

AIR WATER POLLUTION SENSING SMARTWATCH

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Electronics and Communication Engineering

by

JOE RENIN E (39130189)



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

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BONAFIDE CERTIFICATE

This is to certify that this project report is the bonafide work of **Mr. Joe Renin E. (39130189)** who have done the project as an individual who carried out the project entitled "**AIR WATER POLLUTION SENSING SMART WATCH**" under my supervision from January 2023 to April 2023.

Internal Guide

Mrs. S. ANNIE ANGELINE PREETHI M.E., (Ph.D).

Head of the Department

Dr. T. RAVI, M.E., Ph.D.

Submitted for Viva voce Examination held on _____

Internal Examiner

External Examiner

DECLARATION

I, **JOE RENIN E.** (39130189), hereby declare that the Project Report on “**AIR WATER POLLUTION SENSING SMARTWATCH**” done by me under the guidance of **Mrs. S. ANNIE ANGELINE PREETHI M.E., (Ph.D)** Assistant professor, Department of Electronics and Communication Engineering, SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI, is submitted in partial fulfillment of the requirements of the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

DATE: 26/4/2023

PLACE: Chennai

SIGNATURE OF THE CANDIDATE

A handwritten signature in blue ink, appearing to read 'Joe Renin E.', with a horizontal line extending to the right.

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ABSTRACT

According to atmospheric and environmental science, both air and water pollutions are the important causes of global warming. The initial move towards stopping the pollution levels is to measure and analyze it thoroughly every human need to know the exact pollution levels they all are living in and has an access to respond to them. During this period, we all have smartwatches which track our health and fitness but when comes to environmental health it is a question mark. The breakdown of environmental health will affect the well-being of all humans and future generations too. So, here the developed model is a smartwatch type that measures air as well as water pollution with displaying time additionally. Stm32 is the nucleus of this model. With this gear, all people can monitor pollution levels anywhere and anytime certainly. This smartwatch model is an actual combination of sensors and small electronic components which helps every citizen to monitor and ensures to protect oneself from an unhygienic situation. Since all sensors perform their specific role in working on this model, the smartwatch allows setting high and low acceptance values of each parameter using push buttons. If any resulting values scanned show up higher/ lower than the set limits it sounds a buzzer alert as well as displays the alert message on OLED display. In such a manner, the smartwatch model enables the user to identify the hazardous substances present in the environment and skip to the safest circumstances.

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CHAPTER – 1

INTRODUCTION

Air is one of the essential elements of man's surroundings. The earth's atmosphere is full of air which contains gases such as Nitrogen, Oxygen, Carbon Monoxide and traces of some rare elements. Humans need an atmosphere of air that is free from contaminants. This is very crucial for human life and health. Any change in the natural composition of air may cause grave harm to life forms on earth. Air pollution is the presence of one or more contaminants in the atmosphere such as gases in a quantity that can harm humans, animals and plant. Urban air pollution is a major concern in our modern society and, thus, monitoring air quality has received an increasing interest in the last few years. Nowadays various small and cheap environmental sensors, e.g. gas sensors that measure the concentration of pollutants, are available on the market. Their small packaging and low power consumption allows their integration into wearable devices, such as a smart watch. The human body uses air in several ways. Without it, we wouldn't be able to live. Breathing in Oxygen - Air supplies the oxygen to our lungs which circulates through our bodies to combine with sugars in the food we eat to give us energy and to build tissues. Exhaling Waste- Oxygen is primarily combined with carbon in our bodies to produce Carbon Dioxide which is exhaled. Other trace gases are exhaled including a little methane and water vapor. The water vapor is not really a waste product like CO₂ or methane. Regulating Temperature - The air around us helps to keep us warm. In the absence of any heat in the air, our bodies lose heat quickly. If we are working hard or exercising we generate excess heat. The air provides some cooling to help the body maintain an ideal temperature of 37° C. Water pollution is one of the biggest fears for the green globalization. In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time, turbidity sensor and mini display.

1.1 EMBEDDED SYSTEM

An Embedded System is a combination of computer hardware and software, which is used to perform a specific task. It is defined as a way of working, organizing and performing tasks according to the set of rules. The main characteristics of an embedded system are speed, power, size, accuracy, reliability, and adaptability. When this system performs the operations at high speed, then it is used for real-time applications. A set of rules or code embedded into the Microcontroller but by using this only limited range of problems will be solved. Perhaps additional mechanical or other parts, designed to perform a specific function. Digital watches and MP3 players are examples of small embedded systems. Larger embedded systems include home appliances, industrial assembly lines, robotics, transport vehicles, traffic light controllers, and medical imaging systems. They frequently function as components of other machines, such as the avionics in aeroplanes and the astronics in spacecraft. Numerous embedded systems that are networked together are essential to large installations like factories, pipelines, and electrical grids. Embedded systems, like programmable logic controllers, commonly combine their functional parts through software customization. The complexity of embedded systems can range from extremely minimal, with a single microcontroller chip, to very high, with numerous units, peripherals, and networks. These networks may be spread out across a broad geographic region connected by long-distance communications lines, or they may be housed in equipment racks. An embedded system is a microcontroller-based, software driven, reliable, real-time control system, autonomous, or human or network interactive, operating on diverse physical variables and in diverse environments and sold into a competitive and cost conscious market. An embedded system is not a computer system that is used primarily for processing, not a software system on PC or UNIX, not a traditional business or scientific application. High-end embedded & lower end embedded systems. High-end embedded system - Generally 32, 64 Bit Controllers used with OS. Examples Personal Digital Assistant and Mobile phones etc .Lower end embedded systems - Generally 8,16 Bit Controllers used with an minimal operating systems and hardware layout designed for the specific purpose.

Examples Small controllers and devices in our everyday life like Washing Machine, Microwave Ovens, where they are embedded in.



Fig.1.1: Embedded System

1.1.1 CHARACTERISTICS

An embedded system is any computer system hidden inside a product other than a computer. They will encounter a number of difficulties when writing embedded system software in addition to those we encounter when we write applications.

- Throughput – Our system may need to handle a lot of data in a short period of time.
- Response – Our system may need to react to events quickly
- Testability – Setting up equipment to test embedded software can be difficult
- Debug ability – Without a screen or a keyboard, finding out what the software is doing wrong (other than not working) is a troublesome problem
- Reliability – embedded systems must be able to handle any situation without human intervention
- Memory space – Memory is limited on embedded systems, and you must make the software and the data fit into whatever memory exists
- Program installation – you will need special tools to get your software into embedded systems
- Power consumption – Portable systems must run on battery power, and

the software in these systems must conserve power

- Processor hogs – computing that requires large amounts of CPU time can complicate the response problem
- Cost – Reducing the cost of the hardware is a concern in many embedded system projects; software often operates on hardware that is barely adequate for the job.
- Embedded systems have a microprocessor/ microcontroller and a memory. Some have a serial port or a network connection. They usually do not have keyboards, screens or disk drives.

1.1.2 APPLICATIONS

1. Military and aerospace embedded software applications
2. Communication Applications
3. Industrial automatic on and process control software
4. Mastering the complexity of applications.
5. Reduction of product design time.
6. Real time processing of ever increasing amounts of data
7. Intelligent, autonomous sensors.



Fig.1.2: Application of Embedded system

1.1.3 STRUCTURE OF EMBEDDED SYSTEM

Embedded systems vary in complexity but, generally, consist of three main elements:

1.1.3.1 HARDWARE

The hardware of embedded systems is based around microprocessors and microcontrollers. Microprocessors are very similar to microcontrollers and, typically, refer to a CPU (central processing unit) that is integrated with other basic computing components such as memory chips and digital signal processors (DSPs). Microcontrollers have those components built into one chip.

1.1.3.2 SOFTWARE

Software for embedded systems can vary in complexity. However, industrial-grade microcontrollers and embedded IoT systems usually run very simple software that requires little memory.

1.1.3.3 REAL TIME OPERATING SYSTEM

These are not always included in embedded systems, especially smaller-scale systems. RTOS'es define how the system works by supervising the software and setting rules during program execution.

1.1.4 ENABLING TECHNOLOGY IN EMBEDDED SYSTEM

Embedded system and applications are severely increased.

The latest technology in Embedded System and Applications such as

- Artificial Intelligence
- Augmented Reality and Virtual Reality
- Deep Learning
- Embedded security and Cloud Connectivity

1.1.5 LIMITATION

1. Difficult to upgrade - Embedded systems are hard to upgrade, this is because they are system specific, you may require to remove and produce/add a new embedded system instead, designed specifically for the upgrade being done.

2. Nearly not scalable - Carrying on from the point above, a system upgrade could mean that if a system becomes more evolved, or if a working environment becomes more enhanced, then the embedded system will not be able to function as efficiently.
3. No upgrades available - Once the embedded system is configured and placed into functioning order, it cannot be changed, moreover this means any enhancement or any upgrade of any sort cannot be executed.
4. Difficult maintenance - Not only are embedded system difficult to maintain as they require specific hardware constantly, it is also known to be difficult to obtain back-ups of embedded files.
5. Limited hardware & troubleshooting difficulty - Having a system for specific tasks isn't all beneficial of-course, this is because hardware constantly needs to be purchased, whether it was old or new, to maintain the function the system is trying to execute. Furthermore, troubleshooting and the transfer of data from one system to another can be problematic.

1.2 SMART WATCH

The smart watch is one of many types of smart wearable devices. A wearable device is an electronic computing device embedded in the personal space of a user that can be worn, carried, or attached to the body. Wearable computers are expected to become the next big thing but popular press is divided on whether they will be successful. In this paper we review the existing literature on one type of wearable – smart watches – and extend their definition, in addition to highlighting the need to understand users' everyday appropriation of these technologies. We present initial findings from an ongoing interview study with early adopters that is, to the best of our knowledge, the first to investigate why and how people use smart watches in real life. We describe everyday use of smart watches highlight watches, highlight the added value seen by users, and identify the limitations to mass adoption as expressed by current us

1.2.1 HISTORY

Smart watches give individual light weight and quick access to messages, warnings and other advanced information while in a hurry. While officially ground – breaking as independent gadgets, the capabilities of smart watches increment.

Essentially when utilized pair with different gadgets that individuals convey , for example, their telephones or tablets ,which takes into the account novel cross device between activity procedures.



Fig.1.3: Smart watch

Google's Glass, the first wearable device in the form of glasses to gather significant public attention, failed to achieve considerable success, however smart wearable devices in the form of wristbands or watches are yielding better market performance and have become the most widespread and popular form of smart wearable devices. Among global wearable device shipments, the wrist wear category comprised 90.4% (17.7 million units), and is expected to maintain its dominance with 89.2% (40.7 million units) and 80.4% (101.4 million units) in 2015 and 2019, respectively defined a smart watch as “a wrist-worn device with computational power, that can connect to other devices via short range wireless Connectivity; provides alert notifications; collects personal data through a range of sensors and stores them; and has an integrated clock.”

The advent of the first wearable device in the form of a watch is considered to be the IBM Linux Watch, launched in 2000 .The smart watch gained popular attention in 2012 when the Pebble Smart watch was introduced on the crowd funding website 'Kickstarter.com'. After just over a decade of technological evolution, it seems that the smart watch industry is now expected to lift off after the launch of Apple's Apple Watch in April, 2015.

