

IOT BASED SMART WATCH WITH DUST ALLERGY DETECTION SENSOR AND WATER POLLUTION SENSOR

Submitted in partial fulfillment of the requirements for the
award of Bachelor of Technology degree in Information
Technology.

By

P.W. PRASEMA FEMI GRACE (Reg.No- 40120067)

V. KIRTHIGA (Reg.No – 40120046)



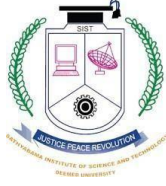
**DEPARTMENT OF INFORMATION TECHNOLOGY
SCHOOL OF COMPUTING**

SATHYABAMA

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

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AICTEJEPPIAAR NAGAR, RAJIV GANDHI SALAI,
CHENNAI - 600119**

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DEPARTMENT OF INFORMATION TECHNOLOGY

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **KIRTHIGA V (Reg.No. 40120046)** and **PRASEMA FEMI GRACE P W (Reg.No. 40120067)** who carried out the project as a **“IOT based smart watch with dust allergy detection sensor and water pollution sensor”** under our supervision from **January 2024 to April 2024**.


Internal Guide

Dr.A. SATHIYARAJ, M.E., Ph.D.,



Head of the Department

Dr. R. SUBHASHINI, M.E., Ph.D.,

Submitted for Viva voce Examination held on 17.04.2024


Internal Examiner


External Examiner

DECLARATION

I, **V. Kirthiga (Reg.No - 40120046)**, hereby declare that the Project Phase-2 Report entitled “**IOT BASED SMART WATCH WITH DUST ALLERGY DETECTION SENSOR AND WATER POLLUTION SENSOR**” done by me under the guidance of **Dr. A. Sathiyaraj, M.E., Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in **Information Technology**.

DATE: 17.04.2024

PLACE: Chennai



SIGNATURE OF CANDIDATE

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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. STM 32 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.

TABLE OF CONTENTS

CHAP NO.	TITLE	PAGE NO
	ABSTRACT	v
	LIST OF FIGURES	ix
	LIST OF ABBREVIATIONS	xi
1	INTRODUCTION	1
	1.1 Embedded System	2
	1.1.1 Characteristics of embedded system	3
	1.1.2 Structure of embedded system	4
	1.1.3 Application of embedded system	5
	1.2 Smart Watch	6
	1.2.1 Uses of smart watch	7
	1.3 Problem statement	8
	1.4 Objectives	8
2	LITERATURE SURVEY	10
	2.1 Overview of Existing Research and Literature	10
	2.2 Inferences from Literature Survey	13
	2.3 Open Problems in Existing System	14
3	REQUIREMENTS ANALYSIS	16
	3.1 Risk Analysis of the Project	16
	3.2 Requirements Specification	18
	3.2.1 Hardware Requirements	18
	3.2.2 Software Requirements	19
	3.2.3 C++	19

	3.2.4 Internet of Things	20
	3.2.5 Sensor Integration	21
	3.2.6 Mobile Development App	22
	3.2.7 Cloud Integration	23
3.3	System Use Case	25
	3.3.1 System Description	25
	3.3.2 System Use case scenario	25
4	DESCRIPTION OF PROPOSED SYSTEM	27
4.1	Hardware Description	29
	4.1.1 STM32 Microcontroller	30
	4.1.2 MQ135 Air Quality Sensor	32
	4.1.3 PH Sensor	33
	4.1.4 OLED Display	34
	4.1.5 Light Dependent Resistor	36
	4.1.6 Buzzer	37
4.2	Software Description	39
	4.2.1 Algorithm	39
	4.2.2 Structure of Program	39
4.3	Project Management Plan	41
5	IMPLEMENTATION DETAILS	42
5.1	Development and Deployment Setup	42
5.2	Working of the setup	44
6	OUTCOMES AND DISCUSSION	47
6.1	Introduction	47
6.2	IEEE Standards followed in the project	48
6.3	Constraints	49

7	RESULTS AND DISCUSSION	50
	7.1 Initial Findings	50
	7.2 Pre-set values	51
	7.3 Air Pollution Detection	51
	7.4 Water Pollution Detection	54
	7.5 Applications and Limitations	57
8	CONCLUSION	58
	8.1 Conclusion	58
	8.2 Recommendations for future research	58
	REFERENCE	60
	APPENDIX	63
	A. Source Code	63
	B. Sample Snapshots	71
	C. Research Paper	76

LIST OF FIGURES

CHAPTER NO	FIGURE NAME	PAGE NO
1.1	Embedded system	3
1.2	Application of embedded system	5
1.3	Smart watch	6
4.1	Block diagram of proposed project	28
4.2	STM32 Microcontroller	31
4.3	MQ135 Air Quality Sensor	32
4.4	MQ135 Air Quality Sensor pin configuration	32
4.5	PH Sensor	34
4.6	OLED Display	36
4.7	LDR Sensor	37
4.8	Buzzer	38
5.1	Circuit Diagram	45
5.2	Flow Chart	46
7.1	Temperature, MQ6, MQ9 and Humidity sensor initial data	50
7.2	Noise Sensor and dust density sensor data	50
7.3	Ph sensor initial data	50
7.4	Pre-set limit values for various sensors	51
7.5	Air Quality on selected days with smoke as pollution	52
7.6	Air Quality on selected days with	52

	Sanitizer as pollution	
7.7	Air Quality on selected days with normal air as pollution	52
7.8	Air Quality on selected days with dust as pollution	53
7.9	Air Quality Index Report	54
B.1	Model Overview	71
B.2	Final Model	71
B.3	Normal AQI Level – no alert	72
B.4	Alert When exceeds the limit	72
B.5	Low AQI Level – no alert	73
B.6	Petrol- fire alert	73
B.7	Pure water – no turbidity	74
B.8	Indication of Turbidity	74
B.9	PH of water with salt	75
B.10	PH value of salt water	75

LIST OF ABBREVIATIONS

ABBREVIATION	EXPANSION
IOT	Internet of Thing
OLED	Organic Light-Emitting Diode
LDR	Light Dependent Resistor
Ph	Potential of Hydrogen

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

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 aero planes and the astrionics 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.



Fig 1.1: Embedded System

1.1.1 CHARACTERISTICS OF EMBEDDED SYSTEM

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.

1.1.2 STRUCTURE OF EMBEDDED SYSTEM

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

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.

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.

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.

4.ENHANCING 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

1.1.3 APPLICATIONS OF EMBEDDED SYSTEM

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.

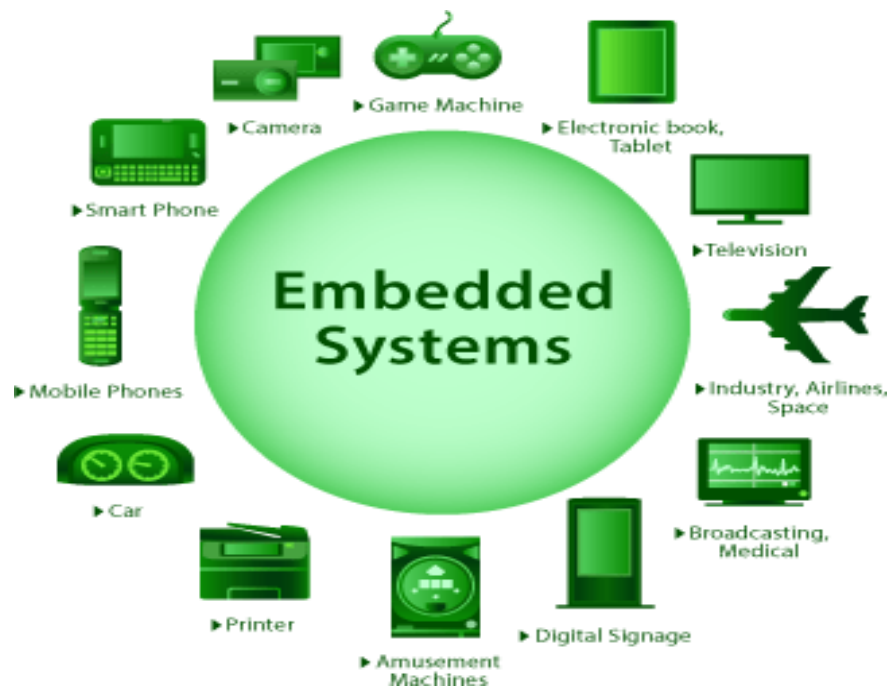


Fig 1.2 APPLICATION OF EMBEDDED SYSTEM

1.2 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 users.

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.



Fig1.3: SMARTWATCH

1.2.1 USES OF SMART WATCH

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 function 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 thing 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. 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.

1.3 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 OBJECTIVES:

1. Less Air-Borne Viruses and Bacteria - Air-borne particulates can be detected and the proper personnel can be notified.
2. 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.

3. 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.
4. 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.
5. 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

2.1 OVERVIEW OF EXISTING RESEARCH AND LITERATURE

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. 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 i.e. Smart watch. (in the form of wireless). This paper ensures 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. 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. Emphasizes 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.

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, utilizing cloud computing, sensors data may be seen on an internet browser application.

2.2 INFERENCES FROM LITERATURE SURVEY

[1] The work of Avnish Singh Jat and Tor- Morten was an assessment of analyzing research work related to the utilization of smartwatches in health informatics present a comprehensive review of different research work on the utilization of smartwatches to deal with various diseases. For this, we have screened 370 research publications related to smartwatches in health informatics and selected 20 journals for the review that matched our selection criteria. Finally, we discussed future research perspectives and concerns regarding smartwatch-enabled healthcare architecture.

[2] The work of Mirza Mansoor Baig and Shereen Afifi was an assessment to present current advancements in wearable technologies and IOT-based applications to support independent living. The secondary aim was to investigate the barriers and challenges of wearable sensors and Internet-of-Things (IOT) monitoring solutions for older adults. The advancement of wearable technology and the possibilities of using advanced IOT technology to assist older adults with their ADLs and independent living is the subject of many recent research and investigation.

[3] In Harsh N. Shah and Zishan Khan article focuses on IOT Based Air Pollution Monitoring System monitors the Air Quality over a web server using internet and will trigger an alarm when the air quality goes down beyond a certain level, means when there are number of harmful gases present in the air like CO₂, smoke, alcohol, benzene, NH₃, NO_x and LPG. The system will show the air quality in PPM on the LCD and as well as on webpage so that it can be monitored very easily. Temperature and Humidity is detected and monitored in the system. LPG gas is detected using MQ6 sensor and MQ135 sensor is used for monitoring Air Quality as it detects most harmful gases and can measure their amount accurately. In this IOT project, it can monitor the pollution level from anywhere using your computer or mobile. This system can be installed anywhere and can also trigger some device when pollution goes beyond

some level, like we can send alert SMS to the user.

[4] In the work of Ravi Kishore Kodali and Sasweth C. Rajanarayan proposed an article on IOT Based smart wearable for air quality Monitoring. This work integrates an air pollution monitoring system into a wearable like a watch that also doubles as a fitness tracker and a temperature monitor. Air pollutant levels, footsteps taken and ambient temperature are all sensed and displayed by the smart watch proposed in this work and is also casted to a custom designed smartphone application. The device proposed is novel in what it can do at the extremely low cost that it takes for its build. Thus, a watch that can do everything that other watches can and cannot do has been proposed, with a tight integration to a smartphone.

2.3 OPEN PROBLEMS IN EXISTING SYSTEM

Below are few problems listed in existing system:

Accuracy of Sensor Data: Dust allergy detection sensors may not always provide accurate data. False positives or false negatives could lead to incorrect alerts or unnecessary worry for users.

Sensor Calibration: Proper calibration of the sensor is essential to ensure accurate readings. If the calibration is off, it can result in inaccurate allergy detection.

Battery Life: lot devices, including smartwatches, often face battery life challenges. Adding an additional sensor for dust allergy detection could further drain the battery, requiring frequent recharging.

Connectivity Issues: Smartwatches rely on stable connectivity to transmit data. If the device struggles with maintaining a connection, it may not provide real-time alerts or updates to the user.

Data Privacy and Security: lot devices collect sensitive health-related data. Ensuring robust data privacy and security measures to protect this information from unauthorized access or breaches is crucial.

False Alarms: Dust particles can be common in various environments, so distinguishing between normal dust and allergenic dust could result in frequent false alarms.

User Interface and Experience: Designing a user-friendly interface to interpret and display dust allergy data is essential. Complicated interfaces or unclear alerts could confuse users.

Maintenance and Updates: Regular maintenance and software updates are necessary to keep the system running smoothly. Failure to update the software could lead to compatibility issues or vulnerabilities.

Cost: The addition of a dust allergy sensor may increase the overall cost of the smartwatch, potentially limiting its accessibility to users.

Integration with Healthcare Systems: For users with severe allergies, integration with healthcare systems for real-time medical support and advice may be necessary but could pose challenges.

CHAPTER 3

REQUIREMENT ANALYSIS

3.1 RISK ANALYSIS OF THE PROJECT:

Data Privacy and Security Risks:

- **Data Breaches:** Personal health data collected by the smart watch could be compromised if the device's security is breached.
- **Unauthorized Access:** Hackers might gain unauthorized access to sensitive user information, leading to identity theft or misuse of health data.
- **Data Encryption:** Ensuring end-to-end encryption of data transmitted from the smart watch to the cloud or mobile app can mitigate these risks.

Technical Risks:

- **Sensor Accuracy:** Inaccurate readings from dust allergy detection and water pollution sensors could lead to false alarms or missed detections, impacting user trust.
- **Device Reliability:** Malfunctions or technical issues with the smart watch may disrupt its ability to monitor allergies or detect water pollution accurately.
- **Firmware Vulnerabilities:** Unpatched vulnerabilities in the smart watch's firmware could be exploited by attackers to gain control over the device.

Health Risks:

- **False Alarms:** Incorrect allergy alerts may cause unnecessary anxiety or medical interventions for users.
- **Dependency:** Overreliance on the smart watch's readings without consulting medical professionals could lead to inappropriate self-medication or health decisions.
- **Water Safety:** Users might assume water is safe based solely on the

watch's readings, potentially exposing themselves to harmful pollutants.

Compliance and Legal Risks:

- **Regulatory Compliance:** Ensuring compliance with data protection regulations such as GDPR or HIPAA, depending on the region and type of data collected, is essential.
- **Liability:** The manufacturer may face legal liabilities in case of harm caused by inaccuracies or failures in the device's allergy detection or water pollution monitoring.

Ethical Risks:

- **Data Ownership:** Clear policies regarding ownership and use of user data must be established to address ethical concerns.
- **Equity:** Accessibility and affordability issues may arise, with certain demographics being unable to afford or access the benefits of such technology.

Environmental Risks:

- **Sustainability:** Manufacturing and disposal of IoT devices can contribute to environmental pollution if not managed responsibly.
- **Sensor Calibration:** Regular calibration and maintenance of sensors are necessary to ensure accurate readings and minimize environmental impact due to false alarms or ineffective pollution monitoring.

User Acceptance and Adoption Risks:

- **Usability:** Complex setup processes or user interfaces may deter users from adopting the technology.
- **Trust:** Building and maintaining trust in the accuracy and reliability of the device's sensors and data processing algorithms is crucial for user acceptance.

