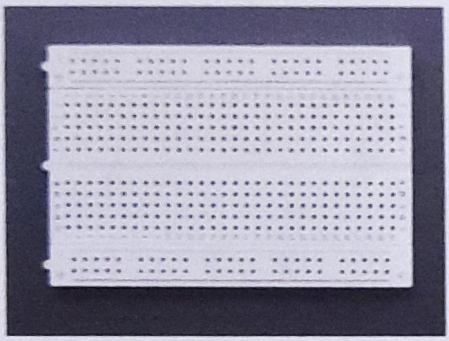


SW-420

ARDUINO

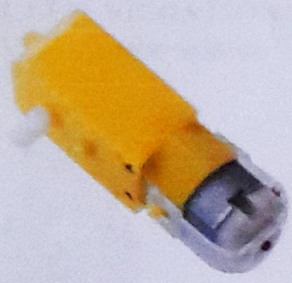
IoT CLOUD

Arduino IoT CLOUD



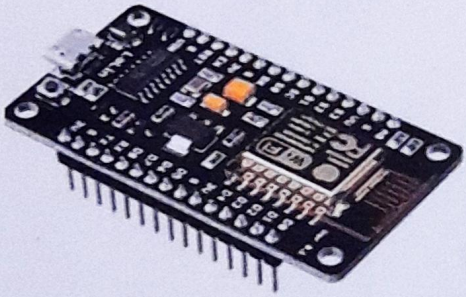
Bread Board

Female to male jumper wire cable



**150 RPM Single Shaft BO Motor – Straight**

**Plastic spur gear**



**AMICA Node MCU ESP8266 Development Board**

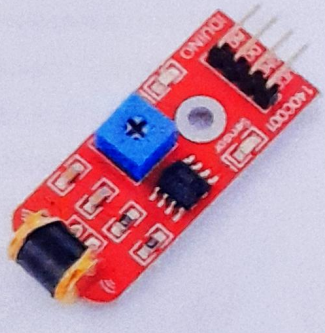
## 2.2 A FEW VIBRATION SENSORS

### IRD 521 Accelerometer


**Technical Performance**

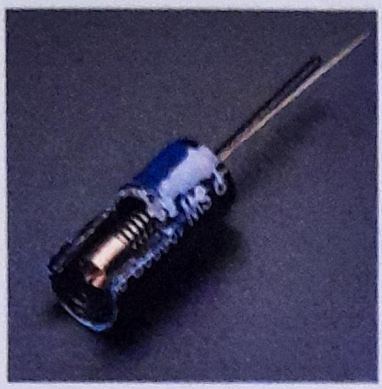
- **Sensitivity** : 100 mV/g
- **Frequency Response** : 2 Hz to 10 kHz +/- 5%
- **Transverse Sensitivity** : Less than 5%
- **Electrical Noise** : 0.1mg max
- **Current Range/Constant Current Excitation** : 0.5mA to 8mA
- Bias Output Voltage :10-12 Volts DC
- Settling Time : 2 seconds
- Output Impedance : 200 Ohms max
- Case Isolation : More than 10 to the power 8 at 500 Volts

### 801s Module



- Size: 20mm* 32mm *11mm
- the main chip: LM393, 801S
- work voltage: DC 5V
- with the signal output instructions;
- the output valid signal is high, the light goes out;
- sensitivity adjustable (fine tuning);

SW18020p



## Specifications

- Maximum working voltage (Vmax) :12V
- Maximum current (Imax) : less than5mA
- Open circuit resistance: more than 10 Mega Ohms
- On resistance: less than 5 ohms
- Ambient temperature: less than 100°C.
- Life expectancy: 5,00,000 times
- Suitable for small current control circuit of trigger.
- Response time: 2ms
- Sensor is in airtight seal
- Gold Plated Contacts

## Advantages

- The sensor's maximum working voltage is 12V DC but it works even at three volts.
- When using it in a circuit, it consumes less than 5mA current and offers around 10-mega-ohm contact resistance in open state and less than 5-ohm in contact state.
- It is highly reliable and its response time is less than 2ms. It works more than 500,000 times without breakdown.

**Applications**

- Anti-theft alarm
- Smart Home systems
- Automotive devices
- Home electrical devices
- Air conditon / Air warm blower fall prevention protect switches
- Communication devices
- Electronic Scale
- Instruments/Toys
- Meters/Lamps
- Digital S hoes
- SportE quipment

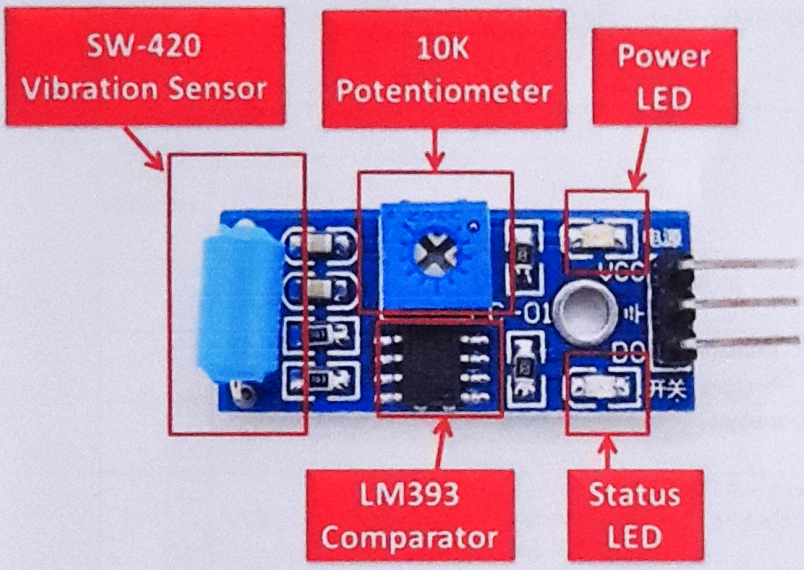
## 2.3 SENSOR USED

### SW-420 Vibration Sensor

SW-420 is a cost-effective vibration sensor module consists of SW-420 and Comparator LM393. The module is embedded with an SW-420 Vibration Sensor, a 10K potentiometer to alter the sensitivity, and an LM393 comparator that produces a smooth digital output. The LM393 comparator uses a preset to sense the vibrations in the surroundings and maintains a state. It gives out logic high if vibrations are detected otherwise it will remain in its default logic low state. The module is a handy, easy interface with a device that finds its applications in DIY projects along with commercial applications.

