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Air and Water Quality Indexing and Environment Monitoring

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Abstract: *The current state of the environment continues to be a pressing global matter resulting from various human activities that release harmful substances posing a threat to living beings. To combat this issue advancements in technology have paved the way for the creation of an Internet of Things (IoT) based Water and Air Quality Monitoring System providing real-time data on environmental conditions. Through web and mobile applications individuals can easily access this system and view graphical representations of water and air quality readings. This innovative system involves sensor nodes strategically placed in different locations collecting field data and evaluating it against the set standards in India. For water monitoring sensors such as the Turbidity Sensor PH Sensor DHT 11 and TDS Sensor are utilized while for air quality the DHT11 sensor MQ-7 sensor and MQ-135 sensor play a crucial role. With this advanced monitoring system timely and accurate information on the state of the environment can be obtained aiding in taking necessary measures to combat pollution.*

Keywords: Real-time, sensor nodes, Internet of Things (IOT), Air and Water quality Detection, Central Server

I. INTRODUCTION

Environmental contamination is a widespread problem that currently plagues our planet. It is caused by various human actions that release pollutants commonly referred to as Man-made Contamination [1]. Pollution is defined as the introduction of harmful substances into the environment which can have adverse effects on humans and other living organisms [2]. The most prevalent forms of pollution particularly in industrial and densely populated areas are Water and Air contamination. Sadly, in India both the general public and the government are often unaware of the deteriorating quality of their surrounding water and air. This lack of awareness can lead to health issues exacerbated by the limited resources available for monitoring through Air Quality Monitoring Stations (AQMS) and water quality measurements conducted by Badan Lingkungan Hidup (BLH). However, with the utilization of modern technology such as the Internet of Things it is possible to address these problems. The Internet of Things is a novel concept that enables electronic devices and sensors to communicate through an internet connection with the aim of simplifying human life [3]. Through the development of a Water and Air Quality Monitoring System real-time monitoring of air and water quality in the surrounding environment can be achieved. Accessible through a website or mobile application this system can help the community and government take preventive measures to combat pollution and its detrimental effects. This monitoring system comprises multiple sensor nodes that provide data on various parameters used to determine water and air quality according to relevant standards in India. The classification of air quality is based on the Index Standard Pencemar Udara(ISPU)which is a numerical value that describes the ambient air quality in a specific location and its impact on human health aesthetic value and other living organisms [4]. Our research focuses on three primary pollutants to determine the ISPU value: Carbon Monoxide (CO) Nitrogen Dioxide (NO2) and Dust Particles (PM10). The classification of water quality in our study specifically looks into the suitability of drinking water and the necessity for Sanitary Hygiene. Drinking water is defined as processed water that meets health requirements and can be consumed directly [5]. Meanwhile Water for Sanitary Hygiene Purposes refers to water used in daily activities that may differ in quality from drinking water [6]. The parameters utilized to assess water quality include PH temperature turbidity and Total Dissolved Solids (TDS). To measure these parameters water quality sensor nodes are equipped with

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a Turbidity Sensor DS18B20 Sensor for temperature PH Sensor for acidity and TDS Sensor for dissolved solids. Additionally, air quality sensor nodes consist of a DHT11 Sensor for humidity and temperature MQ-7 Sensor for Carbon Monoxide levels MQ-135 Sensor for Nitrogen Dioxide levels and GP2Y1010AU0F Sensor for dust particles (PM10). Furthermore, this tool is equipped with an Arduino Uno microcontroller and a NEO-6M GPS sensor to determine the location of the sensor nodes. The data collected from the sensor nodes along with their location will be transmitted to the server through an internet connection accessed via ESP8266. This data will then be analysed and presented in a comprehensible format through the website or mobile application.