Market and Adoption Risks:

- Limited Demand: The market for dust allergy detection may be smaller than expected Competition: Other devices or technologies may offer similar features.
- User Acceptance: Users may not trust or adopt the technology due to privacy concerns.

Manufacturing and Supply Chain Risks:

- Component Shortages: Delays or shortages in sensor components can impact production.
- Quality Control: Ensuring consistent sensor quality is crucial.
- Production Costs: Unexpected cost increases can affect project viability.

Mitigation strategies for these risks may include thorough security testing, adherence to industry standards and regulations, continuous monitoring and updates, user education on the limitations of the device, and transparent communication about data handling practices and privacy policies. Regular risk assessments and feedback mechanisms from users can also help in identifying and addressing emerging risks over time.

3.2 REQUIREMENTS SPECIFICATION

Based on the reference of IEEE Std. 830 – 1998 [19] Recommended Practice for Software Requirements, The Hardware and Software Requirements are described

3.2.1 Hardware Requirements

- ☐ STM32 Controller
- ☐ Battery
- ☐ PH Sensor
- ☐ Turbidity Sensor
- ☐ Air Quality Sensor
- ☐ Gas Sensor
- ☐ OLED Display

- Buzzer
- LED's
- PCB Board
- Resistor
- Capacitors
- Transistors
- Cables and Connectors
- Buoy Body Frame

3.2.2 Software Requirements

- Operating System : Arduino Integrated development Environment.
- Languages : C++

3.2.3 C++

C++ is a cross-platform language that can be used to create high-performance applications. C++ was developed by Bjarne Stroustrup, as an extension to the C language. C++ gives programmers a high level of control over system resources and memory.

C++ Features

- **Object-Oriented Programming (OOP):** C++ supports the principles of encapsulation, inheritance, and polymorphism, allowing for efficient and modular code organization.
- **Strong Typing:** It enforces strict type checking, enhancing program reliability and type safety.
- **Memory Management:** C++ allows both manual memory management using pointers and dynamic memory allocation, as well as automatic memory management through features like RAII (Resource Acquisition Is Initialization).
- **Performance:** C++ is known for its high performance as it allows low-level manipulation of resources and direct access to hardware.

- **Standard Template Library (STL):** It provides a rich set of reusable data structures and algorithms, facilitating rapid development and code reuse.
- **Platform Independence:** C++ code can be compiled to run on various platforms with minimal changes, making it suitable for cross-platform development.
- **Multi-paradigm:** C++ supports multiple programming paradigms, including procedural, object-oriented, and generic programming.
- **Operator Overloading:** It allows operators to be redefined for user-defined types, enabling natural and concise syntax for custom data types.
- **Exception Handling:** C++ provides mechanisms for handling error and exceptional situations gracefully through try-catch blocks.
- **Template Metaprogramming:** C++ templates enable compile-time programming, allowing for the generation of code based on template parameters, leading to highly efficient and flexible code. These features make C++ a versatile and powerful language, suitable for a wide range of applications from system programming to high-performance applications and game development.

3.2.4 IOT (INTERNET OF THINGS)

The internet of things, or IoT, is a network of interrelated devices that connect and exchange data with other IoT devices and the cloud. IoT devices are typically embedded with technology such as sensors and software and can include mechanical and digital machines and consumer objects. Increasingly, organizations in a variety of industries are using IoT to operate more efficiently, deliver enhanced customer service, improve decision-making and increase the value of the business. With IoT, data is transferable over a network without requiring human-to-human or human-to-computer interactions. A thing in the internet of things can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is

low, or any other natural or man-made object that can be assigned an Internet Protocol address and is able to transfer data over a network. Technologies used in IOT Systems may include:

Edge computing: Edge computing refers to the technology used to make smart devices do more than just send or receive data to their IoT platform. It increases the computing power at the edges of an IoT network, reducing communication latency and improving response time.

Cloud computing: Cloud technology is used for remote data storage and IoT device management – making the data accessible to multiple devices in the network.

Machine learning: Machine learning refers to the software and algorithms used to process data and make real-time decisions based on that data. These machine learning algorithms can be deployed in the cloud or at the edge.

3.2.5 SENSOR INTEGRATION

Learning how to interface sensors such as dust allergy detection sensors with microcontrollers or development boards like Arduino or Raspberry PI. Sensor integration is the process of combining data from multiple sensors to enhance understanding, analysis, or control of a system or environment. This can involve synchronizing data streams, calibrating sensor outputs, and applying fusion techniques to obtain a more accurate and comprehensive representation of the observed phenomenon. Sensor integration is crucial in various fields like robotics, environmental monitoring, healthcare, and automotive systems to improve decision-making and overall system performance.

Enhanced Perception: Integrating data from multiple sensors provides a more comprehensive view of the environment or system, allowing for better understanding and perception of the surrounding conditions.

Improved Accuracy: By combining data from different sensors, errors and inaccuracies inherent in individual sensors can be mitigated or corrected,

leading to more accurate measurements and observations.

Redundancy and Reliability: Having redundant sensors and integrating their data ensures reliability and robustness in critical applications. If one sensor fails or provides erroneous data, others can compensate, maintaining system functionality.

Increased Information: Different sensors capture different aspects of a phenomenon. Integrating their data can provide richer information, enabling more informed decision-making and analysis.

Adaptability: Sensor integration allows systems to adapt to changing conditions or requirements by dynamically selecting and combining sensor data based on the current context or task.

Cost-Efficiency: Integrating multiple sensors into a single system can be more cost-effective than relying on a single high-end sensor to provide all required information.

Versatility: Integrated sensor systems can be used in a wide range of applications, from industrial automation to consumer electronics, due to their versatility and ability to adapt to diverse requirements.

Overall, sensor integration plays a crucial role in modern technology, enabling advancements in fields such as robotics, autonomous vehicles, healthcare, environmental monitoring, and more.

3.2.6 MOBILE DEVELOPMENT APP

- Creating a mobile application for android or IOS to interact with the smartwatch, display data, and provide user notifications or alert related to dust allergy detection and water pollution detection. A mobile development app, also known as an integrated development environment (IDE) for mobile applications, is a software tool or platform that enables developers to create, test, and deploy mobile applications for smartphones and tablets. These apps provide a suite of features and tools to streamline the app development process, including code editors, debugging tools, emulators or

simulators for testing, and integration with SDKs (Software Development Kits) and APIs (Application Programming Interfaces) for accessing device functionalities and services. Mobile development apps support various programming languages and frameworks commonly used for mobile app development, such as Java or Kotlin for Android, Swift or Objective-C for iOS, and frameworks like React Native, Flutter, or Xamarin for cross-platform development. They typically offer templates, libraries, and components to accelerate development and ensure compatibility with different device configurations and OS versions. Examples of popular mobile development apps include Android Studio Xcode, Visual Studio App Center, Flutter SDK, React Native, and Xamarin. These tools play a crucial role in empowering developers to create high-quality, feature-rich mobile applications for a wide range of purposes and industries.

3.2.7 CLOUD INTEGRATION

Cloud integration is the process of bringing data from different sources together to enhance enterprise modernization. Across modern enterprises, companies are embracing new systems. This is changing their data and the way they are using it. Sending sensor data to a cloud platform (like AWS, Google Cloud, or Microsoft Azure) for storage, analysis, and remote access.

FEATURES:

- **Scalability:** Cloud platforms provide scalable infrastructure that can accommodate fluctuations in data volume and user demand. This ensures that IoT systems can grow seamlessly as the number of devices and users increases.
- **Reliability:** Cloud providers offer high availability and reliability through redundant infrastructure and data replication across multiple locations.

- **Data Storage:** Cloud integration enables secure and scalable storage of IoT data, including sensor readings, device metadata, and user preferences. Data can be stored in various formats (e.g., structured, semi-structured, unstructured) and accessed via APIs for analysis and visualization.
- **Data Processing and Analytics:** Cloud platforms provide tools and services for processing and analyzing IoT data in real-time or batch mode. This includes stream processing, complex event processing, and machine learning algorithms for detecting patterns, anomalies, and insights from the data.
- **Device Management:** Cloud integration simplifies device management tasks such as provisioning, configuration, monitoring, and software updates. Device management platforms allow administrators to remotely manage and monitor IoT devices at scale, reducing operational overhead and improving efficiency.
- **Security:** Cloud providers offer robust security features to protect IoT data and devices from unauthorized access, data breaches, and cyber threats. This includes encryption, access control, identity management, and security monitoring capabilities.
- **Integration with Other Services:** Cloud platforms support integration with third-party services and systems, enabling interoperability and ecosystem collaboration. This includes integration with enterprise applications, external APIs, and IoT platforms for enhanced functionality and data sharing.
- **APIs and SDKs:** Cloud providers offer APIs and software development kits (SDKs) that simplify the development of IoT applications and integration with cloud services. This allows developers to leverage existing cloud infrastructure and services to accelerate time-to-market and reduce development effort.

Overall, cloud integration empowers IoT systems with scalable, reliable, and feature-rich capabilities that enable innovative applications, insights, and experiences for users.

3.3 SYSTEM USE CASE

By following the IEEE Std. 1016-1998 [22] Recommended Practice for Software Design Descriptions.

3.3.1 System Description

The system is designed to recognize air and water pollution in the environment by using dust detection sensor, Ph sensor and turbidity sensor which is useful for asthma patients, respiratory issue patient.

3.3.2 System Use Case Scenario

1. User Setup and Configuration: User purchases the IoT-based smart watch equipped with a dust allergy detection sensor. Upon unboxing, the user follows the setup instructions to connect the smart watch to their smartphone via Bluetooth or a companion app. During setup, the user grants necessary permissions for the smart watch to access health data and location information if required.

2. Real-Time Dust Allergy Monitoring: As the user wears the smart watch throughout the day, the dust allergy detection sensor continuously monitors the surrounding air quality.

When the sensor detects high levels of dust particles in the air, it sends real-time alerts to the user's smartphone and vibrates the smart watch to notify the user.

3. Health Data Integration: The smart watch integrates with the user's health data, including heart rate, respiratory rate, and activity level. It correlates changes in the user's health data with environmental factors such as dust levels, providing insights into how dust allergies may

affect the user's well-being.

4.Location-Based Insights: Leveraging GPS data from the user's smartphone, the smart watch identifies locations where the user experiences higher levels of dust pollution. It provides personalized recommendations, such as avoiding certain areas during peak pollution times or using protective gear when venturing into dusty environments.

5. Historical Data Analysis: The smart watch stores historical data on dust levels, allergy symptoms, and user activity. Through data analysis, it identifies patterns and trends to help the user better understand their allergy triggers and manage their condition more effectively.

6. Integration with Health Professionals: Users have the option to share their allergy data with healthcare professionals or allergists. Health professionals can remotely monitor the user's allergy symptoms and provide personalized recommendations or adjustments to their treatment plan.

7. Customizable Alerts and Reminders: Users can customize alert thresholds for dust levels based on their sensitivity to allergens. They can also set reminders to take allergy medication or use preventive measures when entering high-risk environments.

8. Emergency Response Assistance: In the event of a severe allergic reaction, the smart watch can trigger an emergency alert to designated contacts or emergency services. It provides the user's location information and relevant health data to ensure prompt assistance.

CHAPTER 4

DESCRIPTION OF PROPOSED SYSTEM

The System 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 is 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 are 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.

ADVANTAGES OF PROPOSED SYSTEM:

Health Monitoring: By detecting dust particles in the air, the smartwatch can alert users to poor air quality, helping them avoid respiratory issues.

Environmental Awareness: Users can contribute to environmental protection by monitoring water pollution levels and reporting any anomalies to relevant authorities.

Personalized Alerts: The smartwatch can provide personalized recommendations based on real-time pollution data.

Data Insights: Continuous monitoring of dust and water pollution levels generates valuable data insights that can be used for urban planning, policy-making, and environmental research.

Efficiency: With IoT connectivity, the smartwatch can sync data with other devices or cloud platforms, enabling centralized monitoring and analysis for better decision-making.

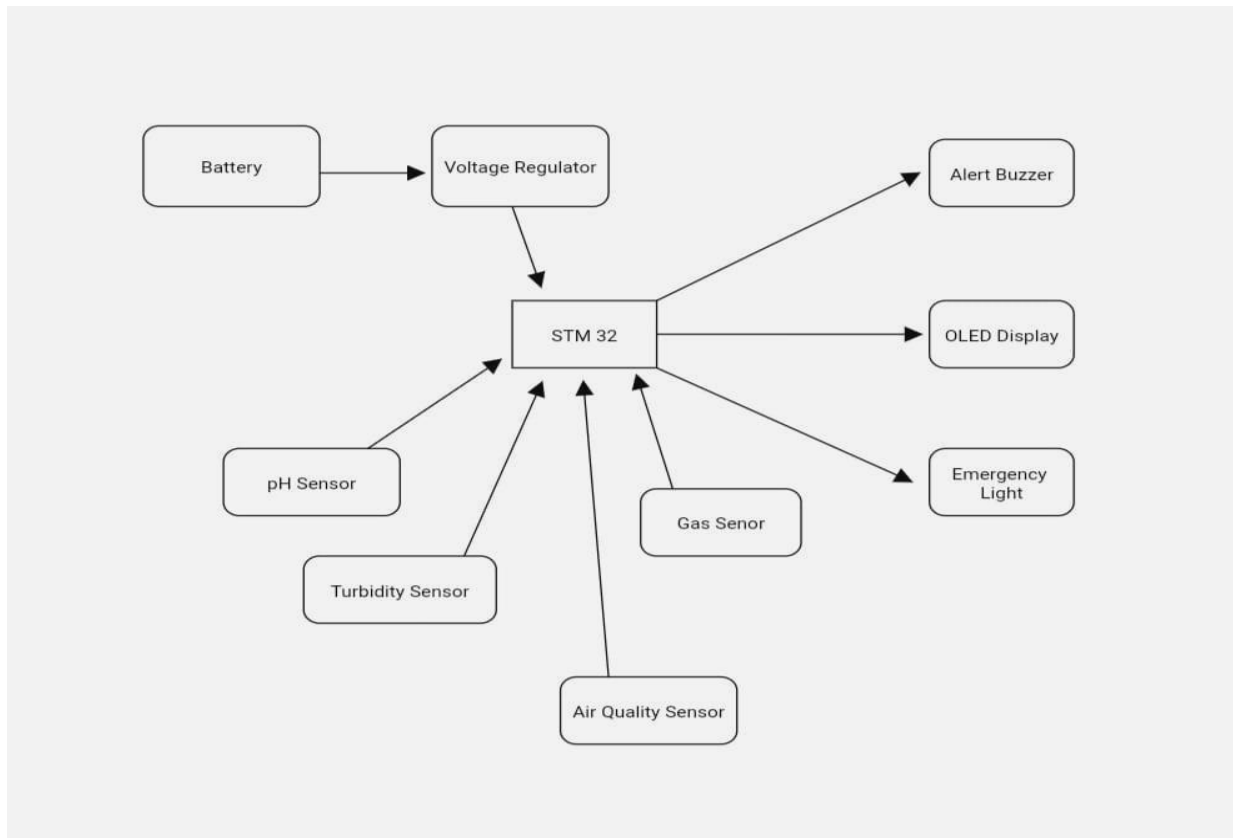


Fig 4.1: Block diagram of proposed project

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.