As major IT firms enter the market, the global retail revenue for smart wearable devices is expected to triple by 2016 compared to 4.5 billion USD in 2014, and is

expected to reach approximately 53.2 billion USD in 2019 (Juniper Research,2014a).

The penetration rate of smart watches is also expected to exponentially increase to 100 million actual users worldwide as premium brands launch various smart watch products over the next 5 years. Although the forecasts paint an optimistic future for smart watches, there are still proliferating concerns regarding the 'technology first' approach from various smart watch hardware makers. To elaborate, there are still doubtful perspectives where people do not realize the benefits of using a smart watch and how it can be used in their daily lives. Leading manufacturers such as Apple, Google, and Samsung are now focusing on fostering smart watch ecosystems with their own operating systems and cooperating with various entities in healthcare or financial sectors. The upcoming differentiation strategies of these firms will begin to Emphasize software differentiation hand-in-hand with hardware.

1.2.2 USES

1. Notifications - A Smartwatch displaying notifications are one of main reasons you would buy one. The ease of having messages sent to your wrist and being able to identify their importance without removing your phone from a pocket or bag is invaluable. It simplifies your life and it saves time.
2. Battery life - A big, high-resolution display is often one of the biggest drains on your mobile's battery life. Using smartwatch reduces the amount of time that large screen needs to be on, and it can have a major impact on battery life.
3. Customization - Being able to adjust your watch face every day is unusually fun on the weekends. For example, you can walk around with a dancing Mickey Mouse on your wrist, but at the Tuesday morning office meeting, you can wear a more professional watch face.
4. Fitness - The fitness aspects of smart watches are perhaps one of the biggest advantages of having one. Different smart watches provide different functions. Most of them offer fitness and wellness services such as running health applications, tracking steps, tracking heart rate, sleep monitoring and any other sensor-related features. Some provide different mobile functions

such scheduling events, app availability, sending messages and answering calls.

5. Business - People nowadays tend to use their phones a lot, for example for checking emails, or setting up appointments between meetings and appointments and other business matters. Keeping a tight schedule is easier than ever before. Smartwatches have a high chance for changing the business industry. Some of the features of many models of smartwatches include alerts which notify their owners that a message or email has been received.
6. On The Go - For individuals on the move, smartwatches can be very ideal. By having a smartwatch, it can be connected to your smart phone and then everything can be accessed from your watch. This gives your day a boost and makes things easier to accomplish without having to have the phone out all the time. The convenience that a smartwatch gives people is that they can do more and not have to be tied down with wires or bulky items. The smartwatch is placed on your wrist and with the small but very readable display, you can do many things that a smart phone can also do.
7. Music - Most of the smartwatches come with a music player feature in them, which enables you to listen to music on the phone in your pocket. For example, if a music track comes on that you don't particularly like, then you can simply hit 'next' on your smartwatch. You can also pause, adjust the volume or line-up the next track. It may sound unimportant, but it really does make listening to music easier. A regular smart watch can also sync to Bluetooth headphones which will free up any worry of loose wires. This allows fitness workouts to be more focused and effective.

1.2.3 APPLICATIONS

1. Never miss anything urgent with notifications - Even if you have your smartphone close by while out and about, you probably have been in a situation where you took your eyes off it just for a while, then you find out that you missed a really urgent call or message. By connecting a smart watch or connected watch to your smartphone, you can instantly receive notifications. Even if your smartphone is just nearby, you still need to be aware of it and check it every so often. With these watches, on the other hand, you wouldn't

need to worry about missing anything important as you can be alerted to notifications by simply wearing one on your wrist.

2. Enjoy excellent functions for health management - These watches are equipped with functions that can help people manage their health easily. Typical examples are apps that record the route you take while exercising and those that measure your heart rate. These functions are very popular among health-minded individuals who run or cycle daily. Similarly, you can also keep track of your sleep with some apps, which is a delightful function for those who are worried about their biological clock.
3. Check the weather easily - Since mornings tend to be busy, there probably are times when you don't feel like wasting time on opening your smartphone just to check the weather with an app. With smartwatches and connected watches, you can quickly and easily check the weather while doing your morning routine.
4. Use it as a mobile wallet - More and more people are using wearable payment devices every year. By simply downloading a mobile payment app, you can step out of the house without cash or a credit card and make payments with just your wristwatch. It makes riding public transportation easy and allows you to drop by a store when you're in the middle of running or out for a short walk, even if you don't have your wallet with you.
5. Listen to music - If you have a smartwatch or connected watch, you can stream and play music. Some models allow you to do it even without your smartphone. They come in handy in situations where you want to listen to music while running but you don't want to carry your smartphone with you.
6. Set your wristwatch alarm from your smartphone easily - The alarm function is one of the reasons people use these watches. You can easily set an alarm by connecting it to your smartphone. With smartphones, you may not notice the alarm go off when you're concentrating on something. With the vibrating alarm of these watches, however, you wouldn't need to worry about that anymore. This popular function is useful when you're taking a nap or concentrating at work.
7. Enjoy easy adjustment of time when you're abroad - When staying abroad, it's sometimes a chore to adjust the time if you're using an analog wristwatch. You have to check the local time as soon as you arrive and then adjust the time by hand. With smartwatches and connected watches, you have nothing to worry

about even if you're overseas; you just need to set the current location and the watch will automatically adjust to local time.

1.3 PROBLEM STATEMENT

The smart watch is a combination of sensors and electronic components to enable every citizen to monitor and helps to protect oneself from unhygienic environment. Since we are in the age of smart watches, monitoring the air and water environment is necessary. All smart watches have the various types of modes for monitoring .Since there are no modes for monitoring the water, here is the initiative that brings the way to monitor both water as well as air in a same device.

1.4 OBJECTIVE

- Less Air-Borne Viruses and Bacteria - Air-borne particulates can be detected and the proper personnel can be notified
- Avoid Sick Building Syndrome - To curb Sick Building Syndrome is to implement air quality monitoring devices to ensure the air your personnel breathe is fresh and healthy.
- Fast Detection of Harmful Chemicals - With rapid detection of an above acceptable level of chemicals such as carbon monoxide, carbon dioxide, methane, ammonia, and more, you can safely evacuate the premises .When harmful chemicals are in the air, time is of the essence to get personnel to safety.
- Ensuring Proper Ventilation - The buildup of chemicals and harmful particulates in the air is due to a ventilation issue. With an air quality monitoring device you can determine if your air quality is suffering due to ventilation
- Importance of monitoring water quality - To ensure that it is safe for humans to drink it as well as for wildlife and marine life

CHAPTER – 2

LITERATURE SURVEY

A. Review of air quality monitoring system using WSN

Muthu Bharathi. M, Rajasekaran entitled “Air Quality Monitoring System Using Wireless Sensor Networks”. Measuring the quality of the air is necessary to sustain in this living environment. They have proposed the air quality monitored system based on the arduino controller and different sensors. The sensor parameter values can be uploaded in web portal using IOT technology. The system is examined separately under each variable condition in a controlled manner. They have conducted two different tests to verify the functionality and durability of the sensor. These tests were performed for 24 hours both indoors and outdoors to test the reliability and accuracy of the wireless sensors against the Dylos air quality monitoring. Also proposed wireless sensor network to monitor the temperature, humidity and also the gas leakage of industrial applications. For Wireless communication they have are used WSN, which helps to collect all nodes data's and can be monitored in PC and can also able to upload in web portal

B. Introduction to smartwatch model for monitoring the air pollution

Prof. L.Thiele entitled” Accurate Air Pollution Monitoring with a Smart watch“. This paper describes the monitoring of air pollution is done with sensors that are used to help with measuring the quality. But the point here is that it is in the form of wearable's ie. Smart watch. (in the form of wireless).This paper ensure the factors that limit the accuracy of the monitoring system(i) Low-cost gas sensors(ii) Depending on the context of the user iii) Certain pollutants are highly reactive(iv) Meteorological effects. Therefore, the measurement quality is degraded. Finally, it concludes that measuring of air quality and pollution content should be done under accepting factors

C. Examining the quality of water by IoT

Vaishnavi V. Daigavane and Dr. M.A Gaikwad entitled ”Water Quality Monitoring

System Based on IOT” Water pollution is one of the biggest fears for the green globalization. In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time. In this paper we present a design and development of a low cost system for real time monitoring of the water quality in IOT(internet of things).The system consist of several sensors is used to measuring physical and chemical parameters of the water. The parameters such as temperature, PH, turbidity, flow sensor of the water can be measured. The measured values from the sensors can be processed by the core controller. The Arduino model can be used as a core controller. Finally, the sensor data can be viewed on internet using WI-FI system

D. A Cloud-based water quality system

Nikhil Kedia entitled “Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project, Published in 2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India. This paper highlights the entire water quality monitoring methods, sensors, embedded design, and information dissipation procedure, role of government, network operator and villagers in ensuring proper information dissipation. It also explores the Sensor Cloud domain. While automatically improving the water quality is not feasible at this point, efficient use of technology and economic practices can help improve water quality and awareness among people.Emphasises the complete water quality monitoring system, sensors, embedded design, and information dissipation procedure, as well as the role of the government, network operator, and villages in guaranteeing effective information dissipation. It also looks into the Sensor Cloud domain. While automatically enhancing water quality is not now achievable, smart use of technology and economic practices can assist enhance water quality and public awareness.

E. Advanced method of Real-time water quality measuring system using Zigbee

Jayti Bhatt, Jignesh Patoliya entitled “Real Time Water Quality Monitoring System”. This paper describes to ensure the safe supply of drinking water the

quality should be monitored in real time for that purpose new approach IOT (Internet of Things) based water quality monitoring has been proposed and presented the design of IOT based water quality monitoring system that monitor the quality of water in real time. This system consists of some sensors which measure the water quality parameter such as pH, turbidity, conductivity, dissolved oxygen, temperature.

The measured values from the sensors are processed by microcontroller and these processed values are transmitted remotely to the core controller that is raspberry pi using Zigbee protocol. Finally, sensors data can view on internet browser application using cloud computing. They have described the architecture of an IOT-based system for monitoring water quality in this study, which tracks that quality in real time.

This system comprises of a few sensors that detect many aspects of water quality, including temperature, conductivity, dissolved oxygen, pH, and turbidity. The microcontroller processes the sensor-measured values before transmitting them over the Zigbee protocol to the raspberry pi, which serves as the core controller. Finally, using cloud computing, sensors data can be seen on web applications.

This study outlines how to assure a safe supply of drinking water by monitoring its quality in real time. To that end, a novel technique IOT (Internet of Things) based water quality monitoring has been developed. They proposed the design of an IOT-based water quality monitoring system that monitors water quality in real time in this study.

This system is made up of sensors that detect water quality parameters including pH, turbidity, conductivity, dissolved oxygen, and temperature. The measured data from the sensors are processed by the microcontroller and sent remotely to the core controller, the Raspberry Pi, through the Zigbee protocol. Finally, utilising cloud computing, sensors data may be seen on an internet browser application.