II. METHADOLOGY

The described functioning of the system involves connecting internet-enabled devices to areas designated for monitoring water and air quality. Once the tools are stable the data collected from the sensors will be transmitted to a server for processing and storage in a database. The processed data is then sorted according to ISPU standards Water Quality Standards (Sanitation) and Drinking Water Quality Requirements. This information can be viewed in real-time on a 16X2 LCD display and a mobile application. The Air and Water Quality Monitoring System utilizes two distinct modules specifically the water module and the air module. Each module is equipped with its own set of components allowing for mobility and the ability to measure water and air quality in varying locations. System overview is in figure1.

A. Water Module

The water system is comprised of multiple sensor units tasked with gathering field data on the factors that determine the quality of both water and air in accordance with established standards in Indonesia. These sensors include a Turbidity Sensor for measuring turbidity levels a DS18B20 sensor to monitor water temperature a DHT 11 sensor to measure air temperature a PH sensor for assessing acidity levels and a TDS (Total Dissolved Solid) sensor for tracking dissolved solids. All of these sensors are linked to an Arduino Uno microcontroller and an ESP-8266 serves as the means for connecting to the API and transmitting the data over the internet, this sensors connection and module you can see in figure 2.

B. Air Module

The air unit consists of various components including a DHT11 Sensor for assessing humidity and temperature an MQ-7 Sensor for detecting Carbon Monoxide levels an MQ-135 Sensor for measuring Nitrogen Dioxide (NO2) levels and a GP2Y1010AU0F Dust Sensor for identifying particles (PM10). Apart from the sensor nodes each module is furnished with an Arduino Uno microcontroller and a NEO-6M GPS sensor for marking the location. All data gathered by the sensor nodes along with their corresponding locations will be transmitted to the server through internet connectivity facilitated by ESP-8266. This sensors connection and module we can see in figure 3.