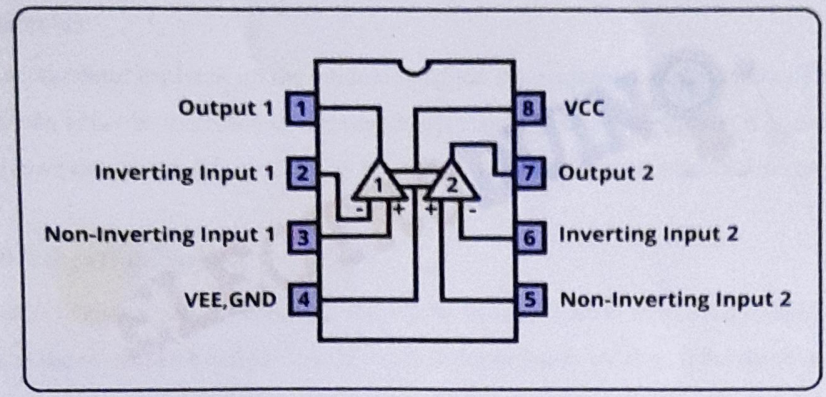
## SW-420 Vibration Sensor Components

The SW-420 vibration sensor module is integrated with the SW-420 vibration sensor, LM393 voltage comparator, a potentiometer, current limiting resistors to act as voltage dividers, therefore, control the current and capacitors as biasing elements and for noise filtering.




## LM393 Voltage Comparator IC

The LM393 integrated circuit (IC) is a dual differential comparator, it consists of two inbuilt operational amplifiers. Each comparator accepts 2 inputs for comparison. It is a high-precise integrated that compares the reference voltage and the input vibration signal and measure which input voltage is the larger, then it provides output l. Pin 2 of the LM393 IC is connected to the adjustable potentiometer while its pin 3 is connected to the vibration sensor. The IC compares both the voltages and passes them to the digital output pin in the form of binary states.




| Pin Number | Pin Name | Description |
|---|---|---|
| 1 | OUTPUT 1 | This is the output of the Op -Amp 1 |
| 2 | INPUT 1- | Inverting Input pin of Op-Amp 1 |
| 3 | INPUT 1+ | Non-Inverting Input pin of Op-Amp 1 |
| 4 | VEE, GND | This is the Ground pin of the IC. It needs to be connected to the Negative (-) terminal of the supply voltage. |
| 5 | INPUT 2+ | Non-Inverting Input pin of Op-Amp 2 |
| 6 | INPUT 2- | Inverting Input pin of Op-Amp 2 |
| 7 | OUTPUT 2 | This is the output of the Op -Amp 2 |
| 8 | VCC | This is the Positive pin of the IC. It needs to be connected to the Positive (+) terminal of the supply voltage. |

If the input voltage 1 is **greater than** the input voltage 2, then the output of the op-amp will be drawn down to the ground, which means the output voltage is **Low (GND)**.If the input voltage 1is **less than** the input voltage 2, then the output of the op-amp stays at VCC, which means the output voltage is **High (VCC)**.

### Potentiometer

A 10K potentiometer is placed on the module to adjust the sensitivity of the sensor. The sensitivity can either be increased or decreased depending on the requirement. It is done by setting a preset or a threshold value which is given to the LM393 as a reference to compare.

### SW-420 Vibration Switch

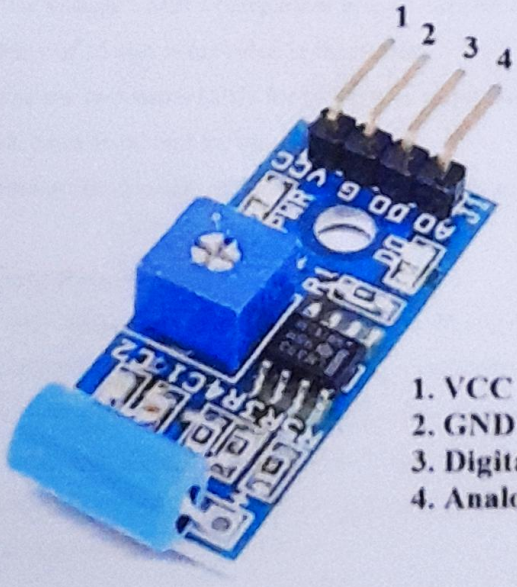
The SW-420 vibration switch senses the magnitude of the vibration in its environment. It responds to the exposed vibration either through the opening or closing of the electrical contact. The trigger switch can be an electromechanical or relay or semiconductor component.

### Inbuilt LEDs

The module has two LEDs. One is to light up when the module is energized and the other is to indicate the digital output.