CHAPTER – 3

AIM AND SCOPE OF THE WORK

3.1 AIM

To build a smart watch that measures air and water pollution along with displaying time using STM32

3.2 SCOPE OF THE WORK

My primary focus is to sense and monitoring the pollution level of the air , harmful gases present in it and detecting the quality of water . To address the issue of sensing the pollution levels, the aim of this research is to determine the sensors and to be bring it out in the model of smart watch. The data collected from my prototype helps to train the model and to identify the safest environment my proposed approach combines computation with hardware designed to utilize the sensors using embedded c to authenticate the results collected the air quality, ph, turbidity and gas sensors to avoid the situation in a particular area

3.3 PROPOSED PROJECT

The model is real time monitoring device of air and water quality in an environment. The overall block diagram of the proposed method is explained. Each and every block of the system is explained in detail. In this proposed block diagram consist of several sensors (air quality, pH, turbidity, gas) is connected to the core controller. The core controller are accessing the sensor values and processing them to transfer the data through internet. STM32 is used as a core controller. Every control and sensor operation is performed by STM32. Data collection consists of utilizing all four sensors and collecting the evaluated data and sending it to the STM 32 through the PCB board. It read the sensor values and directs them to the OLED display. The output is shown in the OLED display. Embedded C is altogether used in the advancement of microcontroller-based applications. It is habitually hardware independent. The PCB (Printed Circuit Board) is used mainly to give the system a steady state flow of signals and data values. The sensor data can be viewed on the OLED display. The core controller is coupled to various sensors, including those for air quality, pH, turbidity, and gas. In order to transmit data via the internet, the core controller accesses the sensor

values and processes them. The core controller is STM32. The OLED display allows for viewing of the sensor data.

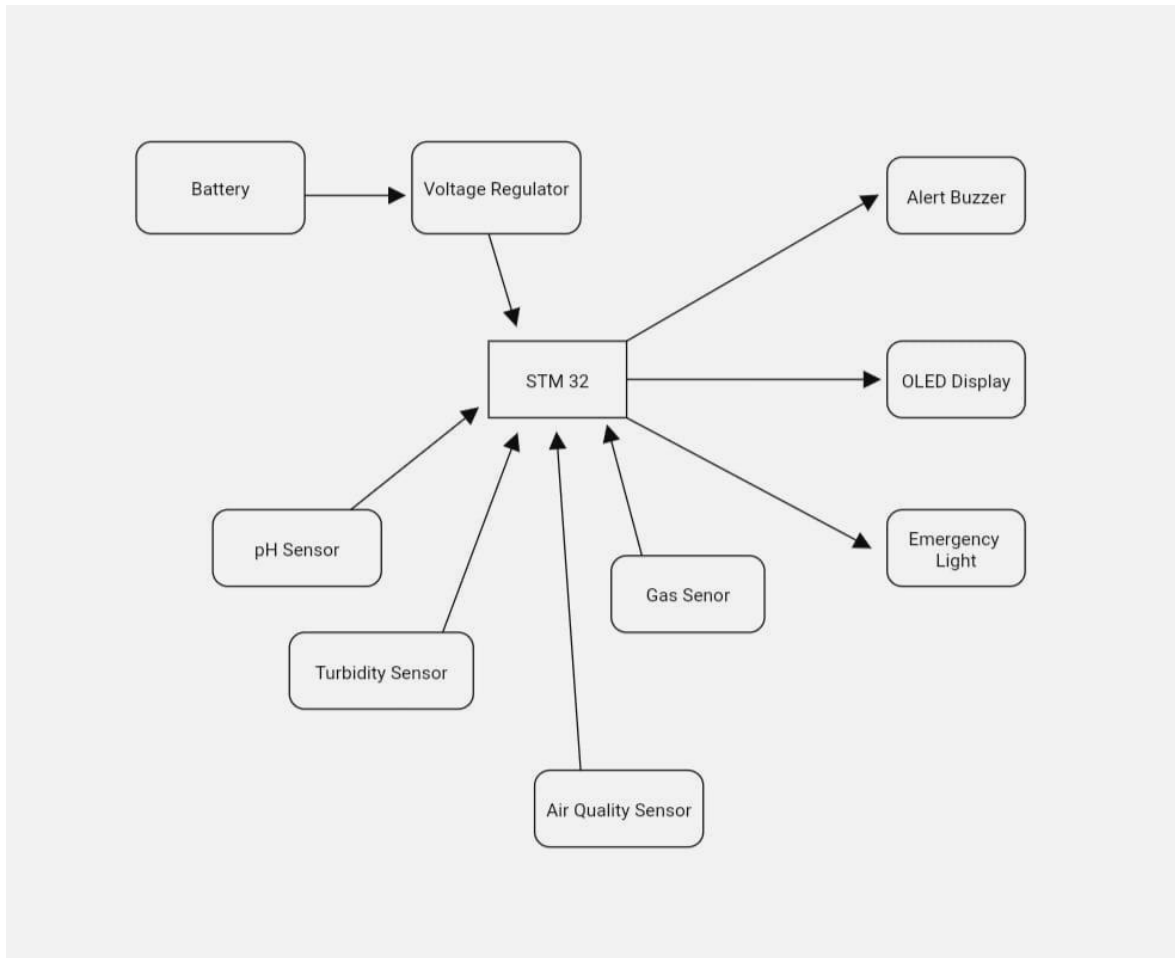


Fig 3.1: Block diagram of proposed project

The power on test is performed to check whether the voltage at different terminals is according to the requirement or not. We take a multi meter and put it in voltage mode. Remember that this test is performed without microcontroller. Firstly, we check the output of the transformer, whether we get the required 12 v AC voltage. Then we apply this voltage to the power supply circuit. Note that we do this test without microcontroller because if there is any excessive voltage, this may lead to damaging the controller. We check for the input to the voltage regulator i.e., are we getting an input of 12v and an output of 5v. This 5v output is given to the microcontrollers' 40th pin. Hence we check for the voltage level at 40th pin. Similarly, we check for the other terminals for the required voltage. In this way we can assure that the voltage at all the terminals is as per the requirement.

CHAPTER – 4

SYSTEM ARCHITECTURE

4.1 HARDWARE

The battery powered smart watch system is operated by an STM 32 along with a air quality sensor, gas sensor, ph sensor, turbidity sensor and mini OLED display.

A battery is a device that converts chemical energy directly to electrical energy. It consists of a number of voltaic cells; each voltaic cell consists of two half cells connected in series by a conductive electrolyte containing anions and cations. One half-cell includes electrolyte and the electrode to which anions (negatively charged ions) migrate, i.e., the anode or negative electrode; the other half-cell includes electrolyte and the electrode to which cations (positively charged ions) migrate, i.e., the cathode or positive electrode. In the redox reaction that powers the battery, cations are reduced (electrons are added) at the cathode, while anions are oxidized (electrons are removed) at the anode. The electrodes do not touch each other but are electrically connected by the electrolyte. Some cells use two half-cells with different electrolytes. A separator between half cells allows ions to flow, but prevents mixing of the electrolytes.

The air quality sensor is used to detect the amount of air pollution in the air in ppm levels. This data is processed by microcontroller to get the current air quality. The watch also monitors for any flammable gases in the vicinity to detect any flammable gas leakages using flammable gas sensor. This sensor is constantly monitored by controller. ph sensor that is used to detect the ph level of any water body. The user can just dip the ph sensor on his/her smart watch to get ph level. The sensor data is processed by controller and displayed on the display module. Similarly turbidity sensor attached to the smart watch as well. The sensor is used to transmit the water turbidity value to controller which is displayed on display. Ph and turbidity are used to display water quality of any water body (lake, pond, canal, sea). The smart watch allows setting high and low acceptance values of each parameter using push buttons. the values for air quality can be set up to 400 ppm . ph above 7 said to be base and below 7 indicates acidic .Turbidity should ideally be kept below 1 NTU (Nephelometric Turbidity unit).The gas sensor detects H₂, LPG, CH₄, CO, Alcohol, Smoke or Propane.

If any of the values scanned shows up higher/lower than set limits it sounds a buzzer alert as well displays the alert message on display to the user.