SYSTEM ARCHITECTURE

4.1. HARDWARE DESCRIPTION

The battery powered smart watch system is operated by an STM 32 along with an 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.

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.

4.1.1STM32 MICROCONTROLLER:

The STM32 series is based on the ARM Cortex-M3 core specially designed for embedded applications that require high performance, low cost, and low power consumption. This article introduces the definition, types, difference between the STM32 microcontroller and 51 microcontrollers as well as the basic system of STM32. The STM32 series is based on the ARM Cortex-M3 core specially designed for embedded applications that require high performance, low cost, and low power consumption. It is divided into different products according to the core architecture: Among them, the STM32F series include: STM32F103 "enhanced" series, STM32F101 "basic" series, STM32F105, STM32F107 "interconnected" series, and enhanced series with a clock frequency of 72MHz, which is the highest performance product among similar products. The basic clock frequency is 36MHz, and the performance of 16-bit products is greatly improved at the price of 16-bit products. It is the best choice for users of 32-bit products. Both series have built-in flash memory of 32K to 128K, the difference is the combination of the maximum capacity of SRAM and the peripheral interface. When the clock frequency is 72MHz, the code is executed from the flash memory, and the STM32 consumes 36mA, which is equivalent to 0.5mA/MHz The microcontroller is a kind of integrated circuit chip, which uses VLSI technology to integrate the central processing unit CPU, random access memory RAM, read-only memory ROM, various I/O ports, interrupt systems, timers with data processing capabilities, counter and other functions (may also include display drive circuit, pulse width modulation circuit, an analog multiplexer, A/D converter, and other circuits) into a silicon chip to form a small and complete microcomputer system.

The biggest difference between it and the 8-bit microcontroller is that it cannot only use registers for programming but also use officially provided library files for programming, which is not only convenient for programming but also easier to transplant.

STM32 microcontroller features:

- (1) Core: ARM 32-bit Cortex-M3 CPU, maximum operating frequency 72MHz, 1.25DMIPS/MHz, single-cycle multiplication and hardware division.
- (2) Memory: 32-512KB Flash memory, 6-64KB SRAM memory are integrated on-chip.
- (3) Clock, reset, and power management: 2.0-3.6V power supply and I/O interface drive voltage, POR, PDR and programmable voltage detector (PVD), 4-16MHz crystal oscillator, embedded before leaving the factory-adjusted 8MHz RC oscillator circuit, internal 40 kHz RC oscillator circuit, PLL for CPU clock, 32kHz crystal oscillator with calibration for RTC.
- (4) Debug mode: serial debug (SWD) and JTAG interface, up to 112 fast I/O ports, up to 11 timers, up to 13 communication interfaces. STM32 commonly used devices: The most used devices: STM32F103 series, STM32 L1 series, STM32W series.



Fig 4.2: STM32 Microcontroller

4.1.2 MQ135 AIR QUALITY SENSOR

An MQ135 air quality sensor is one type of MQ gas sensor used to detect, measure, and monitor a wide range of gases present in air like ammonia, alcohol, benzene, smoke, carbon dioxide, etc. It operates at a 5V supply with 150mA consumption.

Preheating of 20 seconds is required before the operation, to obtain the accurate output. It is a semiconductor air quality check sensor suitable for monitoring applications of air quality. It is highly sensitive to NH₃, NO_x, CO₂, benzene, smoke, and other dangerous gases in the atmosphere. It is available at a low cost for harmful gas detection and monitoring applications. To measure or detect the gases, use analog pins or digital pins. Just apply 5V to the module and you can observe that the module's power LED turns ON (glows) and the output LED turns OFF when no gas is detected by the module. This means that the output of the digital pin is 0V. Now, once when the MQ135 sensor is operated to detect, then the LED output goes high along with the digital output pin. Otherwise, use the potentiometer until the output increases. Whenever the sensor detects a certain gas concentration, the digital pin goes high (5V), otherwise it stays low (0V). We can also use analog pins to get the same result. The output analog values (0-5V) are read from the microcontroller.



Fig 4.3: MQ135 Air Quality Sensor

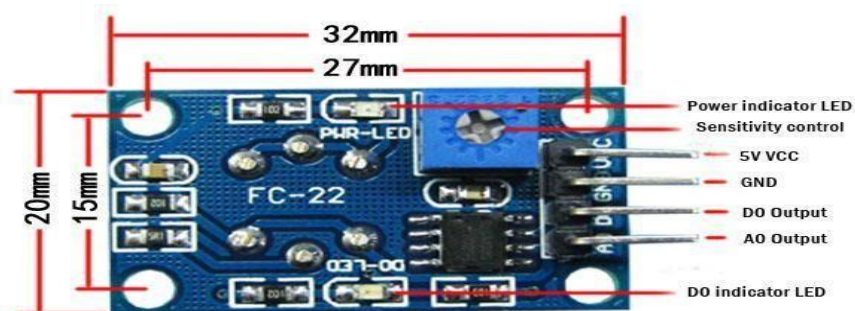


Fig.4.4: MQ135 Air Quality Sensor Pin Configuration

Pin 1: VCC: This pin refers to a positive power supply of 5V that power up the MQ135 sensor module.

Pin 2: GND (Ground): This is a reference potential pin, which connects the MQ135 sensor module to the ground.

Pin 3: Digital Out (Do): This pin refers to the digital output pin that gives the digital output by adjusting the threshold value with the help of a potentiometer. This pin is used to detect and measure any one gas and makes the MQ135 sensor work without a microcontroller.

Pin 4: Analog Out (Ao): This pin generates the analog output signal of 0V to 5V and it depends on the gas intensity. This analog output signal is proportional to the gas vapor concentration, which is measured by the MQ135 sensor module. This pin is used to measure the gases in PPM. It is driven by TTL logic, operates with 5V, and is mostly interfaced with microcontroller.

Applications of the MQ135 quality sensor are:

- Used in the detection of excess or leakage of gases like nitrogen oxide, ammonia, alcohol, aromatic compounds, smoke, and sulphide.
- Used as air quality monitors.
- Used in air quality equipment for offices and buildings.
- Used as a domestic air pollution detector.
- Used as an industrial air pollution detector.
- Works as a portable air pollution detector.

4.1.3 PH SENSOR

pH Sensors and Principles of Operation

In the process world, pH is an important parameter to be measure and controlled. The pH of a solution indicates how acidic or basic(alkaline) it is. The pH term translates the values of the hydrogen ion concentration- which ordinarily ranges between about 1 and 10 x - 14gram-equivalents per litre - into numbers between 0 and 14.

On the pH scale a very acidic solution has a low pH value such as 0, 1, or 2 (which corresponds to a large concentration of hydrogen ions; 10×0 , 10×-1 , or 10×-2 gram-equivalents per litre) while a very basic solution has a high pH value, such as 12, 13, or 14 which corresponds to a small number of hydrogenous (10×-12 , 10×-13 , or 10×-14 gram- equivalents per litre). A neutral solution such as water has a pH of approximately 7. A pH measurement loop is made up of three components, the pH sensor, which includes a measuring electrode, a reference electrode, and a temperature sensor; a preamplifier; and an analyzer or transmitter. A pH measurement loop is essentially a battery where the positive terminal is the measuring electrode, and the negative terminal is the reference electrode. The measuring electrode, which is sensitive to the hydrogen ion, develops a potential (voltage) directly related to the hydrogen ion concentration of the solution. The reference electrode provides a stable potential against which the measuring electrode can be compared.



Fig 4.5: Ph Sensor

4.1.4 OLED DISPLAY

OLED (Organic Light Emitting Diodes) is a flat light emitting technology, made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted. OLEDs are emissive displays that do not require a backlight and so are thinner and more efficient than LCD displays (which do require a white backlight). OLEDs also lose less color contrast at wider viewing angles compared to LCDs. LCDs are best viewed from the Centre and lose color contrast quickly as the angle increases. OLED technology is also improving rapidly.

OLEDs now have a larger color gamut (selection of colors) than before as well as higher HDR and faster response times. OLED is fundamentally different from LED which is based on a p-n diode structure. In LEDs doping is used to create p- and n- regions by changing the conductivity of the host semiconductor. OLEDs do not employ a p-n structure. Doping of OLEDs is used to increase radiative efficiency by direct modification of the quantum-mechanical optical recombination rate. Doping is additionally used to determine the wavelength of photon emission. An OLED display works without a backlight because it emits its own visible light. Thus, it can display deep black levels and can be thinner and lighter than a liquid crystal display (LCD). In low ambient light conditions (such as a dark room), an OLED screen can achieve a higher contrast ratio than an LCD, regardless of whether the LCD uses cold cathode fluorescent lamps or an LED backlight. OLED displays are made in the same way as LCDs, but after TFT (for active matrix displays), addressable grid (for passive matrix displays) or indium-tin oxide (ITO) segment (for segment displays) formation, the display is coated with hole injection, transport and blocking layers, as well with electroluminescent material after the first 2 layers, after which ITO or metal may be applied again as a cathode and later the entire stack of materials is encapsulated. The TFT layer, addressable grid or ITO segments serve as or are connected to the anode, which may be made of ITO or metal. OLEDs can be made flexible and transparent, with transparent displays being used in smartphones with optical fingerprint scanners and flexible displays being used in foldable smartphones.

Components of an OLED:

OLEDs can be made up of either two or three layers of organic material.

A two- layer OLED consists of the following parts:

- Substrate– OLED is supported by either a thin translucent glass or foil material known as substrate. It acts as the base for OLED.
- Anode– When an electric current is passed, the anode loses an electron or adds holes. It is transparent. It is also known as an emitter.
- Organic Layer– They are made up of organic molecules or polymers such as hydrogen or carbon which are placed on top of the anode.

- **Conductive Layer**– It consists of organic plastic molecules such as polyaniline that are used to transport holes from the anode.
- **Emissive Layer** – This is the layer where light is made. It is made up of organic plastics molecules, but different ones from the conducting layer that transmits electrons from the cathode. One such polymer is polyfluorene.
- **Cathode**– When an electric current is applied the cathode injects electrons. It is made up of metals such as aluminum and calcium. It may be transparent or not. The cathode is also known as a conductor.



Fig 4.6: OLED Display

4.1.5 LDR (LIGHT DEPENDENT RESISTOR)

LDR (Light Dependent Resistor) as the name states is a special type of resistor that works on the photoconductivity principle means that resistance changes according to the intensity of light. Its resistance decreases with an increase in the intensity of light. It is often used as a light sensor, light meter, Automatic street light, and in areas where we need to have light sensitivity. It is also called a Light Sensor.

LDR are usually available in 5mm, 8mm, 12mm, and 25mm dimensions. The Light-dependent resistors made with photosensitive semiconductor materials like Cadmium Sulphides (CdS), lead sulphide, lead selenide, indium antimonide, or cadmium selenide and they are placed in a Zig-Zag shape as you can see in the pic below. Now, a transparent coating is applied on the top so that the zig-zag-shaped photosensitive material gets protected and as the coating is transparent the LDR will be able to capture light from the outer environment for its working.

- It works on the principle of photoconductivity whenever the light falls on its photoconductive material, it absorbs its energy and the electrons of that photoconductive material in the valence band get excited and go to the conduction band and thus increasing the conductivity as per the increase in light intensity. Also, the energy in incident light should be greater than the bandgap energy so that the electrons from the valence band got excited and go to the conduction band.
- The LDR has the highest resistance in dark around 10^{12} Ohm and this resistance decreases with the increase in Light.



Fig 4.7: LDR Sensor

4.1.6 BUZZER

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

- The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, printers.

- Based on the various designs, it can generate different sounds like alarm, music, bell & siren. The pin configuration of the buzzer is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the '-' symbol or short terminal and it is connected to the GND terminal.
- This buzzer uses a DC power supply that ranges from 4V – 9V. To operate this, a 9V battery is used but it is suggested to utilize a regulated +5V/+6V DC supply. Generally, it is connected through a switching circuit to switch ON/OFF the buzzer at the necessary time interval.



Fig 4.8: Buzzer

The specifications of the buzzer:

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

4.2 SOFTWARE DESCRIPTION

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.

4.2.1 ALGORITHM

- a) Start
- b) System initializing.
- c) Capture Air quality data, water quality data, and noise intensity data.
- d) Send captured data to webpage portal and display the data on the LCD screen and record the data along with its date and time of capture.
- e) Compare the captured data with the pre-set point of the sensors.
- f) If it exceeds send both SMS and email alerts to the user and also display the data on the webpage portal.
- g) If it does not exceed no alarming messages should be sent but display the data on both LCD and webpage portal.
- h) Go back to step c.

4.2.2 STRUCTURE OF PROGRAM

a) Pin declarations

```
Int TEMP; ////A0  
Int MQ135; ////A1  
Int MQ2; ////A2  
Int HUM; ////A3  
Int PH; ////A4
```

Int measure Pin = A5; ////A5

Int led Power = A6; ////A6

b) Reading sensor data

- TEMP = analogRed (0)
- MQ6 = analogRed (1)
- MQ9 = analogRed (2)
- HUM= analogRed (3)
- PH = analogRed (4)
- Dust voMeasured = analogRead (measurePin)

c) Displaying the data in LCD

lcd.setCursor (0, 0);

lcd.print ("sensor data:");

lcd.setCursor (0, 0);

lcd.print (sensor data);

Delay (1000);

4.3 PROJECT MANAGEMENT PLAN

- **Project Planning and Management Module** - This module will include the overall planning and management of the project, including setting project goals and timelines, creating and assigning tasks, tracking progress, and communicating.
- **Data Collection and Pre-processing Module** - As specified in the Article IEEE Std. 1058-1998 [23] IEEE Standard for Software Project Management Plans, IEEE Std. 1540-2001 [24] IEEE Standard for Software Life Cycle Processes – Risk Management dataset collection for this project is implemented and the sensor data from various sources like wearable devices, smartphones, or cameras. is preprocessed. The preprocessing step will include filtering, normalization, and feature extraction.
- **Dust Detection Sensor Module** - This module is used to detect dust, particulate matter and pollen in the air.
- **Wireless Communication Module:** This module enables wireless communication between different devices or systems. These modules typically include a combination of hardware and software components designed to facilitate communication over radio frequencies without the need for physical wires or cables
- **Display Module:** It is used to provide visual output in electronic devices and consist of a display panel, a driver circuit.
- **Power Management Module:** This module provides smart load protection, defending electrical circuit from damage.
- **Battery Module:** It is used to measure how much electrical current is flowing through a circuit or battery.

CHAPTER 5

IMPLEMENTATION DETAILS

5.1 DEVELOPMENT AND DEPLOYMENT SETUP

To develop and deploy a IOT Based Smart watch with dust allergy detection sensor and water pollution sensor, you can follow the steps below:

- **Hardware Selection:** Choose a Raspberry Pi model that fits your requirements. Consider the processing power, memory, and connectivity options. Select a suitable dust detection sensor that can measure particulate matter (PM) concentrations in the air, such as a laser scattering sensor or a particulate matter sensor.
- **Sensor Integration:** Connect the dust detection sensor to the Raspberry Pi using the appropriate interface (e.g., GPIO pins, I2C, or UART). Implement the necessary drivers and libraries to read data from the sensor.
- **Data Processing:** Develop code to process the raw data from the dust detection sensor. This may involve calibrating the sensor, compensating for environmental factors, and converting raw data into meaningful PM concentration values (e.g., PM2.5 or PM10).
- **Display and User Interface:** Create a graphical user interface (GUI) to display the real-time dust concentration data on the smartwatch's screen. Consider using a small touchscreen display for user interaction.
- **Wireless Communication:** Implement wireless communication capabilities on the Raspberry Pi, such as Wi-Fi or Bluetooth, to transmit the dust concentration data to a smartphone or a cloud server for further analysis and visualization.
- **Data Logging and Storage:** Set up a data logging mechanism on the Raspberry Pi to record the dust concentration data over time. You can store the data locally or upload it to a cloud-based storage service for future analysis.