### SW-420 Vibration Sensor Pinout

The SW-420 vibration sensor module is available in 3.2cm x 1.4cm dimensions. The pinout of the Vibration Sensor module is as shown:




1. VCC
2. GND
3. Digital Output
4. Analog Output

## SW-420 Pin Configuration

It has three headers for interfacing with any microcontroller. The pin configuration in tabular are

| Pin Name | Function |
|---|---|
| VCC | Positive power supply pin. It gives power to the sensor. |
| GND | Ground connection pin |
| D0 | Digital output pin. It passes the digital output of the builtin comparator circuit. |
| A0 | Analog Output pin. It passes the analog output of the builtin comparator circuit |

## Features & Specifications

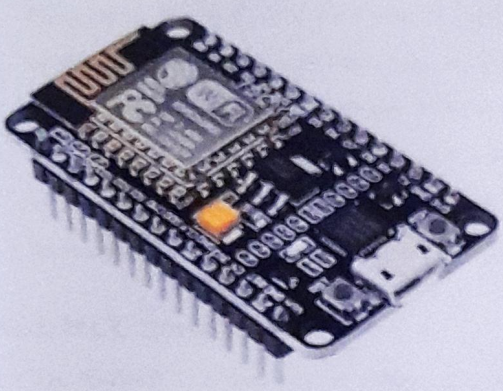
- Operating Voltage: 3.3 Volts – 5.0 Volts DC
- Current driving Capability: 15 mA
- Vibration Sensor module dimensions: 3.2cm x 1.4cm
- The vibration sensor is a close type switch by default.
- An internal 10K potentiometer is given to calibrate the sensitivity of the sensor.
- A low-power voltage LM393 comparator chip to binarize the analog signal and has a driving ability of 15 mA is provided in the sensor.
- SW-420 also has two status LEDs for power and output indication.
- The module has a fixed bolt for easy installation.
- It is microcontroller-friendly and can be interfaced with any of them.

## SW-420 Working Principle

The SW-420 is a switch that operates by the opening and closing of the electrical contact. By default, the vibration sensor is in a closed state. When no vibrations are sensed, it remains closed or in a conduction state. As soon as vibration is detected by the sensor, the contacts open and the resistance rises. Due to this, a pulse is produced and triggers the circuit. It is passed on to the LM393 voltage comparator IC that digitizes the signal and further makes it available on the digital output pin of the module

## 2.4 MICRICONTROLLER USED :

## NodeMCU – ESP8266



- 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**, which 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.
- But, what about **Arduino**? The Arduino project created an **open-source hardware design** and **software SDK** for their versatile IoT controller.

- Similar to NodeMCU, the Arduino hardware is a microcontroller board with a USB connector, LED lights, and standard data pins.
- It also defines standard interfaces to interact with sensors or other boards. But unlike NodeMCU, the **Arduino board can have different types of CPU chips** (typically an ARM or Intel x86 chip) **with memory chips**, and a variety of programming environments. There is an Arduino reference design for the ESP8266 chip as well.
- However, the flexibility of Arduino also means significant variations across different vendors. For example, most Arduino boards do not have WiFi capabilities, and some even have a serial data port instead of a USB port.

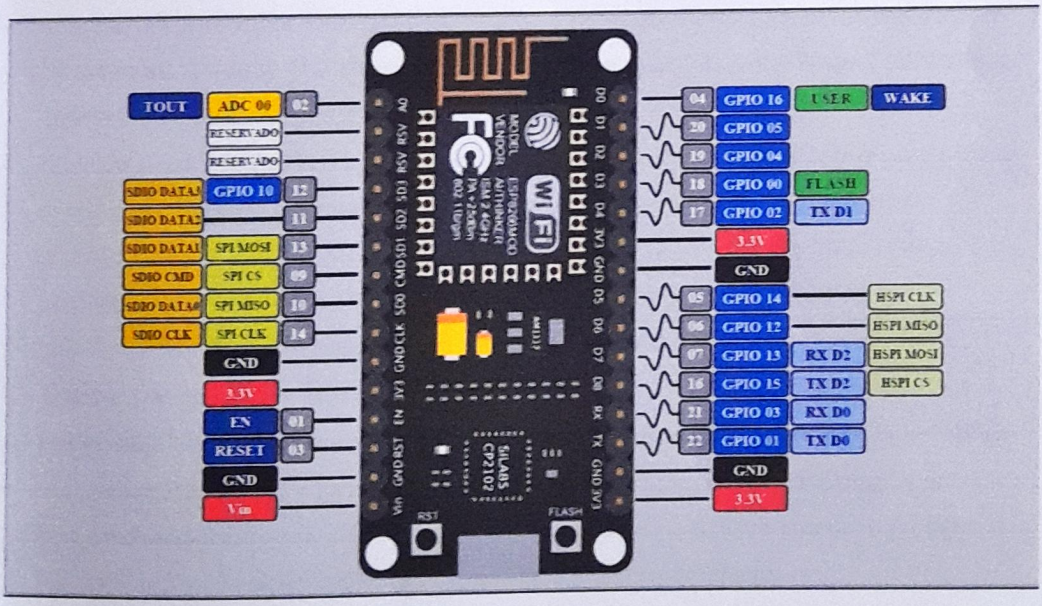
## NodeMCU Specifications

- The NodeMCU is available in various package styles. Common to all the designs is the base ESP8266 core. Designs based on the architecture have maintained the standard 30-pin layout. Some designs use the more common narrow (0.9″) footprint, while others use a wide (1.1″) footprint
- The most common models of the NodeMCU are the Amica (based on the standard narrow pin-spacing) and the LoLin which has the wider pin spacing and larger board.
- The **open-source design** of the base ESP8266 enables the market to **design new variants of the NodeMCU** continually.