Fig 4.1: MQ sensors

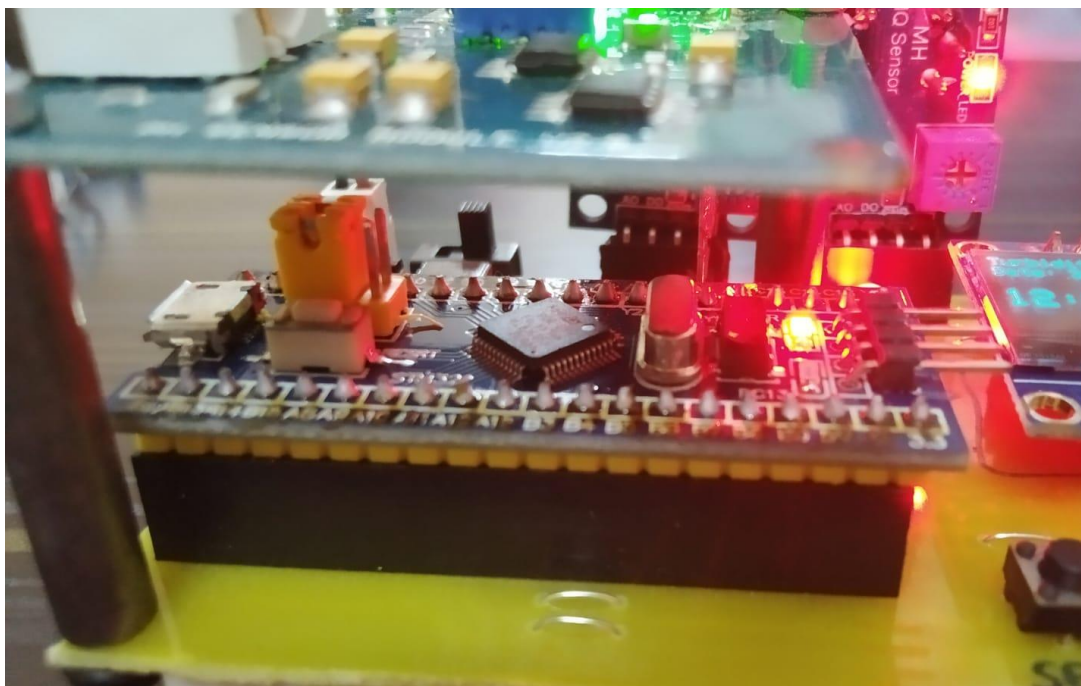


Fig 4.2: STM 32



*Fig 4.3: Turbidity
Sensor & Buzzer*

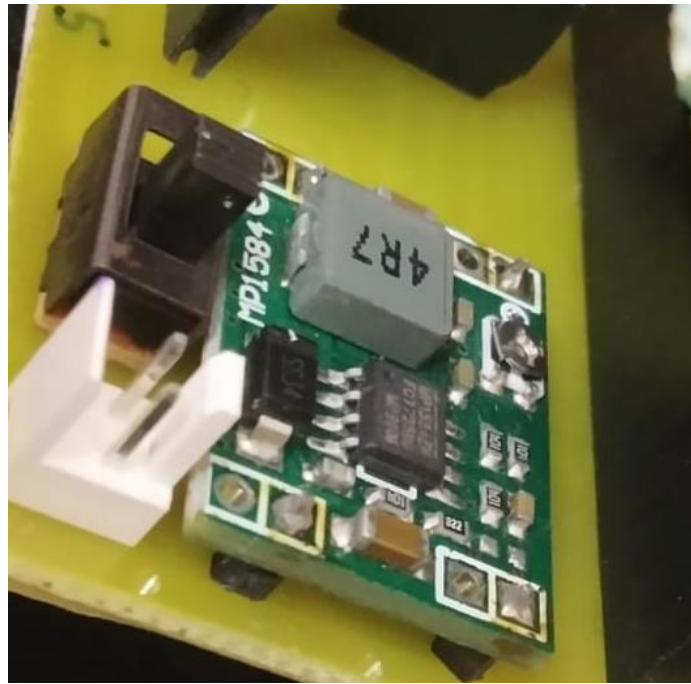


Fig 4.4: Buck Convertor

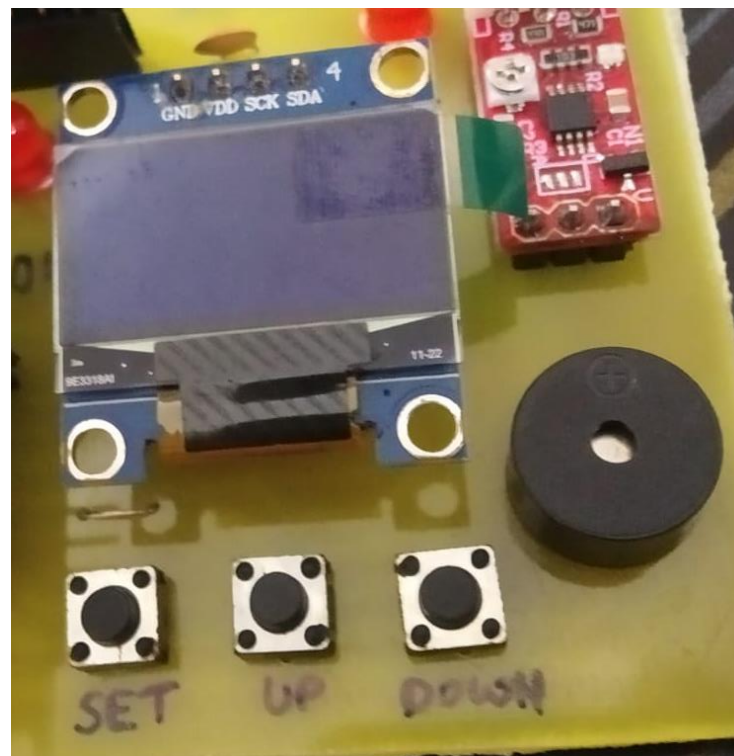


Fig 4.5: OLED display and Push buttons

4.2 SOFTWARE

The Arduino Integrated Development Environment - or Arduino Software (IDE) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with the STM 32

4.3 ALGORITHM USED

Mini buck converts the input supply from battery into the 5 volts DC. The 5 Volts is then feed to the controller (STM32). All the sensors are interface to the controller. OLED is interfaced to the controller through SDA and SCL pins.

1. Load libraries on the sensors
2. Define the pins
3. Collect the data from the sensors
4. Display the data on the OLED display
5. Buzzer alert if reaches the limit
6. Alert message on display
7. Alert sound stops after the user leaves the particular area

4.4 CONSTRAINS

Sometimes glitch is appearing in the OLED display and by tightening the screw of the ph module attached with the PCB board; the glitch disappears and works well. Mini buck converts the input supply from battery into the 5 volts DC. The 5 Volts is then feed to the controller (STM32). All the sensors are interface to the controller. OLED is interfaced to the controller through SDA and SCL pins. The mq2 and mq135 gas sensors are used to detect the gasses. Ph sensor measures the ph of the water and turbidity sensor determines the dirt and impurities present in the liquid. To escape from the voltage drop and short-circuiting, a buck converter, bridge rectifier and voltage regulator have been used. The voltage fluctuations are the significant motive to avoid the adapter.

CHAPTER – 5

RESULT AND DISCUSSION, PERFORMANCE ANALYSIS

5.1 RESULT AND DISCUSSION

Mini buck converts the input supply from battery into the 5 volts DC. The 5 Volts is then feed to the controller (STM32). All the sensors are interface to the controller. OLED is interfaced to the controller through SDA and SCL pins. The mq2 and mq135 gas sensors are used to detect the gasses. Ph sensor is used to measure the ph of the water and turbidity is used to determine the dirt present in the liquid. The gases detected from MQ - 2 and MQ - 135 are accurate. The pH level is quite exact as well as the turbidity. The sensor data is processed by the controller and displayed on the display module. The values are displayed instantly, with a maximum time frame of 0 – 5 seconds. It is accurate. The buzzer alerts the user when surpasses the limit. the values for air quality can kept up to 400 ppm. ph above 7 is said to be base and below 7 indicates acidic. Turbidity should ideally be kept below 1 NTU (Nephelometric Turbidity Unit). The gas sensor detects H₂, LPG, CH₄, CO, Alcohol, Smoke or Propane, etc