- **Power Management:** Design power management features to optimize the smartwatch's battery life. Use sleep modes or low-power configurations to reduce power consumption when the device is idle.
- **Mobile Application:** Develop a mobile application that can receive data from the smartwatch via wireless communication. This application can display real-time dust concentration data and provide additional features like historical data visualization and alerts.
- **Data Visualization and Analysis:** Create data visualization tools or dashboards to analyze the historical dust concentration data. These visualizations can help users understand air quality trends and identify potential air pollution events.
- **User Notifications:** Implement a notification system on the smartwatch and mobile application to alert users when the dust concentration exceeds certain predefined thresholds. This feature can help users take appropriate actions to protect their health.
- **Testing and Validation:** Thoroughly test the smartwatch and its dust detection sensor to ensure accurate and reliable measurements. Validate the data against reference instruments or established air quality monitoring systems.
- **Planning:** Continuous improvement. With proper planning and execution, you can develop a robust and accurate human activity recognition system that can be deployed in a real-world environment.
- **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

5.2 WORKING OF THE SETUP

- The data of air is recognized by MQ135 gas sensor and MQ6LPG gas sensor. The MQ135 sensor can sense NH₃, NO_x, alcohol, Benzene, smoke, CO₂. So, it is dynamic gas sensor for our Air pollution Monitoring system. When it will be connected to STM32 then it will sense all gases, and it will give the Pollution level in PPM (parts per million). Sensor is giving us value of 90 when there is no gas near it and the air quality safe level is 350 PPM and it should not exceed 1000 PPM.
- When it will exceed the limit of 1000 PPM, it will cause Headaches, sleepiness and stagnant, stuffy air. If it exceeds beyond 2000 PPM then it will cause increased heart rate and many different diseases. When the value will increase from 400 PPM, then the buzzer will start beeping and the OLED will display the value. Along with these gas sensors the pH sensor is integrated to STM32 board. The values of air are displayed with the pH sensor dipped in the water sample gives the pH value of the water.
- The device 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. Now we have a 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. pH Sensor is used to display water quality of any water body (lake, pond, canal, sea).
- It allows to set high and low acceptance values of each parameter using push buttons. If any of the values scanned shows up higher/lower than set limits it sounds a buzzer alert as well displays the alert message to the user on the OLED display.
- The Circuit Diagram of our Project “IOT Based smart watch Air and Water Pollution Monitoring” is shown in below.

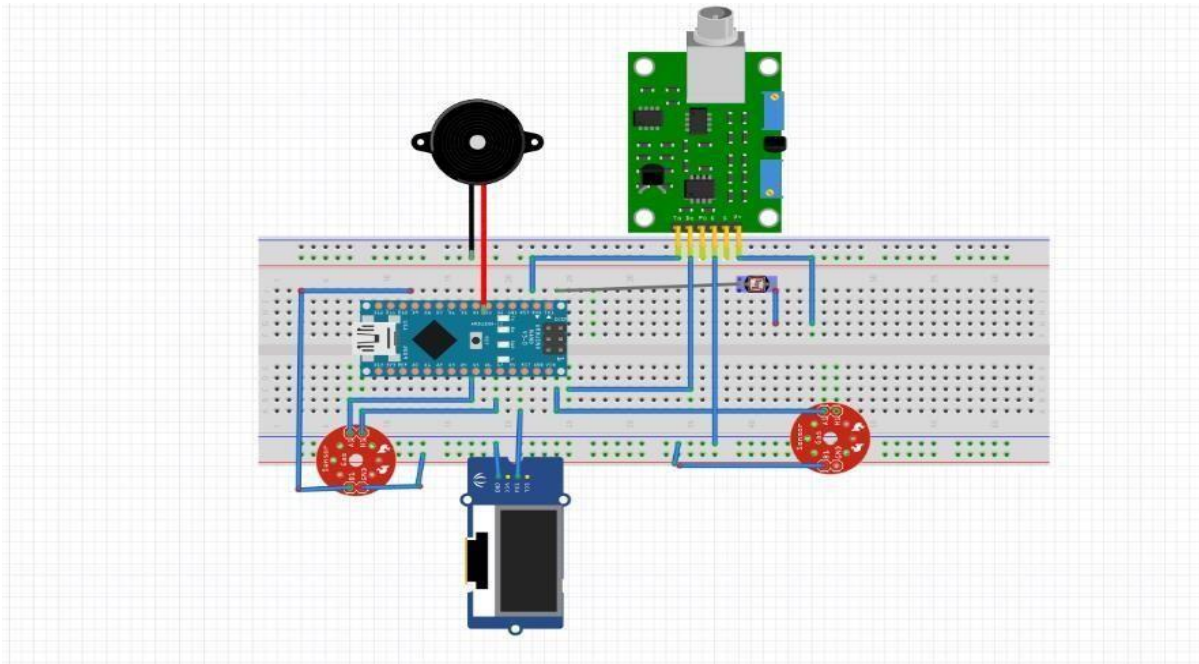


Fig 5.1: Circuit Diagram

The Flow Chart for IOT Based Smart watch with air and water pollution sensor is shown below:

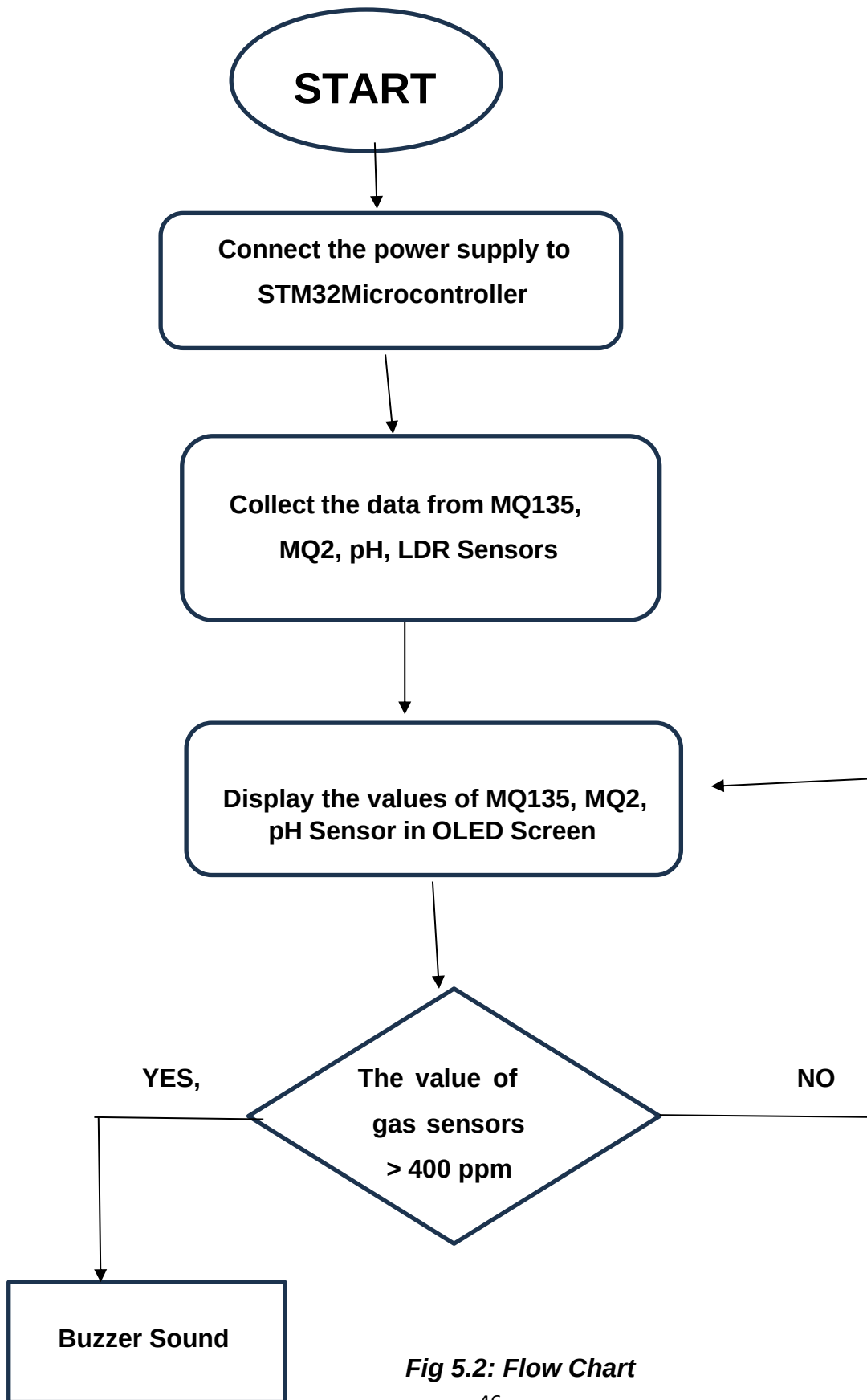


Fig 5.2: Flow Chart

CHAPTER 6

OUTCOMES AND DISCUSSION

6.1 INTRODUCTION

Implementing an IoT-based smartwatch with dust allergy detection and water pollution sensors could have several positive outcomes:

- **Health Monitoring:** Users with dust allergies can receive real-time alerts when the sensor detects high levels of dust particles, enabling them to take preventive measures and manage their allergies better.
- **Environmental Awareness:** The water pollution sensor can alert users to the presence of harmful substances in nearby water sources, raising awareness about environmental pollution and encouraging actions to mitigate it.
- **Data Collection:** Collected sensor data can be aggregated and analyzed to identify patterns and trends in dust levels and water pollution, providing valuable insights for public health initiatives and environmental protection efforts.
- **Personalized Recommendations:** By integrating with mobile apps or cloud services, the smartwatch can provide personalized recommendations based on the user's allergy triggers and local pollution levels, helping them make informed decisions about their activities and surroundings.
- **Community Engagement:** Users can contribute to crowd-sourced data collection efforts by sharing their sensor data anonymously, contributing to a larger database for research and analysis related to allergies and environmental pollution.
- **Early Warning System:** The smartwatch can serve as an early warning system for individuals and communities, alerting them to potential health hazards and prompting timely action to reduce exposure to allergens and pollutants.

- **Improved Quality of Life:** Ultimately, the integration of these sensors into a wearable device can lead to an improved quality of life for individuals with allergies and contribute to the overall well-being of communities by promoting environmental awareness and proactive health management.

6.2 IEEE STANDARDS FOLLOWED IN THE PROJECT

- IEEE 802.15.4: This standard defines the physical layer and media access control for low-rate wireless personal area networks (LR-WPANs). It's commonly used in IoT devices due to its low power consumption and cost-effectiveness.
- IEEE 802.11 (Wi-Fi): If the smartwatch needs higher data rates or connectivity to a local network or the internet, IEEE 802.11 standards (commonly known as Wi-Fi) can be employed.
- IEEE 802.3 (Ethernet): If the smartwatch communicates with a local network through wired connections, IEEE 802.3 standards for Ethernet can be relevant.
- IEEE 21451.x: This family of standards addresses sensor networks, which might be relevant for the dust allergy detection sensor integration.
- IEEE 1451: This standard defines a set of smart transducer interface standards for sensors and actuators, which could be useful for ensuring interoperability and compatibility of the dust allergy detection sensor with the smartwatch.
- IEEE 2413: This standard provides an architectural framework for IoT, guiding the design, deployment, and operation of IoT systems. It can help ensure the overall system's reliability, security, and interoperability.

These standards provide a foundation for interoperability, reliability, and security in IoT devices, ensuring that your smartwatch with a dust allergy detection sensor meets industry best practices and can seamlessly integrated with other devices and system.

6.3 CONSTRAINTS

In the project of Human Designing an IoT-based smartwatch with dust allergy detection and water pollution sensors would involve several constraints to consider:

- **Power Consumption:** Ensuring efficient power management to prolong battery life despite continuous sensor monitoring.
- **Sensor Size and Integration:** Selecting compact yet sensitive sensors that can be seamlessly integrated into the watch without compromising aesthetics or comfort.
- **Data Transmission:** Implementing a reliable wireless communication protocol (e.g., Bluetooth Low Energy) for transmitting sensor data to a companion app or cloud server.
- **Data Security and Privacy:** Incorporating robust encryption and authentication mechanisms to protect sensitive health data transmitted by the device.
- **Sensor Accuracy and Calibration:** Calibrating sensors to provide accurate and reliable readings under varying environmental conditions.
- **Water Resistance:** Designing the smartwatch to be water-resistant to protect it from damage due to exposure to water or moisture.
- **User Interface:** Creating an intuitive user interface on the smartwatch display or companion app for viewing sensor data and receiving alerts or notifications.
- **Regulatory Compliance:** Ensuring compliance with relevant regulations and standards for medical devices, if applicable, particularly regarding health data collection and processing.
- **Cost:** Balancing the inclusion of advanced sensors and features with the overall cost of production to make the device accessible to a wide range of users.

CHAPTER 7

RESULTS AND DISCUSSION

7.1 INITIAL FINDINGS:



Fig 7.1 Temperature, MQ6, MQ9 and Humidity sensor Initial Data



Fig 7.2: Noise Sensor and Dust density Sensor data

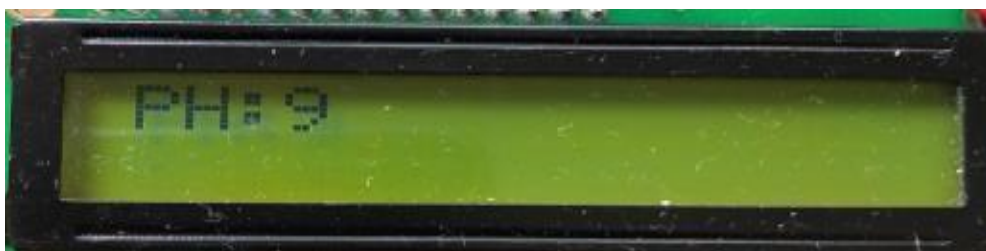


Fig 7.3 Ph Sensor Initial data

7.2 PRE- SET VALUES

- Pre-set Threshold value for respective sensor data above which the system sends alarming messages to the user.

S.NO	SENSOR DATA	PRE-SET LIMIT VALUE
1	Temperature	50 degrees centigrade
2	Humidity	30%
3	CO	200mV
4	LPG	200mV
5	Ph	7
6	Dust density	2V

Fig 7.4: Pre-set limit values for various sensors

7.3 AIR POLLUTION DETECTION

In here, By the using of MQ135 and MQ6 sensor we can observe some values based on gas samples in test in PPM Value. The vales can show in OLED Display. Working of seven days by taking the different gases samples (Smoke, Sanitizer, Normal Air, Dust) on each day we get different output.