| | **Official NodeMCU** | **NodeMCU Carrier Board** | **LoLin NodeMCU** |
|---|---|---|---|
| **Microcontroller** | ESP-8266 32-bit | ESP-8266 32-bit | ESP-8266 32-bit |
| **NodeMCUModel** | Amica | Amica | Clone LoLin |
| **Size** | 49mm * 26mm | 49mm * 26mm | 58mm * 32mm |
| **Carrier Board size** | n/a | 102mm * 51mm | n/a |
| **Pin Spacing** | 0.9“ (22.86 mm) | 0.9“ (22.86 mm) | 1.1” (27.94 mm) |
| **Clock Speed** | 80MHz | 80MHz | 80MHz |
| **USB to Serial** | CP2102 | CP2102 | CH340G |

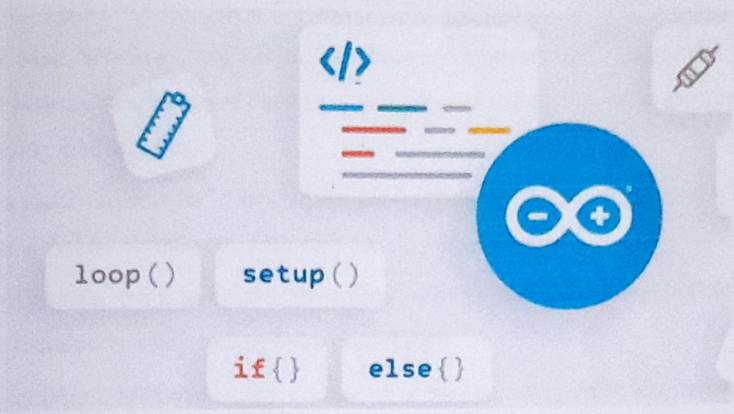
| USB Connector | Micro USB | Micro USB | Micro USB |
|---|---|---|---|
| Operating Voltage | 3.3 V | 3.3 V | 3.3 V |
| Input Voltage | 4.5V – 10V | 4.5V – 10V | 4.5V – 10V |
| Flash Memory / SRAM | 4 MB / 64 KB | 4 MB / 64 KB | 4 MB / 64 KB |
| Digital I/O Pins | 11 | 11 | 11 |
| Analog In Pins | 1 | 1 | 1 |
| ADC Range | 0 - 3.3V | 0 - 3.3V | 0 - 3.3V |
| UART/ SPI / I2C | 1/1/1 | 1/1/1 | 1/1/1 |
| WIFI Built – In | 802 11 b/g/n | 802 11 b/g/n | 802 11 b/g/n |
| Temperature Range | 40C-125C | 40C-125C | 40C-125C |

## Pin Configuration



# 3.PLATFORM USED

## Arduino IoT Cloud




- Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.
- You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the **Arduino programming language (based on Wiring)**, and the **Arduino Software (IDE)**, based on Processing.
- Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.
- Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students **without a background in electronics and programming.**
- As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments.

**Advantages**

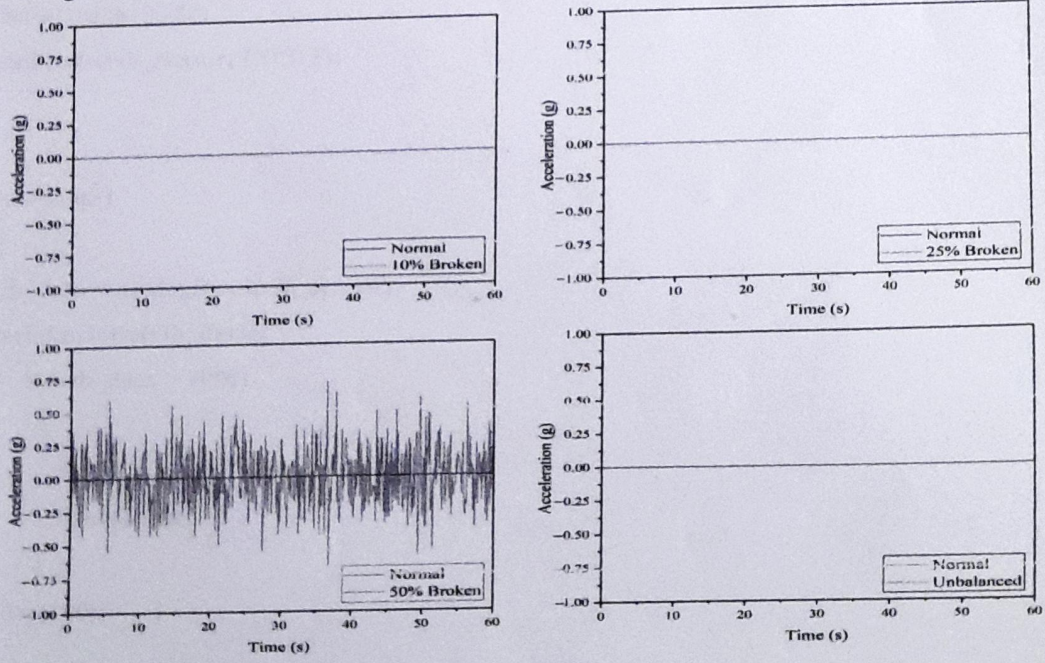
- Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users.
- It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics.
- Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments.
- Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things.
- Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community.
- There are many other microcontrollers and microcontroller platforms available for physical computing. **Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard**, and many others offer similar functionality.
- All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:
- **Inexpensive** - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than \$50
- **Cross-platform** - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- **Simple, clear programming environment** - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.