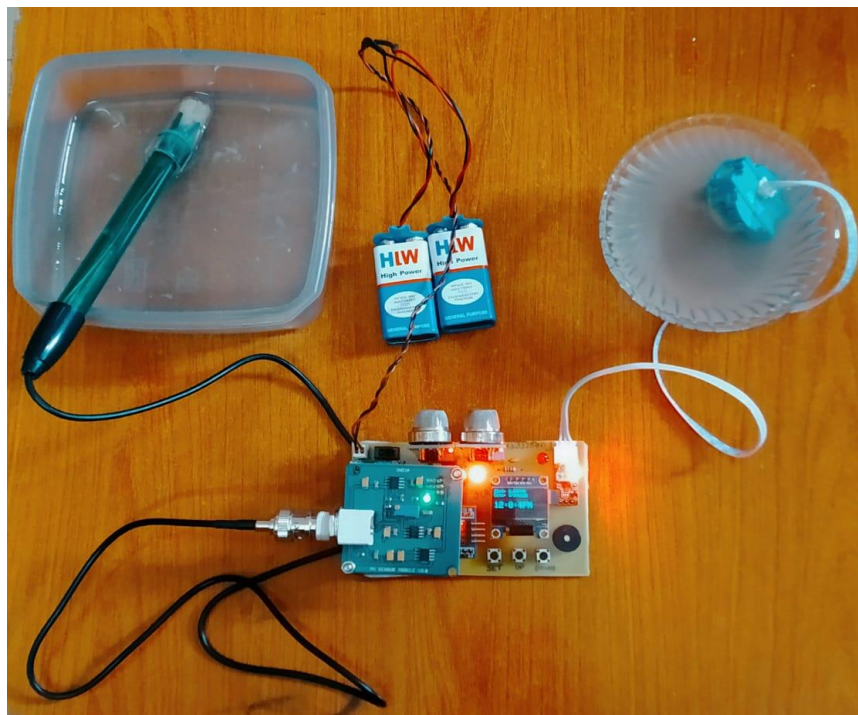


Fig.5.1: Model Overview

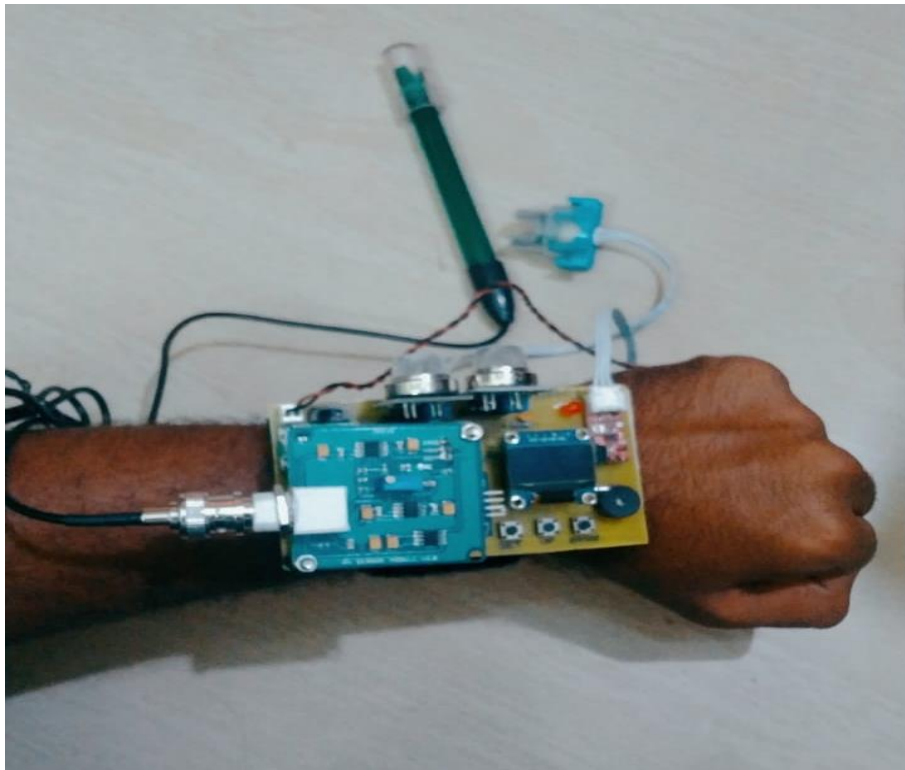


Fig 5.2: Final Model



Fig 5.3: Normal AQI level – no alert

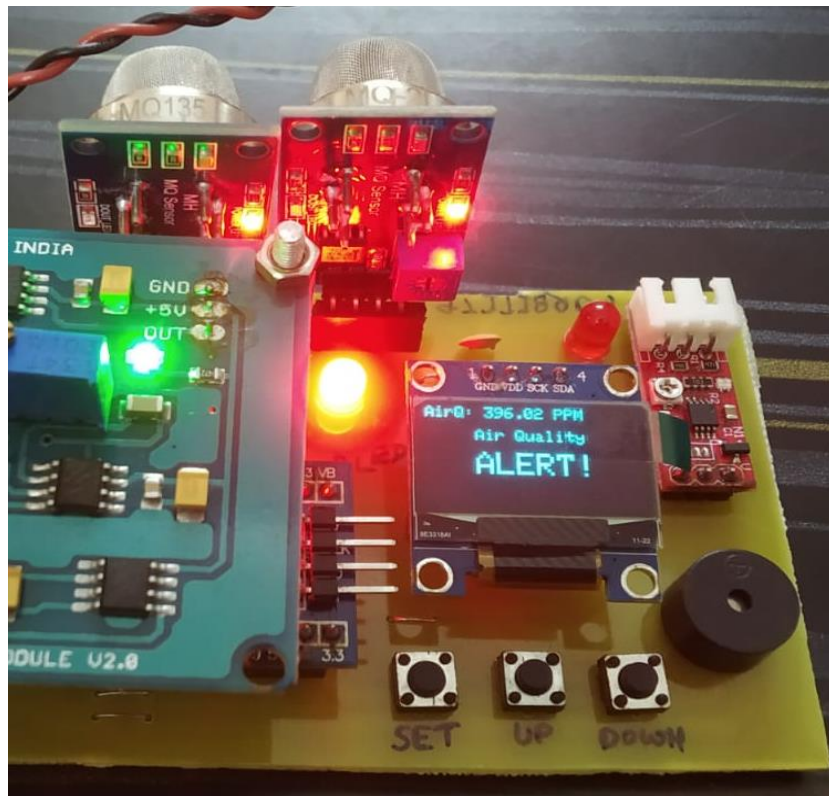


Fig 5.4: Alert when exceeds the limit

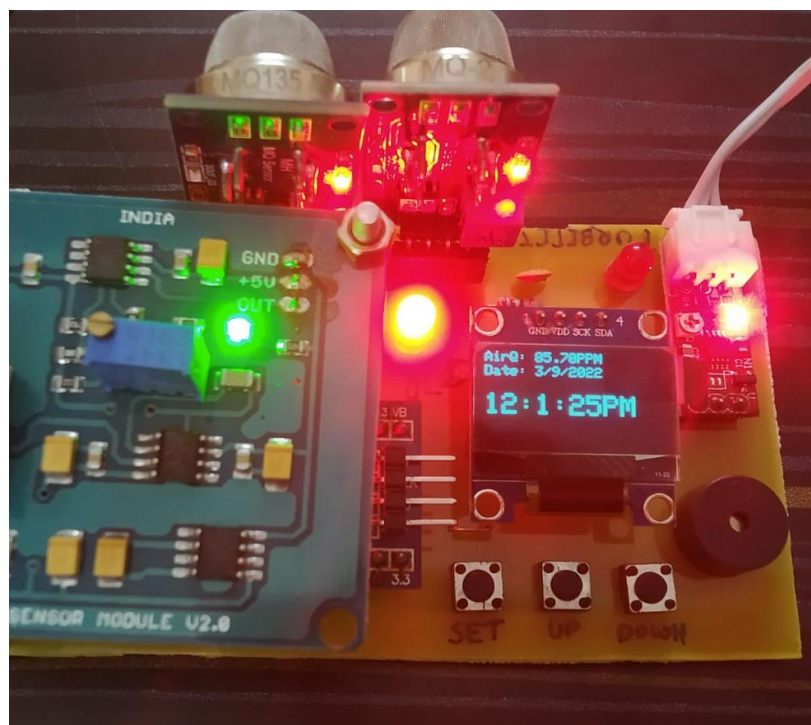


Fig 5.5: Low AQI level – no alert

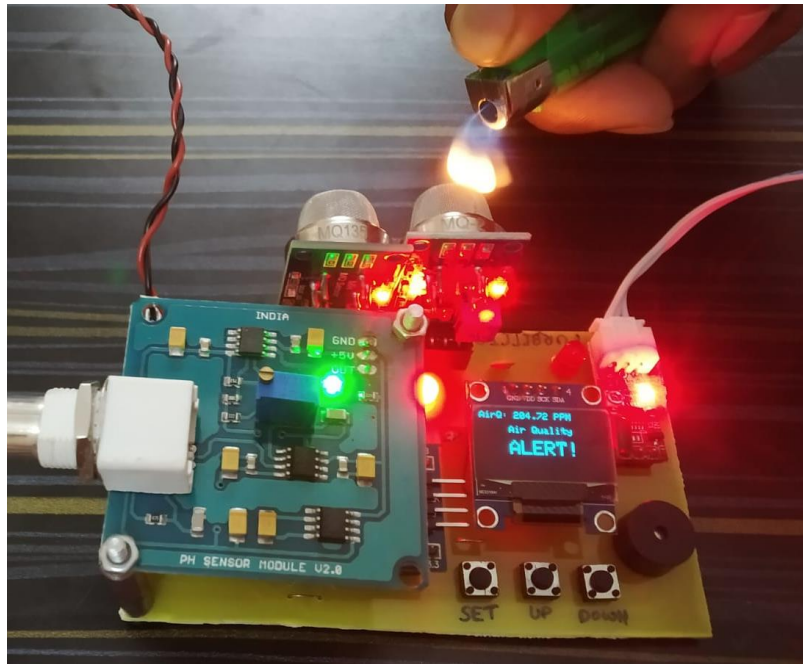


Fig 5.6: Petrol – Fire alert

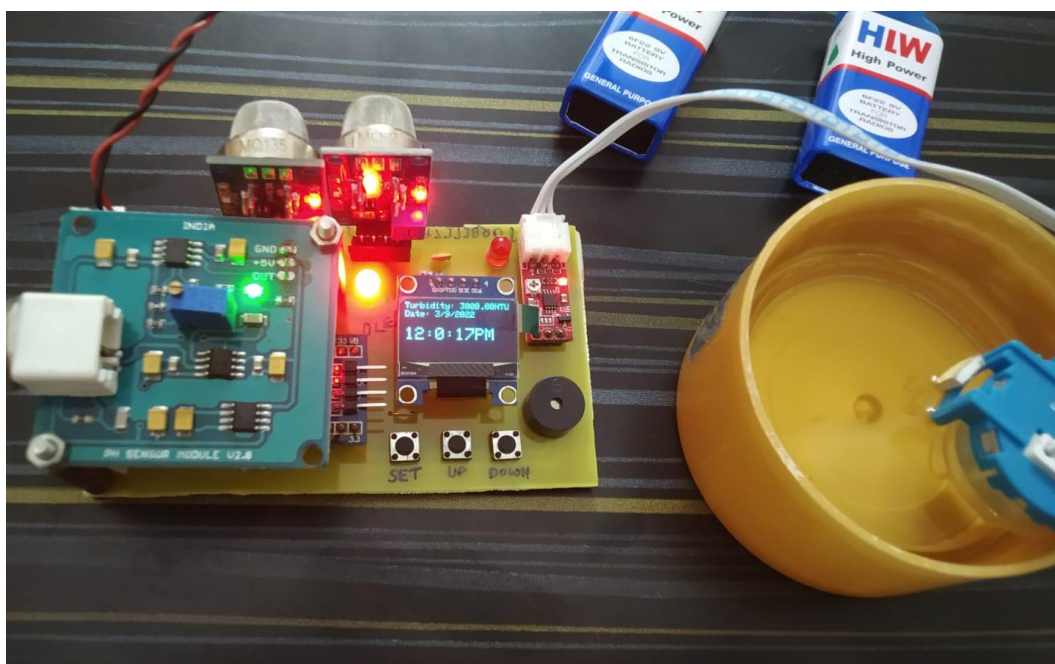


Fig 5.7: Pure Water - No Turbidity



Fig 5.8: Water with Turbidity

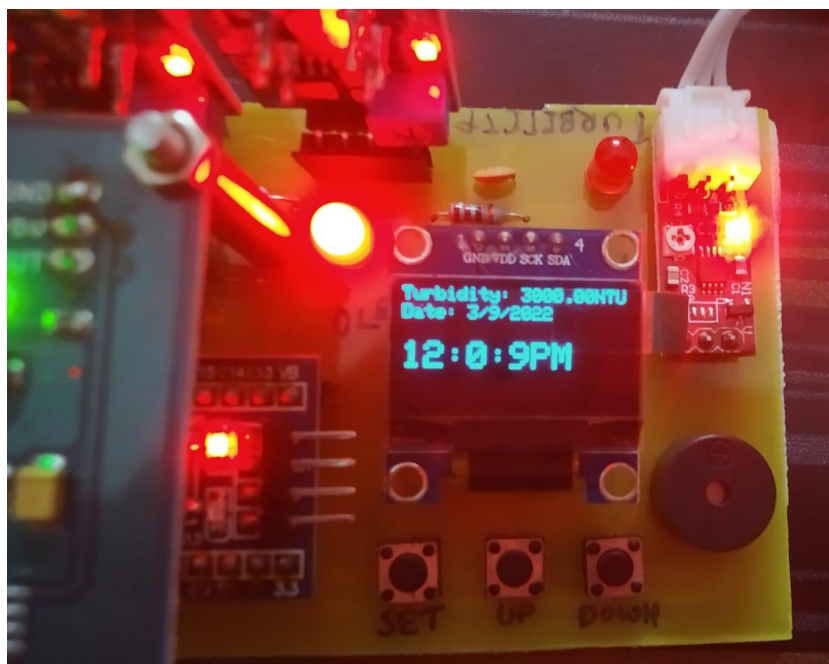


Fig 5.9 Indication of Turbidity



Fig 5.10 Ph of water with salt

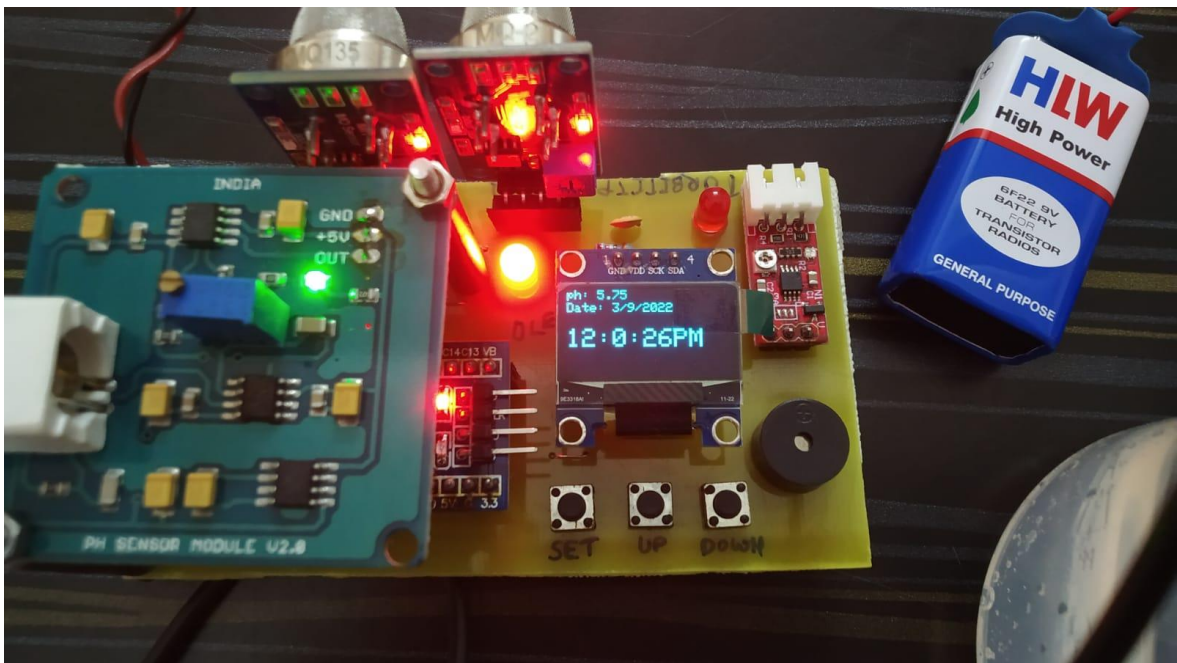


Fig 5.11 Ph value of salt water

CHAPTER – 6

SUMMARY AND CONCLUSION

Monitoring of Turbidity, PH & Temperature of Water makes use of water detection sensor with unique advantage. 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. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters. The operation is simple. With this smart watch, two tasks of identifying the pollution of air and water is achieved simultaneously. The output has been received as such since the flow of current is good in copper. To escape from the voltage drop and short-circuiting, a buck converter, bridge rectifier and voltage regulator have been used. The voltage fluctuations are the significant motive to avoid the adapter. the values for air quality can kept up to 400 ppm. Ph above 7 is said to be base and below 7 indicates acidic. Turbidity values shall ideally be kept below 1 NTU (Nephelometric Turbidity Unit). The gas sensor identifies and exposed certain hazardous gases such as H₂, LPG, CH₄, CO, Alcohol, Smoke or Propane. When reaches the limit, the alarm will alert the handling user. Mini buck converts the input supply from battery into the 5 volts DC. All the sensors are interface to the controller. OLED is interfaced to the controller through SDA and SCL pins. The mq2 and mq135 gas sensors are used to detect the gasses. Ph sensor measures the ph of the water and turbidity sensor determines the dirt and impurities present in the liquid. The Arduino Software (IDE) connects to the Arduino hardware to upload programs and communicate with the STM 32. This model allows setting high and low acceptance values for each parameter with the help of push buttons connected with the buzzer alert. If any resulting values scanned show up higher/lower than the set limits, it sounds a buzzer alert as well as displays the alert message on display. In this way, the smartwatch model enables the user to identify the hazardous substances present in the environment and skip to the safest circumstances.