The graphs below are drawn based on the different air samples sprayed on the gas sensors by taking the PPM values on y-axis and on x-axis by taking the number of days it is tested for.

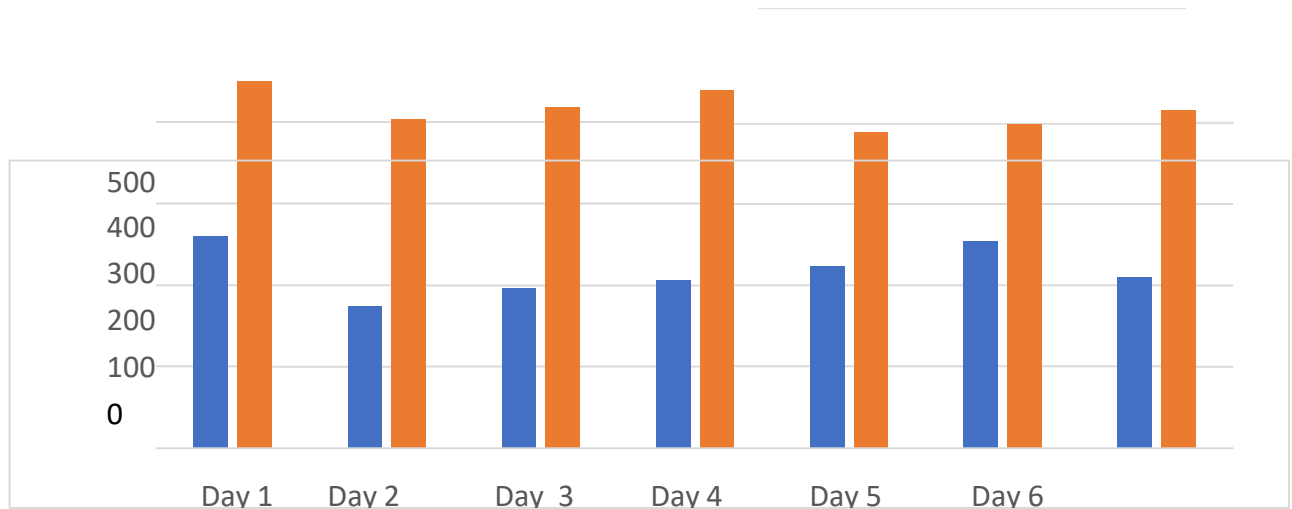


Fig 7.5: Air Quality on selected days with smoke pollution

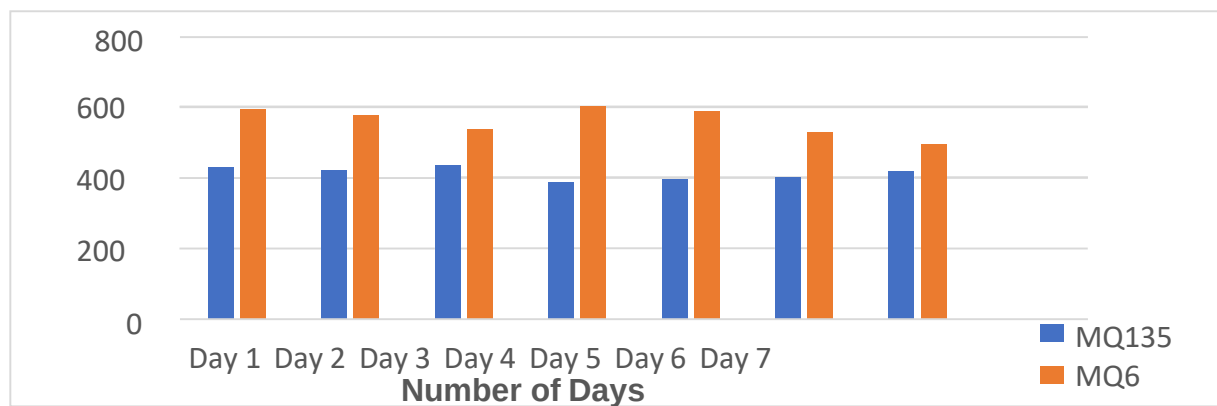


Fig 7.6: Air Quality on selected days with sanitizer as pollution

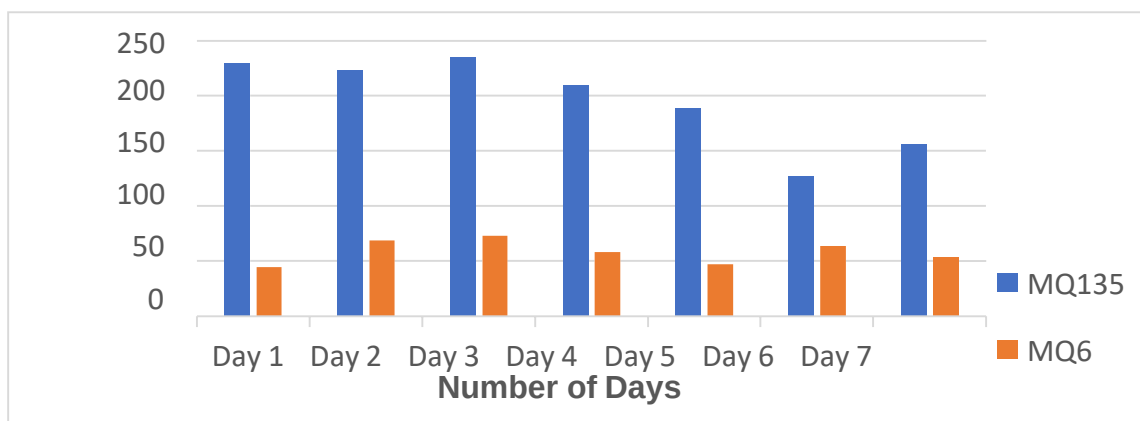


Fig 7.7: Air Quality on selected days with Normal Air as Pollution

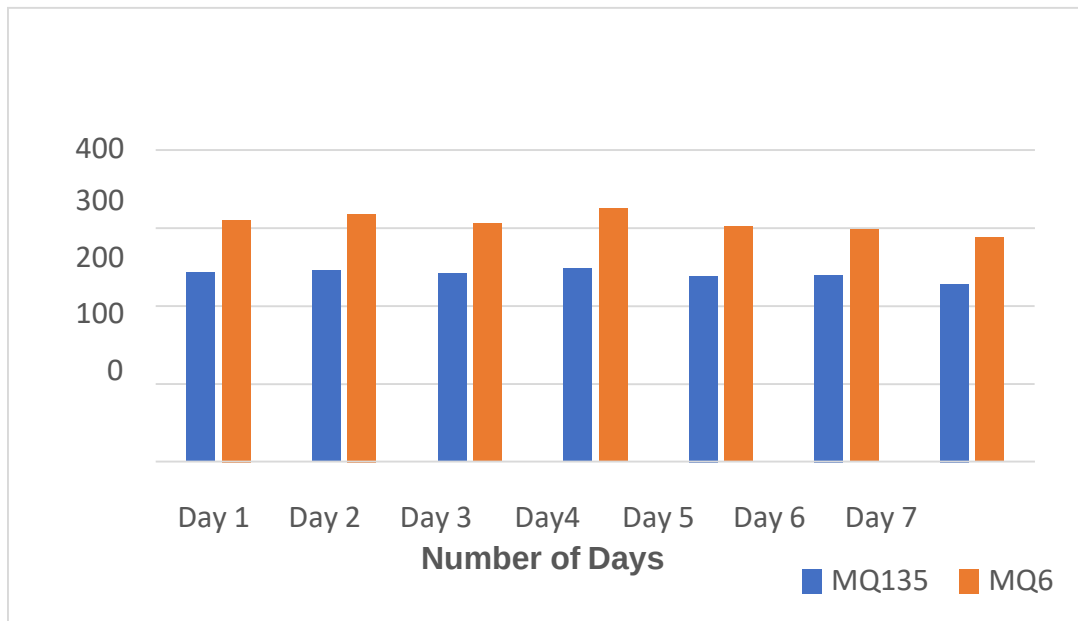


Fig 7.8: Air Quality on selected days with Dust as Pollution

After the observation of different samples of gases, we can conclude the following range of observation of gases.

Range in PPM	Air Quality Index	Associated Health Efforts
0-50	Good	Minimal Impact
51-100	Satisfactory	May cause minor breathing discomfort to sensitive people.
101-200	Moderately polluted	May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and older adults.

201-300	Poor	May cause breathing discomfort to people on prolonged exposure, and discomfort to people with heart disease
301-400	Very Poor	May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases.
401-500	Severe	May cause respiratory impact even on healthy people, and serious health impacts on people with lung/heart disease. The health impacts may be experienced even during light physical activity.
500-1000	Dangerous	may occurs to death

Fig 7.9: Air Quality Index Report

7.4 WATER POLLUTION DETECTION

From the other side of the monitoring in here, we use the pH sensor for the water quality test the different samples of water like ground water, distilled water, tap water, Bottled drinking water, Acid rain sample.

- Groundwater flows through rocks and soil that can affect the water's pH level. For example, contact with sandstone results in a nearly neutral pH between 6.5 and 7.5. Limestone, on the other hand, can result in an alkaline pH of 8.5. Soils contain minerals and other substances that affect groundwater pH. Decaying organic matter in soils causes pH levels in groundwater to drop as low as 4.0. That pH level is well below the recommended 6.5 to 7.5 pH for drinking water. Human-induced pollution affects groundwater pH as well. For example, runoff from shale and coal mining contains iron sulphide, which can result in pH readings as low as 2.
- The pH level in a lake or stream is crucial for the survival of fish and aquatic plants. Freshwater lakes and streams typically have pH levels between 6.0 and 8.0. Deeper lakes usually have a higher pH near the surface. Aquatic organisms are sensitive to pH changes. For example, the optimal pH level for fish ranges from 6.5 to 9.0. At levels outside this range, fish become susceptible to poisoning from toxic chemicals. Changes in pH can also cause an overload of available plant nutrients, resulting in excessive plant growth and depleted oxygen levels for fish.
- In acidic water, iron causes a metallic taste as well as reddish stains on clothing and plumbing, while other metals such as lead are toxic. Alkaline or “hard” water contains excess calcium and other minerals that cause the familiar scaly deposits on cookware and a bitter taste in coffee.

The main purpose of water testing with pH sensor is the water testing takes place on-site using a relatively small, portable meter or in a lab using a larger benchtop meter. The benchtop meter has a cup that holds the water sample and a glass probe with two specialized electrodes. The pH electrode measures the acidity of the water sample, while the reference electrode is immersed in a liquid with a fixed acidity. After the reading from the pH electrode is compared with the reading from the reference electrode, the meter converts the voltage to a pH level. A pH meter provides a much more accurate reading than a test strip kit and prevents

the mess associated with having to use droppers. Calibration before testing water samples ensures that the pH meter will provide accurate readings and test results. The importance of pH in Water is the Water quality is crucial for all living things, as well as for agriculture and recreation. Optimal pH levels are an essential factor in maintaining water quality and healthy ecosystems. Accurate pH testing helps keep drinking water and groundwater safe and helps protect aquatic plants and animals.

- pH values are measured on a scale of 0 to 14.
- It measures the alkalinity and acidity of water and other solutions with this type of sensor pH sensors help assure the safety and quality of water from manufacturing facilities.
- We know that if the pH of a sample is <7 it is acidic, $=7$ is neutral, >7 is basic.

Below table is the different samples of water that are collected and determined their pH values.

TYPES OF WATER	PH LEVEL
Tap Water	7.5
Distilled Reverse Osmosis Water	5 to 7
Package drinking water	6.5 to 7.5
Bottled water with 5mg of salt	8 to 9

7.5 APPLICATIONS AND LIMITATIONS

- The air quality sensor is used to detect the amount of air pollution in the air as ppm levels.
- It is a combination of sensors and electronics to enable every citizen monitor and protect our environment.
- This data is processed by microcontroller to get the current air quality.
- Alert message on display to the user.
- Roadside pollution monitoring.
- Industrial perimeter monitoring.
- Site selection for reference monitoring stations.
- Wide detecting scope.
- Pollution levels in the drinking water can be measured
- Industrial effluents released into lakes can be determined.

LIMITATIONS:

- Only 3 sensors are used.
- Humidity should be less than 95%.
- Accurate measure of contaminating gases cannot be detected in ppm.

CHAPTER 8

CONCLUSION

8.1 CONCLUSION

- The system to monitor the air of environment using STM32 microcontroller.
- Different levels of pH as be measured and the water suitable drinking has been identified.
- Air pollutant have been measured and identified by these sensors MQ135, MQ6.
- Here, using the MQ135 or gas sensor gives the sense of different type of dangerous gases.
- The system can sound the alarm to alert the user when the air quality is detected in a hazardous condition pH sensor for water whether it is safe for drinking and for the daily purposes.
- We had tested the working of various sensors like MQ135, MQ6, pH Now we had to integrate the gas sensors and water quality sensors into a single working model with the inclusion of SMT32 Microcontroller.
- We had successfully calibrated the STM32 microcontroller and used it in the place of Arduino Uno as the development board and satisfied with its efficiency in giving the desired results that we expected.

8.2 RECOMMENDATIONS FOR FUTURE RESEARCH

There are several potential areas of future work for IOT Based smart watch with dust allergy detection sensor and water pollution sensor. Some of these include:

- **Sensor Fusion and Calibration:** Investigate methods for integrating

data from multiple sensors (dust allergy and water pollution) to provide more accurate and comprehensive environmental monitoring. This could involve sensor fusion techniques and calibration methods to ensure consistent and reliable measurements.

- **Miniaturization and Power Efficiency:** Explore ways to miniaturize the sensors while maintaining or improving their performance. Additionally, focus on enhancing power efficiency to prolong battery life, ensuring prolonged usability of the smartwatch without frequent recharging.
- **Real-Time Data Analysis:** Develop algorithms for real-time data analysis to provide timely notifications and alerts to users regarding changes in air quality (dust levels) and water pollution levels. This could involve machine learning approaches for pattern recognition and anomaly detection.
- **Personalized Health Insights:** Research methods to integrate sensor data with user health profiles to provide personalized insights and recommendations. For example, correlating allergy symptoms with environmental factors and providing personalized recommendations to minimize exposure.
- **Localization and Mapping:** Investigate techniques for localizing pollution sources and mapping environmental data to provide users with insights into pollution hotspots. This could involve leveraging GPS data and crowdsourced information for improved spatial awareness.
- **User Interface and Experience:** Conduct user studies to understand how individuals interact with the smartwatch and its accompanying app/interface. Use this feedback to design intuitive interfaces and features that enhance user experience and encourage sustained usage.
- **Long-Term Health Monitoring:** Explore the feasibility of using the smartwatch for long-term health monitoring, tracking trends in allergy symptoms and environmental exposure over time. This could provide valuable insights for both users and healthcare professionals.