- **Open source and extensible software** - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.
- Open source and extensible hardware - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

## 4. VIBRATION ANALYSIS IN INDUSTRIES

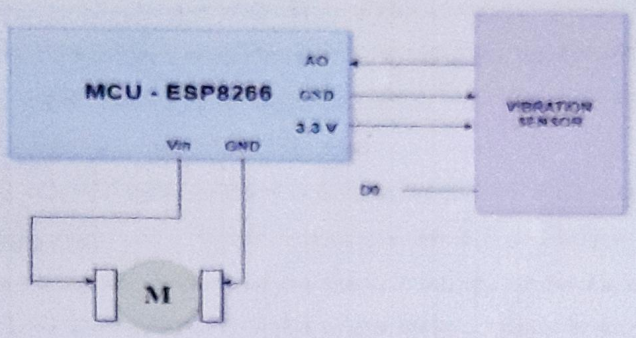
With the help of a the vibration sensor – SW18020p, NodeMCU – ESP8266 Microcontroller, Arduino IoT Cloud.,we have come with a vibration analyzer.

This Vibration Analyzer detects the characterBistic frequency changes from the normal frequency produced by a DC Gear motor as of our consideration and other machineries having rotating parts.



# 5. INTERFACING ARDUINO WITH SW420 AND THE MOTOR

## Circuit Diagram




## Arduino Code :

```
int vib_sensor = A0;
int vib_data = 0;

void setup()
{
Serial.begin(9600);
pinMode(vib_sensor, INPUT);
}

void loop()
 {
vib_data = analogRead(vib_sensor);
Serial.println(vib_data);
    if (vib_data > 1000)
     {
       Serial.println ("VIBERATION");
      delay(1000);
     }
delay(100);      }
```

## 6. CONCLUSION

One of the best and most reliable methods for determining the actual state of your machinery is predictive maintenance, and vibration measurement in particular. It allows you to keep tabs on the machine's condition over time and gives you the ability to plan and schedule possible repairs. Don't stop at simply measuring your vibrations on a frequent basis if you want to keep your machinery operating.

Be wise and make an effort to familiarize yourself with your equipment. Make sure your equipment is tidy. Watch the machine carefully and keep an eye out for any possible air or oil leakage. Investigate any possible foundation cracks, structure cracks, and loose bolts. Listen and Pay close attention to any abrupt changes in noise.

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- https://microcontrollerslab.com/sw-420-vibration-sensor-module-pinout-interfacing-arduino-features/
- https://wiki.seeedstudio.com/Grove-Vibration_Sensor_SW-420/
- https://app.diagrams.net/

# HEART RATE AND RESPIRATORY MONTIORING SYSTEM

A dissertation submitted in partial fulfilment of the requirement for the award of the degree of **BACHELOR OF SCIENCE IN PHYSICS**

by

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Under the guidance of

**Dr. J. SELVI, M.Sc., M.Phil., Ph.D.,**

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RE-ACCREDITED WITH 'A++'GRADE BY NAAC (Cycle IV)

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## CERTIFICATE

This is to certify that the project work **'HEART RATE AND RESPIRATORY MONTIORING SYSTEM'** done under the guidance of Dr. J. SELVI, M.Sc., M.Phil., Ph.D., Assistant Professor, by 2020P35 J.Vishnu Vardhini, 2020P37 S.N.Harish Ifrin, 2020P38 R.Mathumitha, 2020P39 R.Nancy Beaulah , 2020P41 S.Santhiya Research Centre of physics has been submitted for external viva-voce on 05/04/2023 at Fatima College (Autonomous), Madurai.

External Examiner 5/4/23.

Guide

Head of the Department

## DECLARATION

We hereby declare that the dissertation titled '**HEART RATE AND RESPIRATORY MONTIORING SYSTEM**', submitted to Fatima College (Autonomous), Madurai -625018 to the award of degree of **Bachelor of Science in Physics** is a record of original project work carried out under the supervision of **Dr. J.SELVI, M.Sc.,M.Phil., Ph.D., Assistant Professor, Research Centre of physics Fatima College (Autonomous), Madurai** and has not submitted for any degree or diploma in Madurai Kamaraj University or any Institution.

J. Vishnu Vardhini

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# HEART RATE AND RESPIRATORY MONITORING SYSTEM

## Problem statement:

- In this generation, people are facing various problems like heart rate, blood pressure, diabetes, breathing difficulties etc.
- In case of emergency situation, when the patient is alone they may face many difficulties like fainting, breathlessness etc.
- There is no such monitoring device to indicate this kind of situation to related peoples.

## Problem Solving:

- The heart rate and pulse oximeter sensor senses these kinds of problems and indicates to the related peoples about their emergency situation.
- This device used to detect the heart rate and breathing level of a patient.
- By implementing this device in old-age homes or in people with these problems for monitoring their health condition. Many old-age homes didn't have this kind of monitoring system by using this sensor we can avoid many emergency situation

## INTRODUCTION

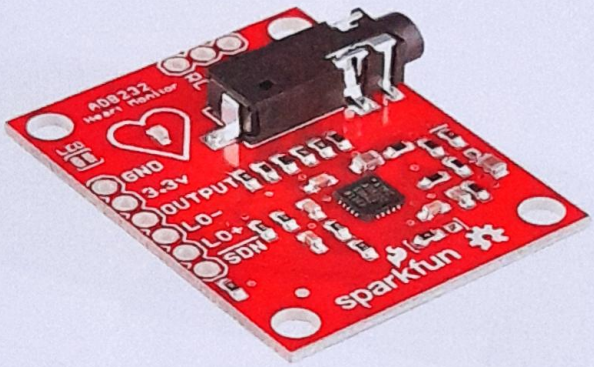
A digital pulse oximeter and health rate sensor is an electronic device which can measure the heart rate and concentration of oxygen in blood. It is important to monitor some important health parameters like body temperature, heart rate and Blood Oxygen levels as they may indicate a precaution before any illness. Especially old age people health should be monitored regularly as their immunity weakens with the increase in age.

Due to work and busy schedules many people don't have time to visit a clinic to track health status, so taking this scenario into consideration let's build a patient health monitoring system using IoT which can sense and monitor few important health parameters at home or work.