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A. SOURCE CODE SCREENSHOTS

```
#include <SPI.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include <MQ135.h>

#define PIN_MQ135 PA6
#define MQ2 PB0
#define TURBIDITY PA7
#define PH PA2

#define START PB5
#define UP PB8
#define DOWN PB9

#define BUZZER PB4
#define LED PA4

#define SCREEN_WIDTH 128 // OLED display width, in pixels
#define SCREEN_HEIGHT 64 // OLED display height, in pixels

#define OLED_RESET -1 // Reset pin # (or -1 if sharing Arduino reset pin)
#define SCREEN_ADDRESS 0x3C ///< See datasheet for Address; 0x3D for 128x64, 0x3C for 128x32

Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, OLED_RESET);
MQ135 mq135_sensor(PIN_MQ135);

unsigned long int avgValue; // Store the average value of the sensor feedback
int buf[10], temp;
float volt;
float ntu;

float temperature = 30.0; // Assume current temperature. Recommended to measure with DHT22
float humidity = 70.0; // Assume current humidity. Recommended to measure with DHT22

unsigned long current_time = 0;
unsigned long display_time = 0;

byte day = 3;
byte month = 9;
int year = 2022;
```

```
byte hour = 12;
byte minute = 0;
byte sec = 0;

String am_pm = "PM";

int flag = 12;

byte low_ph = 4;
byte high_ph = 10;

byte high_air_quality = 200;

int low_turbidity = 2500;
int high_turbidity = 3005;

float air_quality_value = 0;
float ph_value = 7;
float turbidity_value = 9;

bool show_ph = false;
bool show_turbidity = false;

int counter = 0;
int old_counter = 0;

void setup()
{
  Serial.begin(9600);

  pinMode(START, INPUT_PULLUP);
  pinMode(UP, INPUT_PULLUP);
  pinMode(DOWN, INPUT_PULLUP);
  pinMode(BUZZER, OUTPUT);
  pinMode(LED, OUTPUT);
  pinMode(PH, INPUT);
  pinMode(TURBIDITY, INPUT);
  pinMode(MQ2, INPUT);

  digitalWrite(BUZZER, LOW);

  // SSD1306_SWITCHCAPVCC = generate display voltage from 3.3V internally
```

```

    if (!display.begin(SSD1306_SWITCHCAPVCC, SCREEN_ADDRESS))
    {
        Serial.println(F("SSD1306 allocation failed"));
        for (;;)
            ; // Don't proceed, loop forever
    }

    // Clear the buffer
    display.clearDisplay();
    display.setTextSize(1); // Normal 1:1 pixel scale
    display.setTextColor(SSD1306_WHITE); // Draw white text
    display.setCursor(0, 0); // Start at top-left corner
    display.println(F("Air Water Pollution\nSensing Smart Watch!"));
    display.display();

    delay(3000);

    current_time = millis();
    display_time = millis();
}

void loop()
{
    air_quality_value = getAirQuality();
    ph_value = getPh();
    turbidity_value = getTurbidity();

    display.clearDisplay();
    display.setTextSize(1); // Normal 1:1 pixel scale
    display.setTextColor(SSD1306_WHITE); // Draw white text
    display.setCursor(0, 0); // Start at top-left corner

    if (!digitalRead(UP) && counter < 2)
    {
        counter = counter + 1;
    }
    else if (!digitalRead(DOWN) && counter > 0)
    {
        counter = counter - 1;
    }

    if (counter == 1)

```

```

    if (counter == 1)
    {
        display.print(F("ph: "));
        display.print(ph_value);
        if (ph_value >= high_ph)
        {
            display.clearDisplay();
            display.setTextSize(1); // Normal 1:1 pixel scale
            display.setTextColor(SSD1306_WHITE); // Draw white text
            display.setCursor(0, 0); // Start at top-left corner
            display.print(F("pH: "));
            display.print(ph_value);
            display.setCursor(45, 15);
            display.println(F("pH High"));
            display.setCursor(30, 30); // Start at top-left corner
            display.setTextSize(2);
            display.println(F("ALERT!"));
            display.display();
            beep();
        }
        else if (ph_value <= low_ph)
        {
            display.clearDisplay();
            display.setTextSize(1); // Normal 1:1 pixel scale
            display.setTextColor(SSD1306_WHITE); // Draw white text
            display.setCursor(0, 0); // Start at top-left corner
            display.print(F("pH: "));
            display.print(ph_value);
            display.setCursor(45, 15);
            display.println(F("pH Low"));
            display.setCursor(30, 30); // Start at top-left corner
            display.setTextSize(2);
            display.println(F("ALERT!"));
            display.display();
            beep();
        }
        else
        {
            showTime();
        }
    }
    else if (counter == 2)

```

```

{
    display.print(F("Turbidity: "));
    display.print(turbidity_value);
    display.println(F("MTU"));
    display_time = millis();
    if (turbidity_value >= high_turbidity)
    {
        display.clearDisplay();
        display.setTextSize(1);           // Normal 1:1 pixel scale
        display.setTextColor(SSD1306_WHITE); // Draw white text
        display.setCursor(0, 0);           // Start at top-left corner
        display.print(F("Turbidity: "));
        display.print(turbidity_value);
        display.setCursor(25, 15);
        display.println(F("Turbidity High"));
        display.setCursor(30, 30); // Start at top-left corner
        display.setTextSize(2);
        display.println(F("ALERT!"));
        display.display();
        beep();
    }
    else if (turbidity_value <= low_turbidity)
    {
        display.clearDisplay();
        display.setTextSize(1);           // Normal 1:1 pixel scale
        display.setTextColor(SSD1306_WHITE); // Draw white text
        display.setCursor(0, 0);           // Start at top-left corner
        display.print(F("Turbidity: "));
        display.print(turbidity_value);
        display.setCursor(25, 15);
        display.println(F("Turbidity Low"));
        display.setCursor(30, 30); // Start at top-left corner
        display.setTextSize(2);
        display.println(F("ALERT!"));
        display.display();
        beep();
    }
    else
    {
        showTime();
    }
}

```

```

{
    display.print(F("AirQ: "));
    display.print(air_quality_value);
    display.println(F("PPM"));
    if (air_quality_value >= high_air_quality)
    {
        display.clearDisplay();
        display.setTextSize(1);           // Normal 1:1 pixel scale
        display.setTextColor(SSD1306_WHITE); // Draw white text
        display.setCursor(0, 0);           // Start at top-left corner
        display.print(F("AirQ: "));
        display.print(air_quality_value);
        display.println(F(" PPM"));
        display.setCursor(30, 15);
        display.println(F("Air Quality"));
        display.setCursor(30, 30); // Start at top-left corner
        display.setTextSize(2);
        display.println(F("ALERT!"));
        display.display();
        beep();
    }
    else if (analogRead(MQ2) > 300)
    {
        display.clearDisplay();
        display.setTextSize(1);           // Normal 1:1 pixel scale
        display.setTextColor(SSD1306_WHITE); // Draw white text
        display.setCursor(0, 0);           // Start at top-left corner
        display.print(F("AirQ: "));
        display.print(air_quality_value);
        display.println(F(" PPM"));
        display.setCursor(28, 15);
        display.println(F("Gas detected"));
        display.setCursor(30, 30); // Start at top-left corner
        display.setTextSize(2);
        display.println(F("ALERT!"));
        display.display();
        beep();
    }
    else
    {

```

```

        showTime();
    }
}

if (!digitalRead(START))
{
    delay(300);
    settings();
}
}

void showTime()
{
    display.setCursor(0, 10);
    display.print(F("Date: "));
    display.println(getDate());
    display.setCursor(0, 30); // Start at top-left corner
    display.setTextSize(2);
    display.println(getTime());
    display.display();
}

float getAirQuality(void)
{
    float rzero = mq135_sensor.getRZero();
    float correctedRZero = mq135_sensor.getCorrectedRZero(temperature, humidity);
    float resistance = mq135_sensor.getResistance();
    float ppm = mq135_sensor.getPPM();
    float correctedPPM = (mq135_sensor.getCorrectedPPM(temperature, humidity));

    Serial.print("MQ135 RZero: ");
    Serial.print(rzero);
    Serial.print("\t Corrected RZero: ");
    Serial.print(correctedRZero);
    Serial.print("\t Resistance: ");
    Serial.print(resistance);
    Serial.print("\t PPM: ");
    Serial.print(ppm);
    Serial.print("\t Corrected PPM: ");
    Serial.print(correctedPPM);
    Serial.println("ppm");
}

```

```

    delay(300);
    return correctedPPM;
}

float getPh()
{
    for (int i = 0; i < 10; i++) // Get 10 sample value from the sensor for smooth the value
    {
        buf[i] = analogRead(PH);
        delay(10);
    }
    for (int i = 0; i < 9; i++) // sort the analog from small to large
    {
        for (int j = i + 1; j < 10; j++)
        {
            if (buf[i] > buf[j])
            {
                temp = buf[i];
                buf[i] = buf[j];
                buf[j] = temp;
            }
        }
    }
    avgValue = 0;
    for (int i = 2; i < 8; i++) // take the average value of 6 center sample
        avgValue += buf[i];

    float phValue = (float)avgValue * 3.3 / 4095 / 6; // convert the analog into millivolt
    phValue = 3.5 * phValue; // convert the millivolt into pH value

    return phValue;
}

float getTurbidity()
{
    volt = 0;
    for (int i = 0; i < 800; i++)
    {
        volt += ((float)analogRead(TURBIDITY) / 4095) * 5;
    }
    volt = volt / 800;
}