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APPENDIX

A. SOURCE CODE

```
#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("NTU"));
    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);
}

```

B. SAMPLE SCREENSHOTS

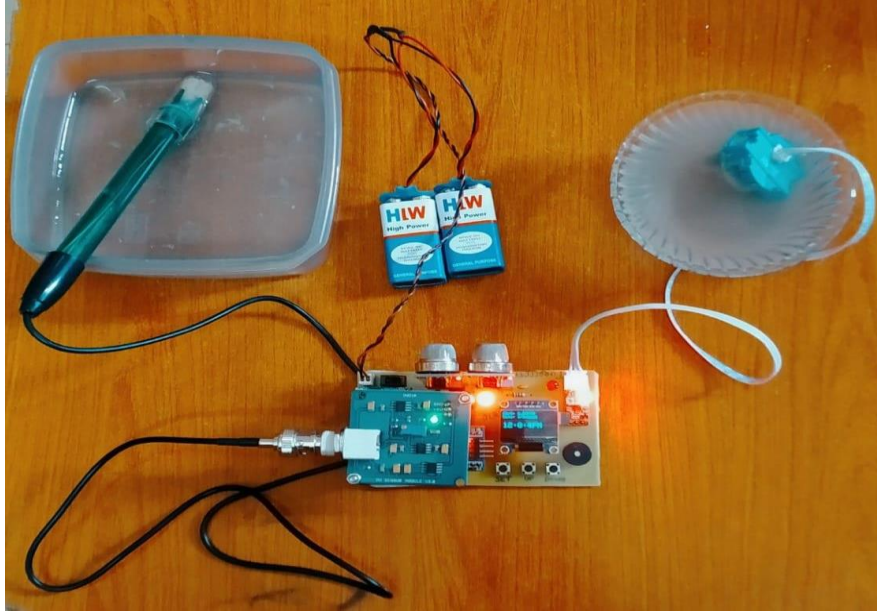


Fig B.1: Model Overview

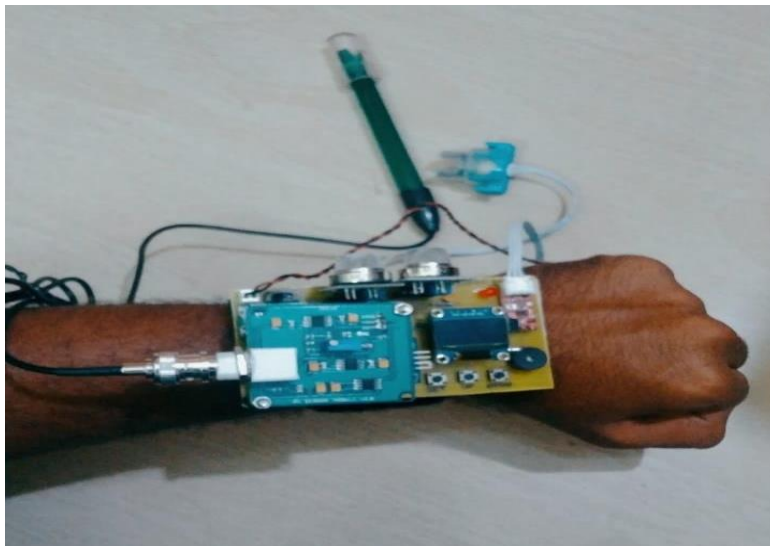


Fig B.2: Final Model



Fig B.3: Normal AQI Level – no alert

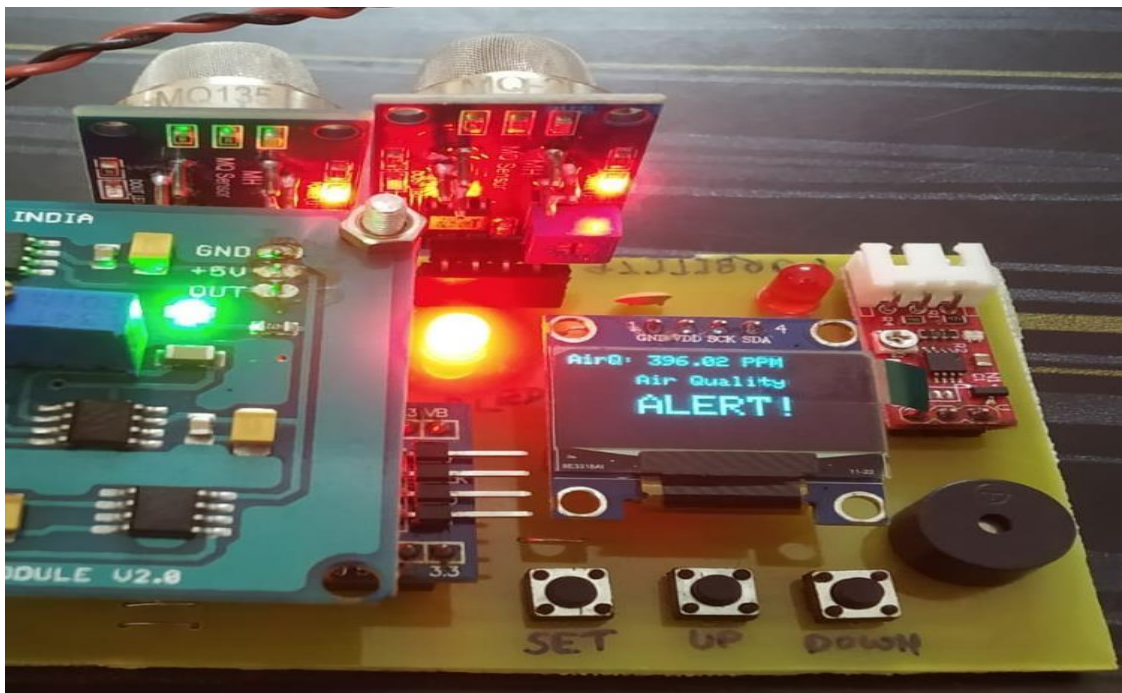


Fig B.4: Alert When exceeds the limit

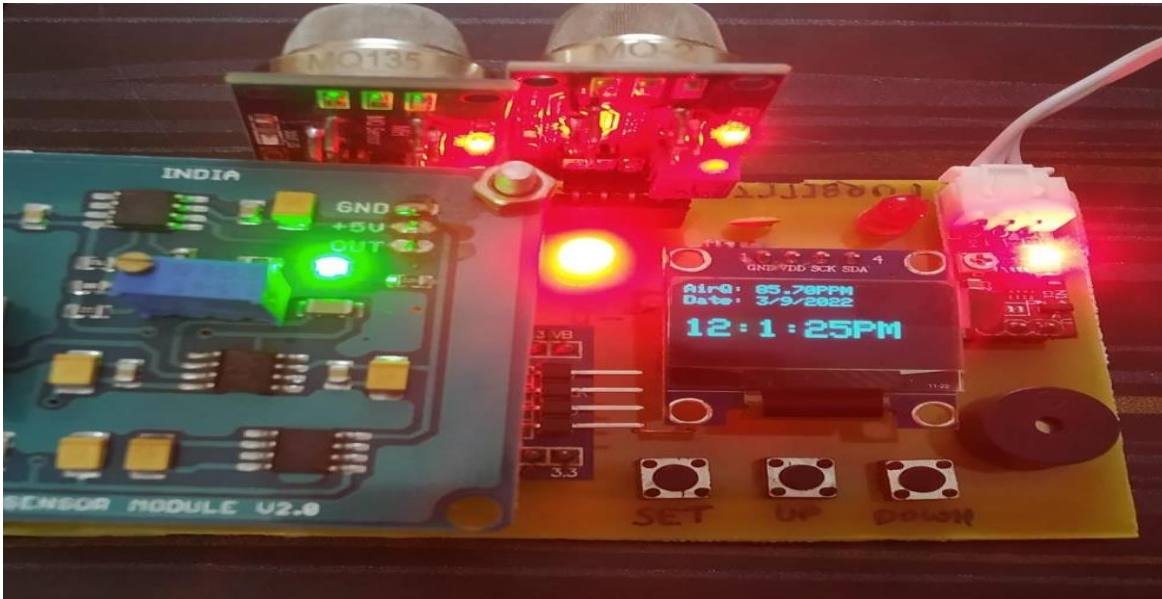


Fig B.5: Low AQI Level – no alert

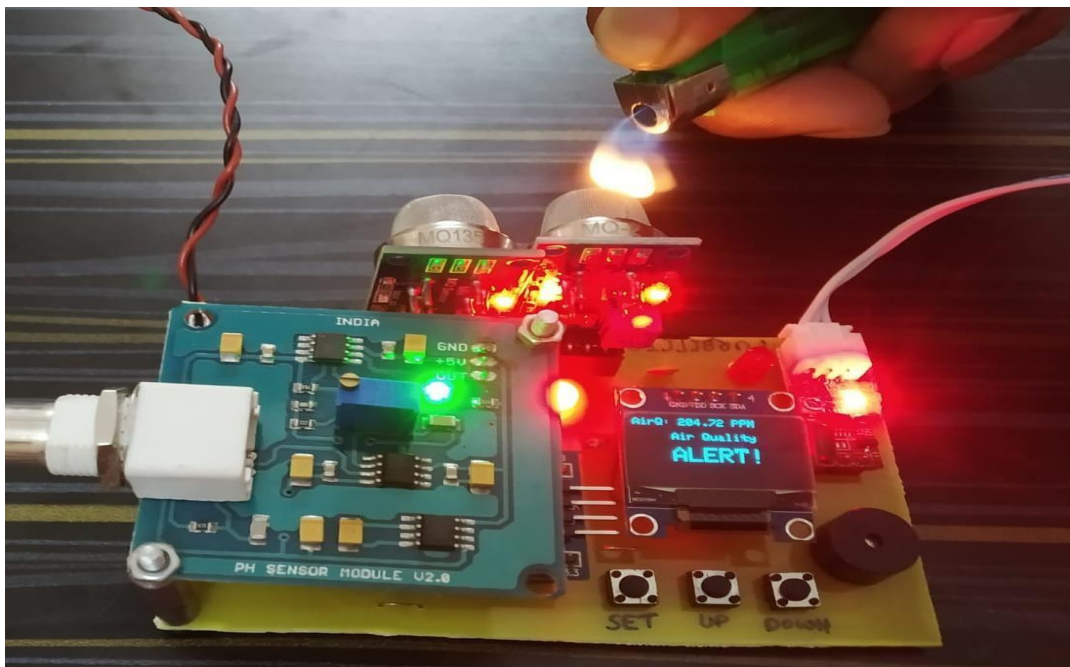


Fig B.6: Petrol – Fire alert



Fig B.7: Pure Water - No Turbidity

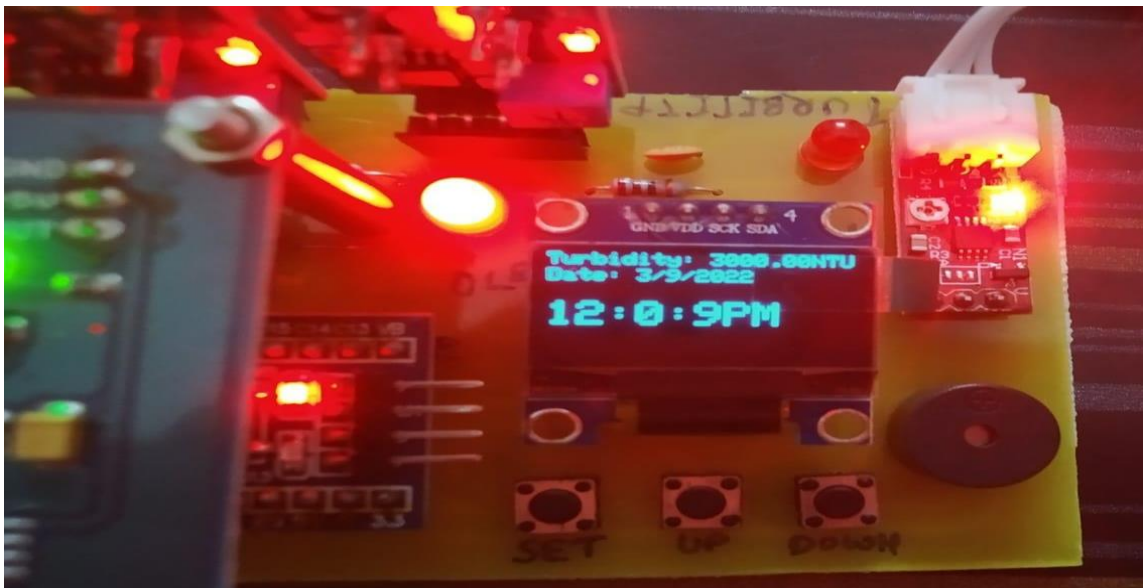


Fig B.8: Indication of Turbidity



Fig B.9: PH of water with salt

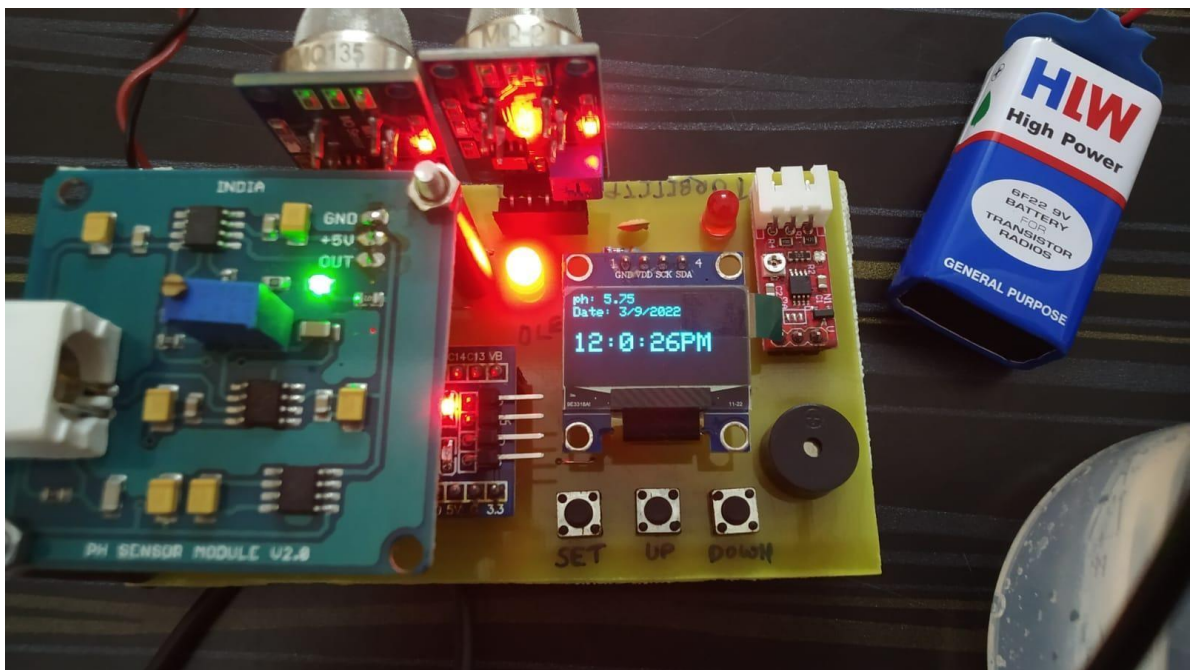


Fig B 10:PH Value of salt water

IOT BASED SMART WATCH WITH DUST ALLERGY DETECTION SENSOR AND WATER POLLUTION SENSOR

Prasema Femi Grace P W
Btech IT, Sathyabama Institute of
Science and Technology.
Chennai, India.
Mail ID: praseprabu02@gmail.com

V. Kirthiga
Btech IT, Sathyabama Institute of Science
and Technology.
Chennai, India.
MailID: aishubrown@gmail.com

Dr. A. Sathiyaraj M.E.,Ph.D.,
Btech IT, Sathyabama Institute of
Science and Technology.
Chennai, India.
Mail ID: sathiyaraj.a.it@sathyabama.ac.in

Abstract - This paper presents a novel solution in the field of the integration of a Smart Watch and the Internet of Things which paved the way for advanced functionalities beyond traditional fitness tracking. The paper presents the implementation of a smart watch equipped with innovative sensors for detecting dust allergies and water pollution. The proposed system aims to enhance user well-being by providing real-time environmental information relevant to health. In addition to dust allergy detection, the smart watch features a water pollution sensor capable of measuring key parameters indicative of water quality. This includes parameters such as pH levels, turbidity, and chemical composition. By utilizing this sensor, users can assess the quality of water sources in their vicinity, empowering them to make informed decisions regarding water consumption and potential health risks. This research contributes to the growing field of IoT-enabled health monitoring devices, addressing not only personal well-being but also fostering environmental awareness. The integration of dust allergy detection and water pollution sensing capabilities in a smart watch offers a holistic approach to health management, promoting a healthier lifestyle in an increasingly interconnected world.