So, in our IoT project we are interfacing MAX30102 heart rate and Pulse Oximeter sensor with ESP8266 Microcontroller, to measure Blood SpO2 and Heart rate.

## SENSOR USED FOR HEART RATE:

### AD8232 ECG Sensor:




**Features:**

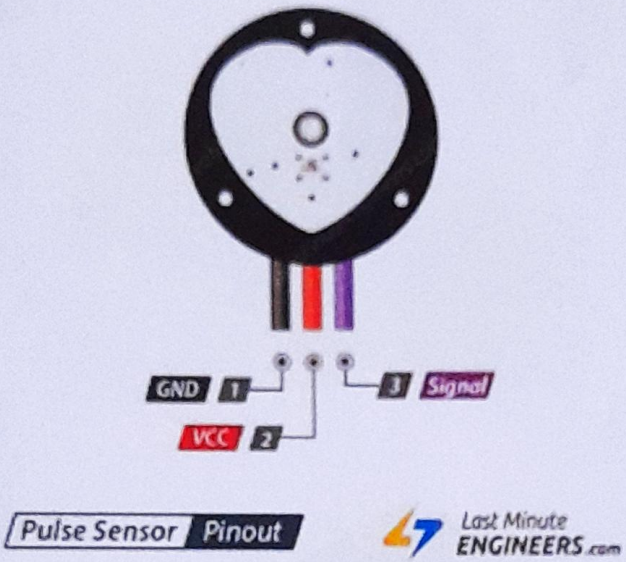
- Operation of single supply ranges from 2V to 3.5V
- The front end is integrated fully with only lead ECG
- The current supply is low like 170 μA
- CMRR is 80 dB
- Incorporated RLD amplifier (right leg drive
- Electrode configurations are 2 or 3
- It accepts half cell potential up to ±300 mV
- Filter settling can be improved by quick restore
- Two-pole adaptable HPF
- 4 mm × 4 mm and 20-lead LFCSP package

**PULSE H10 SENSOR:**


**Features:**

- Interference-preventing electrodes in the strap
- A new measuring algorithm
- Internal memory for 1 training session
- Improved battery life
- Updatable software
- Improved chest strap design

## PULSE SENSOR BPM:

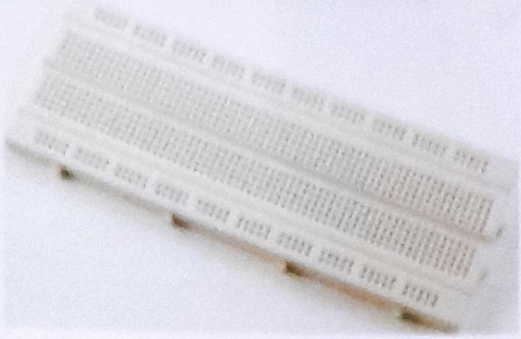



**Features:**

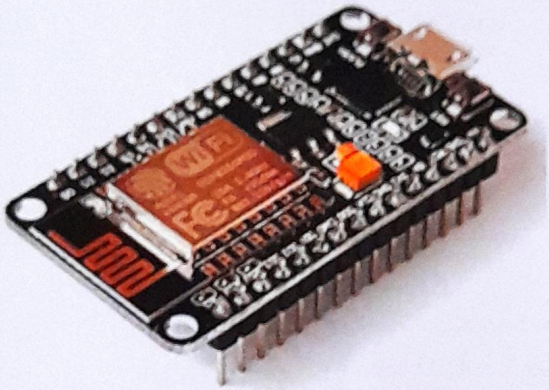
- Blinks LED on Pin 13 to a User's Live Heartbeat.
- "Fancy Fade Blink" an LED on Pin 5, to a User's Live Heartbeat.
- Calculates User's BPM, Beat-Per-Minute.
- Calculates User's IBI, the Interbeat Interval (Time between beats).
- Uses Arduino's Timer interrupt to calculate a5ccurate BPM and IBI
- Serial. Print the Signal, BPM, and IBI.

**COMPONENTS:**

- BREADBOAD



- ESP8266



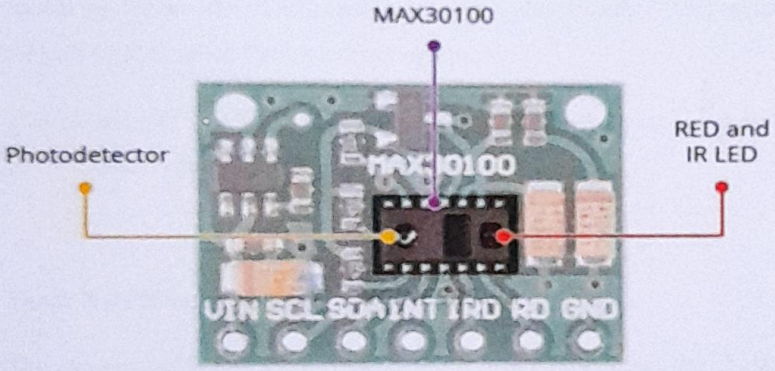
- MAX30100

# PROPOSED SYSTEM

**Max 30100 pulse oximeter and heart rate sensor with ESP8266:**

**Introduction:**

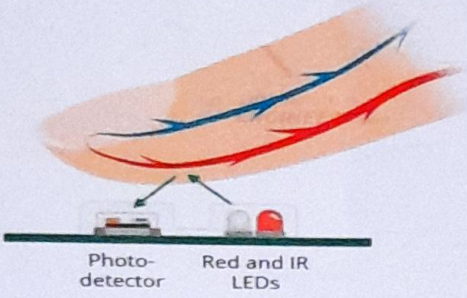
The module features the MAX30100 – a modern, integrated pulse oximeter and heart rate sensor IC, from Analog Devices. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry (SpO2) and heart rate (HR) signals.