```

```

    volt = round_to_dp(volt, 2);
    if (volt < 2.5)
    {
        ntu = 3000;
    }
    else
    {
        ntu = -1120.4 * sq(volt) + 5742.3 * volt - 4353.8;
    }
    return ntu;
}

float round_to_dp(float in_value, int decimal_place)
{
    float multiplier = powf(10.0f, decimal_place);
    in_value = roundf(in_value * multiplier) / multiplier;
    return in_value;
}

String getTime()
{
    if (millis() - current_time >= 1000)
    {
        sec = sec + 1;
        if (flag < 12)
            am_pm = "AM";
        if (flag == 12)
            am_pm = "PM";
        if (flag > 12)
            am_pm = "PM";
        if (flag == 24)
            flag = 0;

        if (sec == 60)
        {
            sec = 0;
            minute = minute + 1;
        }
        if (minute == 60)
        {
            minute = 0;
            hour = hour + 1;

```

```

            flag = flag + 1;
        }
        if (hour == 13)
        {
            hour = 1;
        }
        current_time = millis();
    }

    return (String(hour) + ":" + String(minute) + ":" + String(sec) + am_pm);
}

String getDate()
{
    return (String(day) + "/" + String(month) + "/" + String(year));
}

void settings()
{
    counter = 0;
    old_counter = 0;
    display.clearDisplay();
    display.setTextSize(1);
    display.setTextColor(SSD1306_WHITE); // Normal 1:1 pixel scale
    display.setCursor(0, 0); // Draw white text
    display.setCursor(0, 0); // Start at top-left corner
    display.println(F("Settings:"));
    display.setCursor(0, 15);
    display.print(F("=> Set pH"));
    display.setCursor(0, 25);
    display.print(F("    Set Turbidity"));
    display.setCursor(0, 35);
    display.print(F("    Set Air Quality"));
    display.display();
    delay(1000);

    while (true)
    {
        if (!digitalRead(DOWN) && counter < 2)
        {
            counter = counter + 1;
        }
        else if (!digitalRead(UP) && counter > 0)

```

```

{
    if (!digitalRead(UP) && counter < 14)
    {
        counter = counter + 1;
    }
    else if (!digitalRead(DOWN) && counter > 1)
    {
        counter = counter - 1;
    }
    else if (!digitalRead(START))
    {
        delay(300);
        high_ph = counter;
        break;
    }
    if (old_counter != counter)
    {
        display.clearDisplay();
        display.setTextSize(1); // Normal 1:1 pixel scale
        display.setTextColor(SSD1306_WHITE); // Draw white text
        display.setCursor(0, 0); // Start at top-left corner
        display.println(F("Set high pH:"));
        display.setTextSize(2);
        display.setCursor(0, 15);
        display.print(counter);
        display.display();
    }
    delay(300);
}
}

void setLowTurbidity()
{
    counter = low_turbidity;
    old_counter = low_turbidity;
    display.clearDisplay();
    display.setTextSize(1); // Normal 1:1 pixel scale
    display.setTextColor(SSD1306_WHITE); // Draw white text
    display.setCursor(0, 0); // Start at top-left corner
    display.println(F("Set low Turbidity:"));
    display.setTextSize(2);
    display.setCursor(0, 15);

```

```

        counter = counter + 1;
    }
    else if (!digitalRead(DOWN) && counter > 1)
    {
        counter = counter - 1;
    }
    else if (!digitalRead(START))
    {
        delay(300);
        low_ph = counter;
        break;
    }
    if (old_counter != counter)
    {
        display.clearDisplay();
        display.setTextSize(1); // Normal 1:1 pixel scale
        display.setTextColor(SSD1306_WHITE); // Draw white text
        display.setCursor(0, 0); // Start at top-left corner
        display.println(F("Set low pH:"));
        display.setTextSize(2);
        display.setCursor(0, 15);
        display.print(counter);
        display.display();
    }
    delay(300);
}
}

void setHighPh()
{
    counter = high_ph;
    old_counter = high_ph;
    display.clearDisplay();
    display.setTextSize(1); // Normal 1:1 pixel scale
    display.setTextColor(SSD1306_WHITE); // Draw white text
    display.setCursor(0, 0); // Start at top-left corner
    display.println(F("Set high pH:"));
    display.setTextSize(2);
    display.setCursor(0, 15);
    display.print(counter);
    display.display();
    while (true)
    {

```

```

display.setTextSize(2);
display.setCursor(0, 15);
display.print(counter);
display.display();
while (true)
{
    if (!digitalRead(UP) && counter < 3010)
    {
        counter = counter + 1;
    }
    else if (!digitalRead(DOWN) && counter > 2000)
    {
        counter = counter - 1;
    }
    else if (!digitalRead(START))
    {
        delay(300);
        low_turbidity = counter;
        break;
    }
    if (old_counter != counter)
    {
        display.clearDisplay();
        display.setTextSize(1); // Normal 1:1 pixel scale
        display.setTextColor(SSD1306_WHITE); // Draw white text
        display.setCursor(0, 0); // Start at top-left corner
        display.println(F("Set low Turbidity:"));
        display.setTextSize(2);
        display.setCursor(0, 15);
        display.print(counter);
        display.display();
    }
    delay(300);
}

void setHighTurbidity()
{
    counter = high_turbidity;
    old_counter = high_turbidity;
    display.clearDisplay();
    display.setTextSize(1); // Normal 1:1 pixel scale

```

```

display.setTextSize(1); // Normal 1:1 pixel scale
display.setTextColor(SSD1306_WHITE); // Draw white text
display.setCursor(0, 0); // Start at top-left corner
display.println(F("Set high Turbidity:"));
display.setTextSize(2);
display.setCursor(0, 15);
display.print(counter);
display.display();
while (true)
{
    if (!digitalRead(UP) && counter < 3010)
    {
        counter = counter + 1;
    }
    else if (!digitalRead(DOWN) && counter > 2000)
    {
        counter = counter - 1;
    }
    else if (!digitalRead(START))
    {
        delay(300);
        high_turbidity = counter;
        break;
    }
    if (old_counter != counter)
    {
        display.clearDisplay();
        display.setTextSize(1); // Normal 1:1 pixel scale
        display.setTextColor(SSD1306_WHITE); // Draw white text
        display.setCursor(0, 0); // Start at top-left corner
        display.println(F("Set high Turbidity:"));
        display.setTextSize(2);
        display.setCursor(0, 15);
        display.print(counter);
        display.display();
    }
    delay(300);
}

void setHighAirQuality()
{

```

```

        counter = high_air_quality;
        old_counter = high_air_quality;
        display.clearDisplay();
        display.setTextSize(1); // Normal 1:1 pixel scale
        display.setTextColor(SSD1306_WHITE); // Draw white text
        display.setCursor(0, 0); // Start at top-left corner
        display.println(F("Set high Air Quality:"));
        display.setTextSize(2);
        display.setCursor(0, 15);
        display.print(counter);
        display.display();
        while (true)
        {
            if (!digitalRead(UP) && counter < 255)
            {
                counter = counter + 1;
            }
            else if (!digitalRead(DOWN) && counter > 10)
            {
                counter = counter - 1;
            }
            else if (!digitalRead(START))
            {
                delay(300);
                high_air_quality = counter;
                break;
            }
            if (old_counter != counter)
            {
                display.clearDisplay();
                display.setTextSize(1); // Normal 1:1 pixel scale
                display.setTextColor(SSD1306_WHITE); // Draw white text
                display.setCursor(0, 0); // Start at top-left corner
                display.println(F("Set high Air Quality:"));
                display.setTextSize(2);
                display.setCursor(0, 15);
                display.print(counter);
                display.display();
            }
            delay(300);
        }
    }
}

```

```

        display.display();
        while (true)
        {
            if (!digitalRead(UP) && counter < 255)
            {
                counter = counter + 1;
            }
            else if (!digitalRead(DOWN) && counter > 10)
            {
                counter = counter - 1;
            }
            else if (!digitalRead(START))
            {
                delay(300);
                high_air_quality = counter;
                break;
            }
            if (old_counter != counter)
            {
                display.clearDisplay();
                display.setTextSize(1); // Normal 1:1 pixel scale
                display.setTextColor(SSD1306_WHITE); // Draw white text
                display.setCursor(0, 0); // Start at top-left corner
                display.println(F("Set high Air Quality:"));
                display.setTextSize(2);
                display.setCursor(0, 15);
                display.print(counter);
                display.display();
            }
            delay(300);
        }
    }

void beep(void)
{
    digitalWrite(BUZZER, HIGH);
    digitalWrite(LED, HIGH);
    delay(100);
    digitalWrite(BUZZER, LOW);
    digitalWrite(LED, LOW);
    delay(100);
}

```

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Air Water Pollution Sensing Smart Watch

^[1] JOE RENIN E., ^[2] ANNIE ANGELINE PREETHI S.

^[1] B.E (Electronics and Communication) ^[2] Faculty (Electronics and Communication),
Sathyabama Institute of Science & Technology, Chennai, Tamilnadu, India.

^[1] apjsjr232002@gmail.com, ^[2] preethiannie91@gmail.com.

Abstract—According to atmospheric and environmental science, Water and air pollution are significant contributors to global warming. An initial move in order to stop the pollution levels is to measure it and analyze it thoroughly. Every human must know the pollution levels they all living in and has an access to respond to them. During this period, we all have smartwatches that monitor our fitness and health, but when comes to environmental public health, it is a question mark. The breakdown of environmental health will affect the well-being of both present and future generations of people. Now, this developed model is a smartwatch type that measures air as well as water pollution with displaying time additionally. STM32 is the nucleus of this model. With this gear, all people can undoubtedly keep an eye on pollution levels anywhere and whenever. This particular smartwatch model combines sensors and small electronic components which helps every citizen to monitor and ensures to protect oneself from an unhygienic situation. Since all sensors perform their specific role in working on this model, the smartwatch allows setting high and low acceptance values of each parameter using push buttons. If any resulting values scanned show up higher/ lower than the set limits it sounds a buzzer alert as well as displays the alert message on OLED display. In such a manner, the smartwatch model enables the user to identify the hazardous substances present in the environment and skip to the safest circumstances.

Keywords—Air, Embedded, Pollution, Sensing, Sensors, Smartwatch, STM32, Water.

standard must be evaluated in real-time.