Keywords: IOT, PH Sensor, MQ135, Turbidity sensor, IN4007, Capacitors, Resistors, Efficiency.

I. INTRODUCTION

Air and Water pollution is the major cause for global warming. The first step in preventing pollution is being able to identify it. People need to know exactly what amount of pollution they are in order to respond correctly. In our modern age of smart watches, we have devices to trace our personal health and fitness, but what about the health of the environment? Future generations' and everyone's well-being will suffer if environmental health continues to deteriorate.

Thus, in addition to telling the time, we are creating a smart watch that analyses pollutants in the air and water. As a result, anyone may now check pollution levels anywhere at any time without the need for specialised equipment. An STM32 controller, in conjunction with a gas sensor, the air quality sensor, pH sensor, turbidity sensor, small display, powers this battery-operated wristwatch system. With the help of sensors and technology, any person may monitor and safeguard our environment with a smart watch.

The particulate matter of air pollution in the atmosphere is measured by the air quality sensor. After processing this data, the micro controller calculates the current air quality. The watch also looks out for any flammable gases around in

order to use a flammable gas sensor to detect any hazardous gas leaks.

This sensor is constantly monitored by the controller. Thanks to pH sensors, it is now possible to assess the pH level of any type of water. The user merely needs to immerse the pH sensor on the smart watch to determine the pH level. Prior to being displayed on the display module, the sensor data is processed by the controller.

Similarly, a turbidity sensor is attached to the smart watch. The sensor sends the water turbidity value to the controller, which is shown on the display. Turbidity and pH may be used to depict the water quality of any body of water (lake, pond, canal, sea). The wristwatch allows users to set the high and low acceptable by push button. The water turbidity. The user receives a warning message on the display and hears a buzzer alert if any of the scanned values are found to be greater or lower than the predetermined limits.

Overall, the importance of the SHA256 hashing algorithm in the larger blockchain ecosystem is demonstrated by the Blockchain Mining and Hashing prototype. It is a pillar of data integrity and security due to its resilience to attacks. The prototype demonstrates the core ideas of blockchain technology by fusing hashing and mining, guaranteeing the decentralized, transparent, and unchangeable character of the blockchain network. It is an effective tool for companies and sectors looking to make use of blockchain technology while protecting their information against manipulation and unwanted access.

II. RELATED WORKS

1] In the study by Jayendra Kumar, Paidi Raja Ramesh, for IoT networks, an optimised affordable, environment friendly smart security system with information stamping is presented [1]. The authors proposed an inexpensive, environment friendly smart security system for CCTV that integrates with additional node in the network. Passive infrared (PIR) sensors detect motion, and only then do camera and other security sensor nodes in the network activate. Image processing algorithms on the Python

platform are then used to stamp the acquired video, information (sensor data) on the image.

2] Smart Sensors: Deepti Sehrawat, Nasib Singh Gillet al. conducted an analysis of several IoT sensor types [2]. This article describes several sensors based IoT applications and showcases a number of IoT sensors. This article also clarifies which IoT application needs which kind of sensor after examining several sensor applications. This work will provide the framework for more research in the field in the future.

3] IOT-Aided Charity: An Excess Food Redistribution Framework by Seng W. Loke, Arkady Z., and Seng W. This study offers an IOT-based context-aware framework that can perform real-time matchmaking based on collected data and capture changing requirements of suppliers and customers in real-time.

4] Dough Garg and Mayank Deve's "Securing IoT Devices and Securely Connecting the Dots Using REST API and Middleware." Describe the use of REST API in IOT systems and some of the early ideas behind the technology that allows the Internet of Things to count and record everything. We also emphasise the idea of middleware, which serves as a bridge between these gadgets and the cloud. The emergence of new cloud based IoT applications has resulted in fresh risks to data security and privacy.

5] Energy-efficient Sensors for the Industrial Internet of Things (IIoT) in Data Centres by Williams Dong-Seong Kim and Paul Nwadiugwu [5]. With a focus on energy consumption and management, throughput dependability, sensor stability, and embedded security features, this study has also demonstrated how they are categorised differently from what is needed by consumer sectors.

6] Shu long Wang, Yebin Hou, Fang Gao, and Xintong Ji provided a unique IOT access architecture for a vehicle monitoring system [6]. They suggest a unique IoT access architecture built on field programmable gate array (FPGA), which may offer uniform interface to the Internet of Things for a range of high- and low-speed devices with related extendibility and configurability.

7] Soon-Ju Kang, Cheol Sik Pyo, Dong-Hwan Park, and HyoChan Bang's semantic open Internet of things service platform technology [7]. This article's primary focus is in the ways that technologies provide better interoperability across IoT devices and facilitate their easy

use. Semantic interoperability of IoT devices and semantic-based IoT information services are provided by the suggested platform technology.

8] IOT Based Smart Waste Management System: India prospective by Rishabh Kumar Singhvi, Roshan Lal Lohar, Ashok Kumar [8]. They put in place an Internet of Things (IoT)-based system that may notify corporations about the debris bins' degree of toxicity and overflow. In order to oversee the information about the trash cans, a webpage is also being created. Information on the dustbin's state is updated on the internet and a message is delivered to the mobile device via a GSM module.

III. EXISTING SYSTEM

The existing system is an innovative and technologically advanced smart watch that incorporates Internet of Things (IoT) capabilities and is specifically designed to monitor and provide real-time information about two critical environmental aspects: dust particle concentrations for allergy detection and water pollution levels. This smart watch is equipped with integrated sensors that enable it to collect data from the surrounding environment, allowing users to stay informed about potential health hazards and environmental conditions.

The smart watch features a dust allergy detection sensor designed to measure airborne particulate matter. This sensor is capable of identifying and categorizing dust particles based on size and concentration. It utilizes advanced technology to ensure accurate readings, enabling users to receive timely notifications when the dust levels exceed predefined thresholds. The integration of this sensor aims to empower individuals, particularly those with respiratory conditions or allergies, to make informed decisions about their activities and minimize exposure to airborne irritants.

Additionally, the smart watch incorporates a water pollution detection sensor capable of monitoring various water quality parameters. This sensor provides real-time information about the quality of nearby water sources, categorizing them into

safe, moderate, or polluted conditions. The water pollution sensor is designed to detect levels of heavy metals, pH, and dissolved oxygen, contributing to a comprehensive assessment of water quality. This feature is valuable for users who are concerned about the safety of water sources for drinking, recreational activities, or other purposes.

Efforts have been made to optimize the smart watch for efficient power consumption, ensuring prolonged battery life while maintaining continuous monitoring capabilities. The device is designed to seamlessly connect with smartphones or other devices, allowing users to access more detailed information or historical data through dedicated applications. This connectivity enhances the overall user experience and enables a more comprehensive understanding of environmental trends.

In summary, the existing IoT-based smart watch with dust allergy detection sensor and water pollution sensor represents a significant advancement in wearable technology. By combining environmental monitoring capabilities with a userfriendly interface, this smart watch addresses the growing need for real-time information on air and water quality, ultimately contributing to individual well-being and environmental awareness.

IV. PROPOSED SYSTEM

The proposed system revolves around the development and integration of an Internet of Things (IoT) based smart watch, designed to address environmental concerns through the incorporation of advanced sensors. Specifically, the smart watch features a dual-sensor system for dust allergy detection and water pollution monitoring. This innovative wearable aims to empower users with real-time environmental data, enhancing their health awareness and facilitating informed decision-making.

The dust allergy detection sensor employs advanced technology to capture and analyze airborne particulate matter. This includes particles of varying sizes, ensuring a comprehensive assessment of the ambient air quality. The sensor's real-time capabilities enable it to categorize dust levels and trigger timely alerts to the smart watch wearer when concentrations surpass predetermined thresholds. This functionality is especially valuable for individuals with

respiratory conditions, providing them with the opportunity to proactively mitigate exposure and protect their health.

The water pollution sensor is designed to assess the quality of water sources in real-time. It analyzes key parameters such as heavy metal concentrations, pH levels, and dissolved oxygen content. The data obtained from the sensor is processed to categorize water quality into safe, moderate, or polluted conditions. Users receive immediate notifications on their smart watch, allowing them to make informed decisions about engaging with water bodies. This feature is particularly relevant for outdoor enthusiasts, ensuring they can enjoy recreational activities without compromising their health.

The proposed IoT-based smart watch with dust allergy detection and water pollution sensors represents a significant advancement in wearable technology. By combining environmental monitoring capabilities with the convenience of a smart watch, this system empowers users to take control of their health and make informed choices in response to changing environmental conditions. The integration of cutting-edge sensors, data processing algorithms, and a userfriendly interface positions this smart watch as a valuable tool for individuals seeking to balance their outdoor activities with health-conscious decision-making.

V. SYSTEM ARCHITECTURE

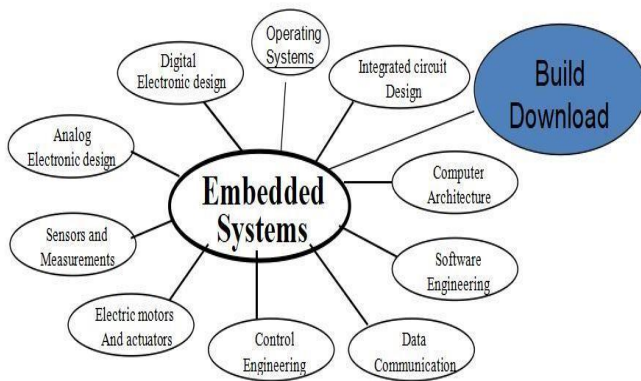


Fig. 1. System Architecture

VI. METHODOLOGY

Innovative solutions in environmental and health monitoring have been made possible by the incorporation of Internet of Things (IoT) technology into wearable devices. The goal of this project is to create and test a smart watch that can identify dust allergies and water pollution using sensors, giving people access to real-time environmental information.

Module 1: A combination of computer hardware, software, as well as additional mechanical or other components designed to do a certain task is called an embedded system. An embedded system is a software-driven, reliable, real-time control system that can function alone or in combination with people or network in a range of physical environments and in competitive, economical situations.

An embedded system is neither a typical commercial or scientific application, UNIX software system nor a computer system principally used for processing superior and inferior embedded systems. High-end embedded systems frequently use controllers and operating systems that are 32- or 64-bit. PDAs and cell phones are such examples. Lower end embedded systems: These usually use purpose-built hardware and 8,16-bit controllers with a simple operating system. Microwave ovens and washing machines are two examples of tiny controllers and embedded devices that we use on a regular basis.

A battery is a device that directly converts chemical energy into electrical energy. Each of the several voltaic cells that make up this structure is connected in series by an electrolyte that contains both cations and anions. Cations, or positively charged ions, travel to the anode, or negative electrode, and the cathode, or positive electrode. In one half-cell, the electrolyte and anions negatively charged ions move towards the anode, or negative electrode. The redox process that drives the battery involves anions being oxidised (electrons being extracted) at the anode and cations being reduced (electrons being added) at the cathode. The electrodes are not in touch with one another; instead, the electrolyte links them electrically. Some cells use two half-cells.

Rectification is the process by which an electrical device called a rectifier change direct current (DC), which travels in a single direction, to alternating current (AC), which sporadically changes direction. Rectifiers are employed in many different applications, including power supply components and radio signal detectors. Rectifiers contain mercury arc valves, solid-state diodes, vacuum tube diodes, and other components. The rectifier gets the transformer's output. It changes AC power into DC power. There are 2

types of rectifiers: full wave and half wave. Because of its complete wave rectification and outstanding stability, a bridge rectifier is chosen for the project.

In this project, a filter capacitor is utilised. FC minimises the D.C. and removes output ripples from the rectifier. The filter's output stays constant as long as the mains voltage and load are maintained at the same levels. The D.C. voltage received at this moment, however, alters if one of the two is changed. As a result, the output stage applies a regulator. The most fundamental kind of power supply filter is the basic capacitor filter. There is relatively little usage for this filter. On related electron tubes and cathode-ray which needs very little load current from the source, it his occasionally utilised on very high voltage, low current power supplies. In zcircuits, where the power-supply ripple frequency is not significant this filter may also be utilised considerably.

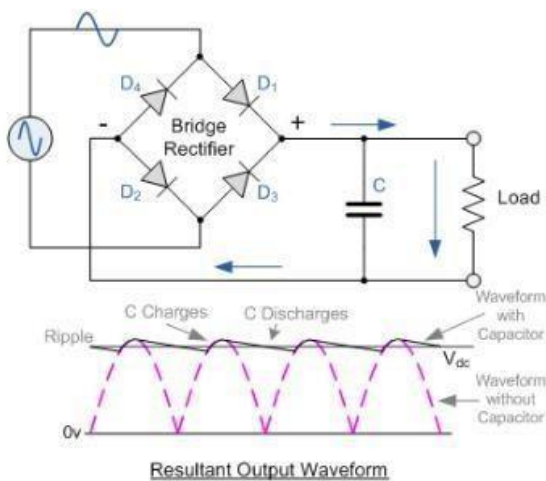


Fig 2. Output waveform

Module 2: This project makes use of turbidity sensors. It computes the amount of light scattered by suspended particulates in the water. The amount of total suspended solids (TSS) in the water increases its turbidity level as well as its cloudiness or haziness. Turbidity probes work by shining a laser beam into the water to be tested. After that, any suspended particles will scatter this light. When a light detector is placed at 90-degree angle to the light source, it detects the amount of light that is reflected back to it

An air quality sensor called the MQ135 Gas Sensor can identify a variety of gases, such as NH_3 , CO_2 , NO_x , benzene, alcohol, and smoke. Perfect for usage in a factory or office.

The MQ135 gas sensor is extremely sensitive to fumes, other dangerous gases, ammonia, sulphur, and benzene steam. MQ135 Air Quality sensor is used in this project.