On the right, the MAX30100 has two LEDs – a RED and an IR LED. And on the left is a very sensitive photodetector. The idea is that you shine a single LED at a time, detecting the amount of light shining back at the detector, and, based on the signature, you can measure blood oxygen level and heart rate.

**Max 30100 pulse oximeter and heart rate sensor working:**

The MAX30100, or any optical pulse oximeter and heart-rate sensor for that matter, consists of a pair of high-intensity LEDs (RED and IR, both of different wavelengths) and a photodetector. The wavelengths of these LEDs are 660nm and 880nm, respectively.




The MAX30100 works by shining both lights onto the finger or earlobe (or essentially anywhere where the skin isn't too thick, so both lights can easily penetrate the tissue) and measuring the amount of reflected light using a photodetector. This method of pulse detection through light is called Photoplethysmogram.

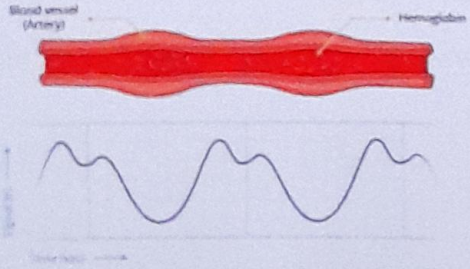
The working of MAX30100 can be divided Into two parts: Heart Rate Measurement and Pulse Oximetry (measuring the oxygen level of the blood).

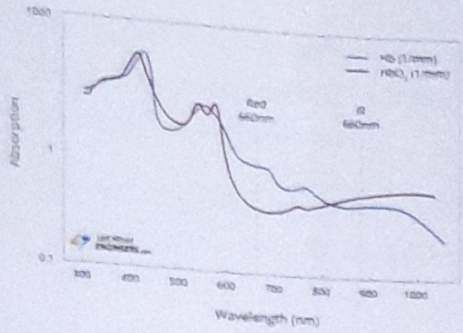
**Heart Rate Measurement:**

The oxygenated hemoglobin (HbO2) in the arterial blood has the characteristic of absorbing IR light. The redder the blood (the higher the hemoglobin), the more IR light is absorbed. As the blood is pumped through the finger with each heartbeat, the amount of reflected light changes, creating a changing waveform at the output of the photodetector. As you continue to shine light and take photodetector readings, you quickly start to get a heart-beat (HR) pulse reading.

**Pulse Oximetry:**

Pulse oximetry is based on the principle that the amount of RED and IR light absorbed varies depending on the amount of oxygen in your blood. The following graph is the absorption-spectrum of oxygenated hemoglobin (HbO2) and deoxygenated hemoglobin (Hb).

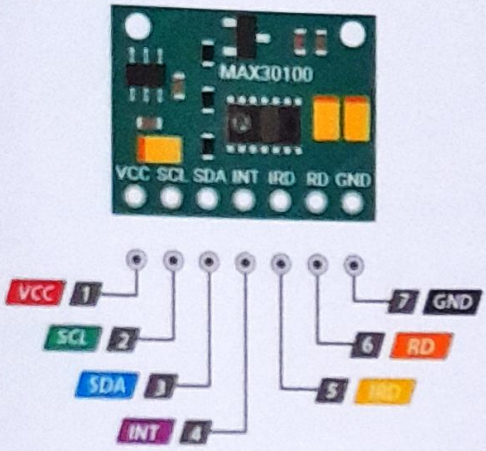





As you can see from the graph, deoxygenated blood absorbs more RED light (660nm), while oxygenated blood absorbs more IR light (880nm). By measuring the ratio of IR and RED light received by the photodetector, the oxygen level (SpO2) in the blood is calculated.

**Max30100 pin configuration:**

The MAX30100 module brings out the following connections.




**VIN** -is the power pin. You can connect it to 3.3V or 5V output from your Arduino.

**SCL** -is the I2C clock pin, connect to your Arduino's I2C clock line.

**SDA** -is the I2C data pin, connect to your Arduino's I2C data line.

**INT-** The MAX30100 can be programmed to generate an interrupt for each pulse. This line is open-drain, so it is pulled HIGH by the onboard resistor. When an interrupt occurs the INT pin goes LOW and stays LOW until the interrupt is cleared.

**IRD-** The MAX30100 integrates an LED driver to drive LED pulses for SpO2 and HR measurements. Use this if you want to drive the IR LED yourself, otherwise leave it unconnected

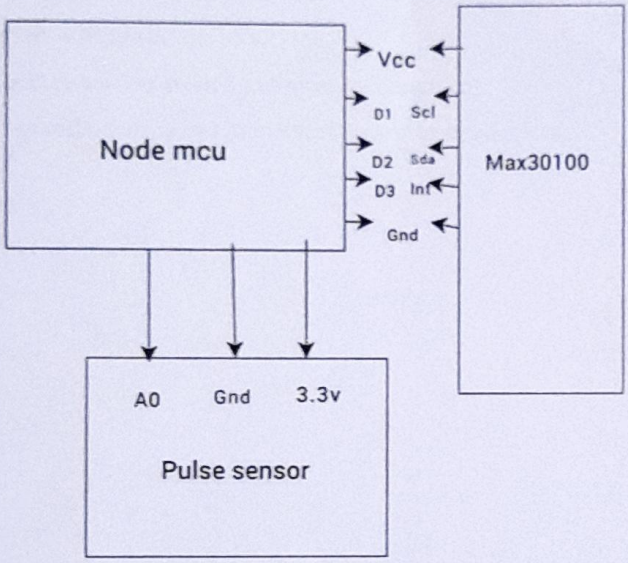
**RD-** pin is similar to the IRD pin, but is used to drive the Red LED. If you don't want to drive the red LED yourself, leave it unconnected.