I. INTRODUCTION

Air is also one of the main essentials for human survival. The air that makes up the earth's atmosphere is composed primarily of the primary gases oxygen, carbon monoxide, nitrogen, and a few minor amounts of rare elements. An uncontaminated air environment is pollution-free and it is the main essence all people need. They are essential for maintaining human life and health. If any changes are made to the air's natural structure, it might result in enormous distress to the living organisms on the Earth. Air pollution is defined as a existence of one or more pollutants present in the atmosphere in a quantity that can cause harmful effects on humans and other living habitats. Today's society places a high priority on reducing urban air pollution and monitoring air quality has received a peak interest in the last few years. In recent days, various small and very cheap environmentally stabilized gas sensors are easily available that measures the concentration of pollutants. Small packaging and low power consumption allow their integration into the wearable device which is also in the form of smartwatches. The human body uses air under a diversified mechanism. Besides air or oxygen, the existence of all living creatures, natural organisms as well as the human race would have been unimaginable. Inhaling pure air provides oxygen to the lungs, which then circulates it throughout the body. for combining with sugars give us energy and helpful in building the body matter. Carbon dioxide, which is exhaled, is produced when oxygen and carbon combine in our bodies. Moreover, a small amount of water vapour and methane are expelled as trace gases. Like CO₂ or methane, water vapour is not an unusable substance. One of the main concerns with green globalization is water contamination. So as to establish whether water we use in day-to-day life is hygienic or not, its

Category	Quantity	References	Value
Modules	1	M2	STM32
Capacitors	1	C6	104
Resistors	2	R1,R4	220
Resistors	3	R2-R3,R11	10k
Integrated Circuits	1	U3	MINI BUCK
Diodes	2	D1-D2	DIODE-LED
Miscellaneous	1	BATT1	2 pin
Miscellaneous	1	BUZ	BUZZER
Miscellaneous	1	J1	oled
Miscellaneous	1	J3	TURBIDITY
Miscellaneous	1	J2(F-BERG)	MQ135
Miscellaneous	1	J3(F-BERG)	MQ2
Miscellaneous	1	J6(F-BERG)	PH SENSOR
Miscellaneous	1	SW1	DOWN
Miscellaneous	1	SW2	UP
Miscellaneous	1	SW3	START
Miscellaneous	1	SW4	SLIDE SWITCH

Table 1: The specification of components and modules

II. PROBLEM DESCRIPTION

The smartwatch is a union of sensors and electronic modules that helps to authorize all people to keep track of a particular environment and helps protect oneself from an unhygienic domain. Since we are surviving in a polluted world, evaluating the air and water environment is imperative. All smartwatches have various types of modes for monitoring. Since there is no model or system for evaluating the air as well as water simultaneously, here is the initiative that brings out the way to examine both the water as well as air standards in the same device.

III. PROJECT DESCRIPTION

To build a smartwatch that analyses water and air pollution while also showing the time using STM32. The primary focus is to sense and monitor the pollution level of the air, and the harmful gases present in it and encounter the standard of water. To address the issue of sensing pollution levels, this research aims to regulate the sensors and to bring them out in the model of a smartwatch. The data collected from my prototype helps to train the model and to identify the safest environment my proposed approach combines computation with hardware designed to utilize the sensors using embedded c to authenticate the results collected from the air quality, pH and turbidity and gas sensors to avoid the situation in a particular area.

IV. RELATED WORKS

A. Review of air quality monitoring system using WSN

Proposed work of air quality monitoring system using Arduino and sensors. Using IoT, the sensor values are uploaded to the web. The system is evaluated separately under suitable conditions. By conducting two tests, verified the durability and functionality. To check the dependability and accuracy of the wireless sensors, these tests were carried out for 24 hours both inside and outside. Using the help of WSN, the data collected is monitored and uploaded to the web portal.

B. Introduction to smartwatch model for monitoring the air pollution

This paper describes the monitoring of air pollution is done with sensors that are used to help with measuring the quality. But the point here is that it is in the form of wearable i.e. Smartwatch. (in the form of wireless). He discussed the factors that restrict the accuracy of the monitoring system including the types of sensors used, specifying the pollutants and some meteorological effects.

C. Examining the quality of water by IoT

By observing the context, they have implemented a creation of a system for real-time monitoring at a low cost. To measure the water's chemical and physical characteristics, several sensors were employed. The characteristics include turbidity, temperature, and pH and flow etc. Arduino is used here. Wi-Fi is used to connect the entire system..

D. A Cloud-based water quality system

The project paper highlights the methods, design, information, procedure and all types of components as well as modules used. It also traverses the sensor cloud domain. It discusses the ways to improve the quality of water and bring out awareness to the people through an actuator system which

later transfers to the sensor-cloud model. It also focuses on the viability model involving Government and Mobile Network Operator.

E. Advanced method of Zigbee-based system for detecting water quality in real-time

According to this paper's description, a new IoT strategy must evaluate the grade and standard of drinking water's safe contribution in real-time. They have demonstrated the architecture of an IoT system that performs real-time analysis. The sensors are connected to the system. The sensor data values are processed to the raspberry pi using ZigBee protocol. the main reason for using Zigbee is to support a variety of network topologies, including mesh, point-to-point, and other topologies.

V. PROPOSED SYSTEM

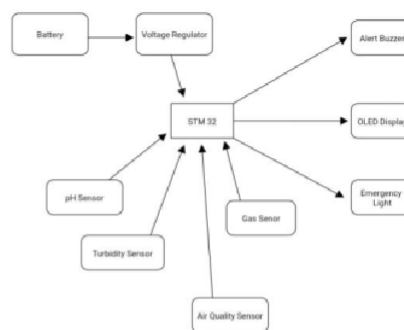


Fig: 1 Proposed System

Here, I present the real-time monitoring system of air and water quality in an environment. The system architecture was demonstrated. Every working phase was described in detail. Here, the displayed flow diagram consists of many sensors (gas, turbidity, pH, air quality) were attached to the microcontroller. This microcontroller is accountable for the approach of sensor values and processing them. STM32 microcontroller is used. The data values of the sensors are projected on the OLED display.

VI. ADVANTAGES OF PROPOSED SYSTEM

This system's key benefit is that it can track water and air pollutants, simultaneously along with displaying time. It is also an advantage that combines the existing technologies into a single system. The buck converter acts against the input voltage to make sure to protect the whole system from damage (short-circuiting). This system is actually a wireless device and it can also tied up to the belt and also to the bag

VII. OBJECTIVES

- Need for examining the quality of water
- Checking proper ventilation
- Rapid detection of harmful substances

- Steer clear of ill-causing syndrome
- Least possible air-borne virus and bacteria

VIII. SYSTEM ARCHITECTURE

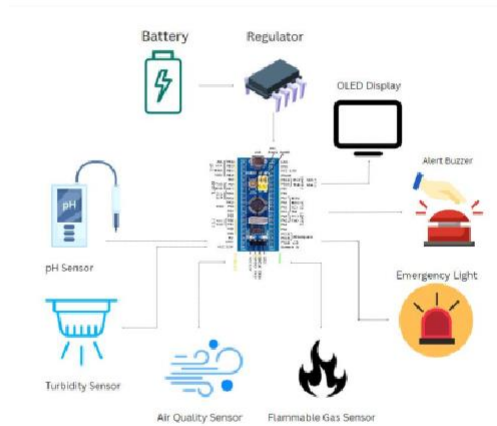


Fig. 2 System Architecture

An STM32 controller operates the implementation model of this battery-powered smart watch system in addition to a small OLED display, a gas sensor, a pH sensor, a turbidity sensor, and an air quality sensor. The heart of this project is the STM32. Every control and sensor operation is performed by STM32. Data collection consists of utilizing all four sensors and collecting the evaluated data and sending it to the STM 32 through the PCB board. It read the sensor values and directs them to the OLED display. The output is shown in the OLED display. Embedded C is altogether used in the advancement of microcontroller-based applications. It is habitually hardware independent. The PCB (Printed Circuit Board) is used mainly to give the system a steady state flow of signals and data values. The output has been received as such since the flow of current is good in copper. To escape from the voltage drop and short-circuiting, a buck converter, bridge rectifier and voltage regulator have been used. The voltage fluctuations are the significant motive to avoid the adapter. The values for air quality can kept up to 400 ppm. Ph above 7 is said to be base and below 7 indicates acidic. Turbidity values shall ideally be kept below 1 NTU (Nephelometric Turbidity Unit). The gas sensor identifies and exposed such as H₂, LPG, CH₄, CO, alcohol, smoke, or propane, is dangerous gases. When reaches the limit, the alarm will alert the handling user. To upload code and communicate with the Arduino hardware, the Arduino Software (IDE) establishes a connection with the hardware. STM 32 This model allows setting high and low acceptance values for each parameter with the help of push buttons connected with the buzzer alert. . If any resulting values scanned show up higher/lower than the set limits, it sounds a buzzer alert as well as displays the alert message on display. In this way, the smartwatch model enables the user to identify the hazardous substances present in the environment and skip to the safest circumstances.

IX. SCHEMATIC DIAGRAM

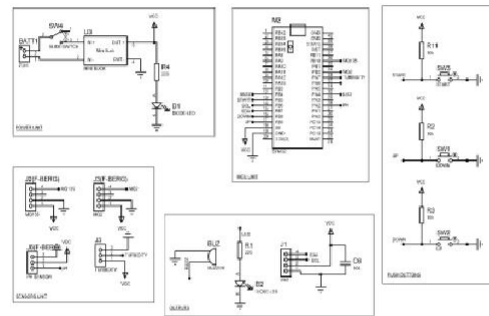


Fig. 5 Component Diagram

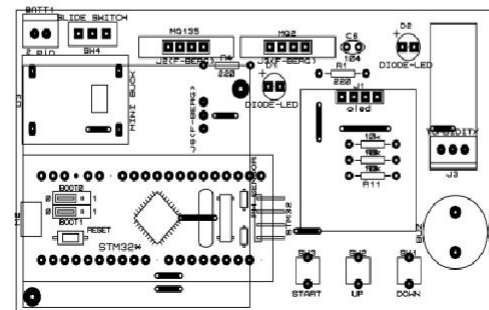


Fig. 6 Schematic Circuit Diagram

X. ALGORITHM

1. Load libraries on the sensors
2. Define the pins
3. Data collection from all sensors
4. Displays the gathered data on the OLED display
5. Buzzer alert if reaches the limit
6. Alert message on the display
7. Alert sound stops after the user leaves the particular area

XI. SYSTEMATIC DESIGN OF MODEL



Fig. 3 Design Model



Fig: 4 Final Model

XII. FUTURE SCOPE

The evolution of embedded devices in examining the ecosystem entitles the self-protection of the circumstances we live in (i.e., smart environment). To accomplish this, we have to make use of the other useful sensors for gathering the data and undergoing the analysis. This results in pairing and communicating with other devices through the networks.

XIII. RESULT AND DISCUSSION

Mini buck converts the input supply from battery into the 5 volts DC. The 5 Volts is then feed to the controller (STM32). All the sensors are interface to the controller. OLED is interfaced to the controller through SDA and SCL pins. The mq2 and mq135 gas sensors are used to detect the gasses. Ph sensor measures the ph of the water and turbidity sensor determines the dirt and impurities present in the liquid. The gases detected from MQ - 2 and MQ - 135 are accurate. The pH level is quite exact as well as the turbidity. The sensor data is processed by the controller and displayed on the display module. The values are displayed instantly, with a maximum time frame of 0 – 5 seconds. It is accurate. The buzzer alerts the user when surpasses the limit. the values for air quality can kept up to 400 ppm. ph above 7 is said to be base and below 7 indicates acidic. Turbidity should ideally be kept below 1 NTU (Nephelometric Turbidity Unit). The gas sensor detects H₂, LPG, CH₄, CO, Alcohol, Smoke or Propane, etc.

CONCLUSION

Air quality index AQI values are perfectly exhibited. The AQI levels give us terrifying awareness while measured in this smartwatch than in a smartphone. This system is stretchable and flexible. It has extensive application and value. The observation of turbidity and pH of water ply these sensors with a distinctive edge. This system can examine water quality not automatically. So water quality testing is known to be inexpensive, agreeable and also a fast process. This system is adaptable to concept that by only feeding in the appropriate software programs as well as compatible sensors, other

parameters for the water quality can be tracked accurately. It can be enlarged on a large scale for inspecting various kinds of unknown crises. The operation is quite simple. With this smartwatch, two tasks of identifying the pollution of air and water are achieved simultaneously.

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