Ammonia, smoke, nitrogen oxide, CO_2 , and other hazardous pollutants are all detected by the air quality sensor. The air quality sensor has a tiny potentiometer that lets you change the load resistance of the sensor circuit. The 5V source powers the air quality sensor. An infrared diode emits infrared light into the medium. The receiver finds the irradiation light that is reflected by the media's particles (backscatter principle). Based on the received signal, the electronics determine the media's relative turbidity.

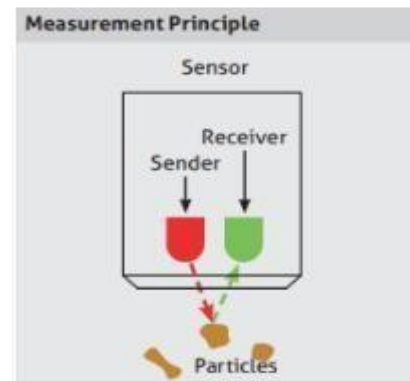


Fig.3. Measuring principle of relative turbidity meter

The MQ-2 Flammable sensor is used in this project. The MQ9 sensor can detect combustible gases including carbon monoxide. It has a detection range of 10 to 1000 PPM for carbon monoxide and 100 to 10000 PPM for combustible gases. A pH sensor, which has a value between 0 and 14, is useful for determining how acidic or alkaline the water is. The pH decreases below seven, at which point the water becomes more acidic. A value of seven or above denotes an alkaline condition. Different pH sensors use different techniques to measure the purity of water.

Many sectors, including chemicals, food and beverage, power plants, oil and gas, water and wastewater, and pharmaceuticals, employ pH sensors and transmitters. The application determines which sensor to use. Select the reference system and diaphragm for the glass sensor based on your requirements. When acids are dissolved in water, hydrogen ions (H^+) with a positive charge are formed. The

stronger the acid, the higher the concentration of hydrogen ions. Diodes can be used as full wave or half wave rectifiers to convert AC power into DC.

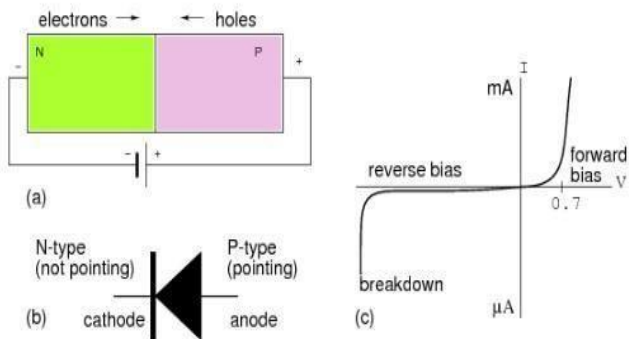


Fig 4. PN Junction diode

A resistor is a passive electronic component with two terminals that is used to implement electrical resistance in a circuit. A resistor will conduct a current I that is directly proportional to the voltage V that is put across its terminals. A dielectric separates the two conductors of a passive electrical component known as a capacitor or condenser. When there is a voltage potential difference between the conductors, the dielectric material contains an electric field. This field stores energy and produces a mechanical force between the plates. Broad, flat, parallel, and closely spaced conductors have the biggest effect on each other.

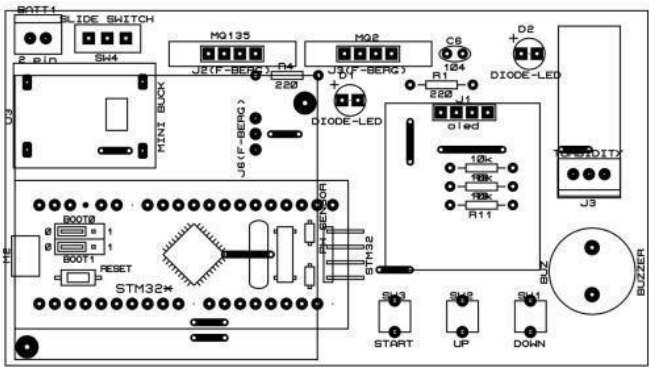


Fig 5. Circuit Diagram

A continuity test in electronics verifies that an electric circuit is indeed complete by seeing if current flows across it. To conduct a continuity test, a modest voltage is applied across the selected line connected in series with a piezoelectric speaker or other LED or noise-producing device. If there is something preventing electrons from passing through the circuit—such as broken wires, damaged components, or excessive resistance—the circuit is said to be "open". Among the instruments that may be used to do continuity checks are multimeters, which measure current, and specialist continuity testers, which are more affordable and straightforward gadgets that frequently contain a basic lightbulb that glows when current flows. A continuity test is carried out as soon as the hardware setup and soldering are finished. The purpose of this test is to determine whether the circuit has any electrically accessible paths after soldering. Poor soldering, irresponsible PCB handling, improper soldering iron use, component failures, and circuit design defects are often requiring inspection. You will hear a buzzer if there is more action.

Module 3: Next, we connect the power supply circuit to this voltage. Please take note that we are not using a microcontroller for this test since any high voltage might damage the controller. We verify that the voltage regulator is receiving an input of 12 volts and an output of 5 volts. The 40th pin of the microcontroller receives this 5-volt output. As a result, we examine the voltage level at pin 40. In a similar manner, we verify the necessary voltage at the other terminals. We can guarantee that the voltage at each terminal follows the necessary levels in this way.

STM32 BOOTLOADER

Following are the steps to bootloader STM32 in the manner –
1. Connect the ST-Link connector in the below manner.

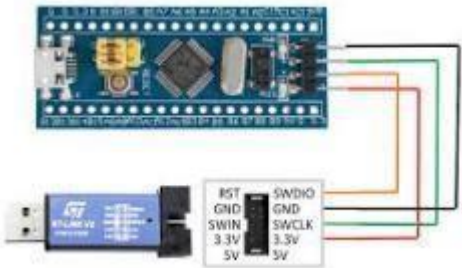


Fig 6. STM32 Bootloader

2. Open the STM32 ST-Link Utility Software, Load the generic. In file and go to Target option in the Menu toolbar, click on the program and verify for the successfully boot loading.
3. Upload the program in the STM32 using Arduino IDE.

Electrical energy can be transferred between two or more circuits using a transformer, a static electrical device. One transformer coil's fluctuating current causes a fluctuating magnetic flux, which in turn causes a second coil coiled around the same core to experience a fluctuating electromotive force, or "voltage." An external power supply that resembles an AC plug is called an AC adapter, AC/DC converter. Other names for this type of device are power brick, wall wart, plug pack, plug-in adapter, adapter block, domestic mains adapter and line power adapter.

A printed circuit board (PCB) is a device that uses conductive tracks, pads, and other features carved from one or more copper sheet layers bonded onto and/or between sheet layers of a non-conductive substrate to physically support and electrically link electronic or electrical components. In order to mechanically and electrically attach components to the PCB, they are often soldered onto it. The multi-sensor system included into the smart watch comprised dust particle and water quality sensors to identify airborne particulate matter and contaminants, respectively. In order to give the user accurate and timely information, the data gathered by these sensors were analysed using machine learning algorithms after being transferred over Bluetooth to a centralised server.

In summary, this module is a crucial steppingstone in our journey towards a fully operational IoT system, where the principles of electricity, sensor network, and immutability come together to revolutionize various industries and redefine the way we live every day.

VII. RESULT AND DISCUSSION

1.1 The water pollution detection sensor successfully identified various water quality parameters, including levels of heavy metals, pH, and dissolved oxygen. The smart watch displayed real-time water quality information, categorizing it into safe, moderate, or polluted conditions. The accuracy of the water pollution detection system was validated through

laboratory testing and comparison with standard water quality measurement techniques, demonstrating a high level of precision.

1.2 The dust allergy detection sensor effectively measured airborne particulate matter, categorizing it based on size and concentration. Users received notifications when dust levels exceeded predefined thresholds, allowing them to take necessary precautions. The sensor's accuracy was verified through field tests in diverse environmental conditions, showing reliable performance in detecting dust particles associated with respiratory allergies.

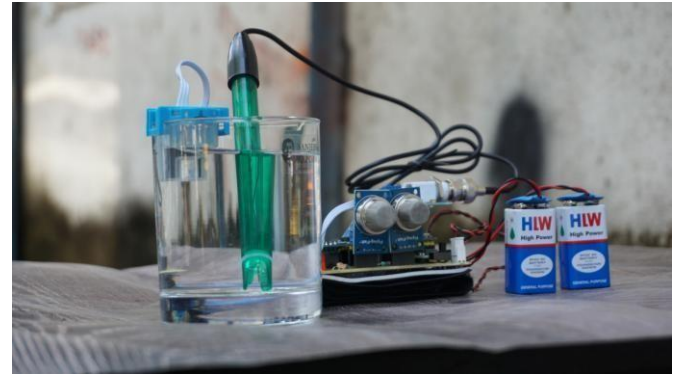


Fig 7. Project output

2.1 The integration of water pollution and dust allergy sensors into a wearable device enhances users' awareness of their environmental conditions. Real-time monitoring empowers individuals to make informed decisions about outdoor activities, ensuring their well-being and minimizing exposure to potential health hazards.

2.2 The dust allergy detection sensor plays a crucial role in protecting individuals with respiratory conditions by providing timely alerts to avoid environments with high dust concentrations. This feature is particularly beneficial for individuals prone to allergies, asthma, or other respiratory issues.

2.3 The study's results indicate a high level of accuracy and reliability in both water pollution and dust allergy detection. The machine learning algorithms employed in data processing contribute to minimizing false positives and negatives, ensuring that users can trust the information provided by the smart watch.

The IoT-based smart watch with water pollution and dust allergy detection sensors demonstrates promising results in providing users with real-time information about their surroundings. This technology holds great potential in contributing to both individual health and environmental awareness, laying the foundation for a more sustainable and health-conscious future.

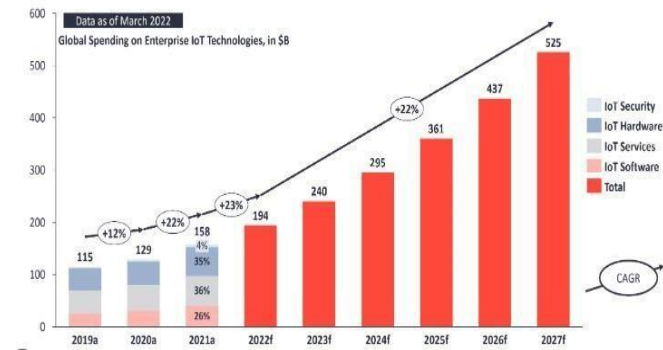


Fig.8. .IoT market 2019 - 2027

Future iterations of the smart watch could explore additional environmental sensors for a more comprehensive monitoring system. Integration with a mobile application could offer personalized health recommendations based on the collected data, creating a holistic approach to health and environmental awareness.

VIII. CONCLUSION

In conclusion, The IoT-based smart watch with water pollution and dust allergy detection sensors demonstrates promising results in providing users with real-time information about their surroundings. This technology holds great potential in contributing to both individual health and environmental awareness, laying the foundation for a more sustainable and health-conscious future. In conclusion, the development and evaluation of the IoT based smart watch with dust allergy detection and water pollution sensors have yielded promising results, demonstrating the potential of this innovative technology in addressing both individual health concerns and environmental monitoring. The multifaceted capabilities of the smart watch provide users with real-time information about their surroundings, empowering them to make informed decisions for their well-being.

The dust allergy detection sensor showcased its efficacy in identifying airborne particulate matter, categorizing it based on size and concentration. This functionality is especially crucial for individuals with respiratory conditions, such as allergies or asthma, as it enables them to receive timely alerts and take precautionary measures when entering environments with elevated dust levels. The accuracy and reliability of the sensor were validated through rigorous field tests, ensuring that users can trust the information provided for their health and safety.

Similarly, the water pollution sensor exhibited robust performance in detecting various water quality parameters, including heavy metals, pH, and dissolved oxygen. The realtime display of water quality conditions on the smart watch, categorized into safe, moderate, or polluted states, enables users to assess the environmental conditions around them. Laboratory validation and comparison with established water quality measurement techniques confirmed the precision of the sensor, providing users with a reliable tool for assessing the safety of water sources in their vicinity.

The successful integration of these sensors into a wearable device opens new possibilities for environmental monitoring on a personal scale. Users are now equipped with a comprehensive tool that not only safeguards their health by alerting them to potential allergens but also raises awareness about the quality of the water they may encounter. This dual functionality contributes to a more holistic approach to health and environmental consciousness.

As we move forward, future developments in this technology could explore additional environmental sensors to enhance the smart watch's capabilities. Integration with machine learning algorithms and artificial intelligence could further refine the data processing mechanisms, improving the accuracy of detection and providing users with more personalized insights. Additionally, the incorporation of a mobile application could extend the functionality, offering users a centralized platform for accessing historical data, personalized health recommendations, and community-based environmental insights.

In conclusion, the IoT-based smart watch with dust allergy detection and water pollution sensors represents a significant step towards a more sustainable and health-conscious future. By combining cutting-edge sensor technology with the convenience of wearable devices, this innovation contributes to individual well-being while fostering a greater sense of environmental awareness and responsibility.

IX. FUTURE WORK

Future work on the IoT based wearable devices will be in advancing sensor integration. Explore the integration of additional sensors to enhance the smart watch's capabilities. Consider incorporating sensors for detecting other environmental pollutants, such as air quality sensors for monitoring gases like nitrogen dioxide, carbon monoxide, and volatile organic compounds. This expansion would provide users with a more comprehensive understanding of their surroundings.

Additionally, developing a dedicated mobile application that pairs with the smart watch to offer a user-friendly interface for data visualization and analysis. The application can provide historical trends, personalized health recommendations, and notifications based on real time sensor data. This integration enhances the user experience and promotes a more interactive and informative platform.

Moreover, Incorporate GIS technology to map and visualize pollution levels in specific geographical areas. This feature would enable users to make informed decisions about their routes, outdoor activities, and travel plans based on real time environmental data. GIS integration could also provide a broader perspective on pollution patterns and hotspots. Develop algorithms to correlate environmental data with individual health patterns. By collecting and analysing users' health data, such as respiratory patterns, heart rate, and allergy symptoms, the smart watch can provide personalized insights into how environmental factors may be impacting an individual's well-being. This could lead to more targeted health recommendations and proactive measures.

Implementing machine learning algorithms for predictive analysis based on historical data. By identifying patterns and trends in environmental pollution and allergy triggers, the smart watch can anticipate potential issues and provide proactive recommendations to users. This predictive capability enhances the device's utility as a preventive health tool.

The overarching aim of future endeavours is to Encourage users to contribute feedback on the accuracy of sensor readings through a crowd sourced validation system. This feedback loop can help improve the precision of the sensors over time by continuously updating and calibrating the algorithms based on user-reported experiences. Integrate

sustainability-focused features, such as a carbon footprint calculator or water usage monitor, to encourage environmentally conscious behaviour. This expansion aligns with a broader trend towards promoting sustainability and encourages users to make lifestyle choices that benefit both personal health and the environment. Work towards aligning the smart watch's environmental sensing capabilities with existing environmental standards and regulations. This ensures that the data collected by the device is not only accurate but also compliant with established norms, fostering trust among users and regulatory bodies.

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