**GND-** is the ground

**Max30100 Specifications:**

| | |
|---|---|
| Power supply | 3.3V to 5.5V |
| Current draw | ~600µA (during measurements) |
| | ~0.7µA (during standby mode) |
| Red LED Wavelength | 660nm |
| IR LED Wavelength | 880nm |
| Temperature Range | -40°C to +85°C |
| Temperature Accuracy | ±1°C |

**Block diagram:**




**Key Features:**

These are some features of MAX30100.

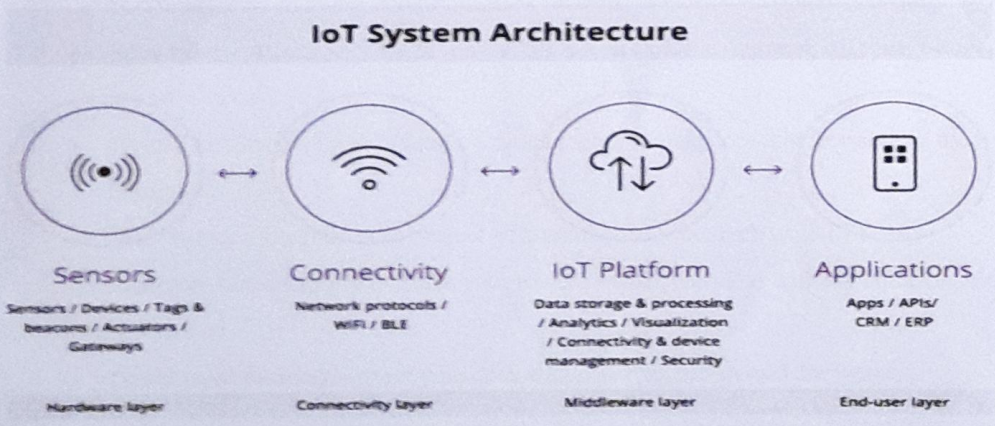
- This sensor is available in the simplest circuitry for heartbeat measurements.
- This module consists of two led infrared and red, a photodiode for light sensing, and, has an analog front end.
- The dimensions of this module are 5.6mm x 2.8mm x 1.2mm with the fourteen pinouts which are available in optically improved closed packages.
- It provides low power battery solutions for handheld electronic devices. We can program It in an easy way and suitable for low power components.
- Its high signal to noise ratio (SNR) gives high motion production flexibility.
- This sensor provides the confined light annulment, higher rate capacity, and fast-moving output data.

**PLATFORM SUPPORTED:**

**IoT CLOUD**

- An IoT cloud is a massive network that supports IoT devices and applications. This includes the underlying infrastructure, servers and storage, needed for real-time operations and processing. An IoT cloud also includes the services and standards necessary for connecting, managing, and securing different IoT devices.
- IoT clouds offer an efficient, flexible, and scalable model for delivering the infrastructure and services needed to power IoT devices and applications for businesses with limited resources. IoT clouds offer on-demand and cost-efficient
- We can connect smart devices in minutes. Choose from a wide range of compatible devices to connect; we will take care of the necessary code.
- Control projects from anywhere in the world
- Control your project from any device, share it with others, automate it, or control with voice.

  Here Arduino IoT cloud is employed.



## ARDUINO IoT CLOUD


The Arduino IoT Cloud is a platform that allows **anyone** to create IoT projects, with a user friendly interface, and an all in one solution for **configuration, writing code, uploading** and **visualization.**

### FEATURES:

- **Data Monitoring** - learn how to easily monitor your Arduino's sensor values through a dashboard.
- **Variable Synchronisation** - variable synchronisation allows you to sync variables across devices, enabling communication between devices with minimal coding.
- **Scheduler** - schedule jobs to go on/off for a specific amount of time (seconds, minutes, hours).
- **Over-The-Air (OTA) Uploads** - upload code to devices not connected to your computer.
- **Web hooks** - integrate your project with another service, such as IFTTT.
- **Amazon Alexa Support** - make your project voice controlled with the Amazon Alexa integration.
- **Dashboard Sharing** – share your data with other people around the world.

**Project Implementation:**

**Coding:**

```
#include <Wire.h>
#include "MAX30100_PulseOximeter.h"
#define REPORTING_PERIOD_MS     1000

// Create a PulseOximeter object
PulseOximeter pox;
// Time at which the last beat occurred
uint32_t tsLastReport = 0;
// Callback routine is executed when a pulse is detected
void onBeatDetected() {
    Serial.println("Beat!");
}

void setup() {
    Serial.begin(9600);
    Serial.print("Initializing pulse oximeter..");
    // Initialize sensor
    if (!pox.begin()) {
        Serial.println("FAILED");
        for(;;);
    } else {
        Serial.println("SUCCESS");
    }
 // Configure sensor to use 7.6mA for LED drive
pox.setIRLedCurrent(MAX30100_LED_CURR_7_6MA);
 // Register a callback routine
  pox.setOnBeatDetectedCallback(onBeatDetected);
}

void loop() {
    // Read from the sensor
```

```
    pox.update();
// Grab the updated heart rate and SpO2 levels
    if (millis() - tsLastReport > REPORTING_PERIOD_MS) {
        Serial.print("Heart rate:");
        Serial.print(pox.getHeartRate());
        Serial.print("bpm / SpO2:");
        Serial.print(pox.getSpO2());
        Serial.println("%");
        tsLastReport = millis();
    }
}
```

## CONCLUSION:

Heart rate and respiratory monitoring system will be more useful in assisting people's health condition and it is portable. we can use this system also in hostels ,old age home. This device is so efficient that it can indicate to their related people about the people's emergency situation.