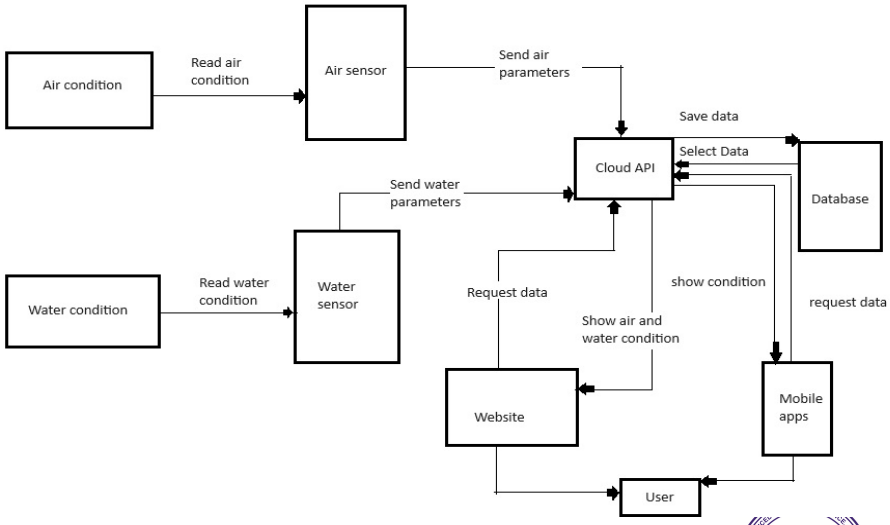

Figure 1: System overview

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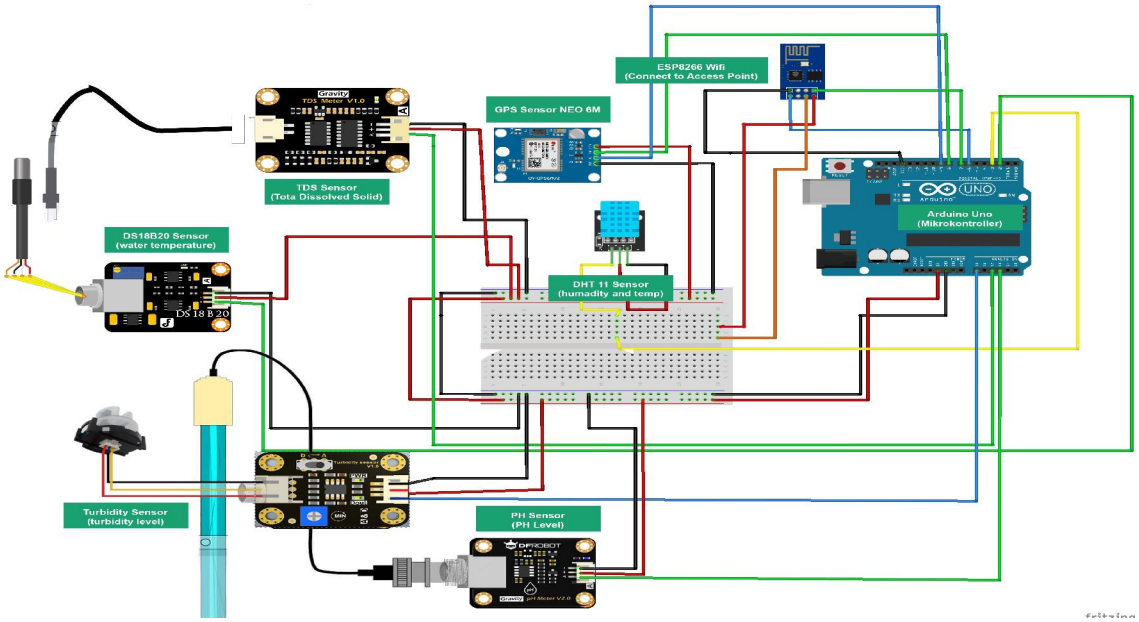

Figure 2: Design Hardware for water module

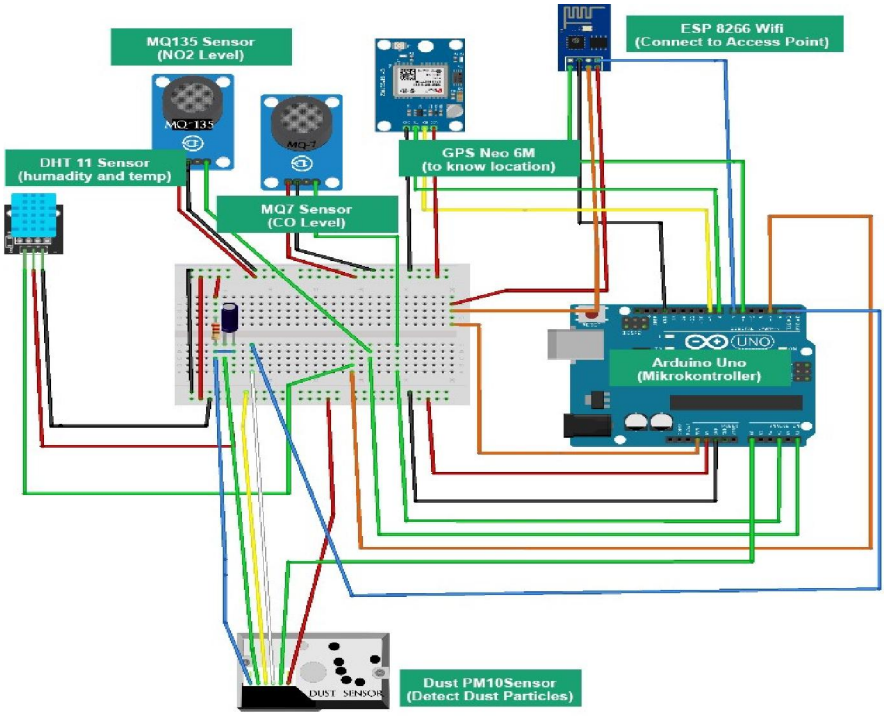

Figure 3: Design Hardware for Air module

III. PROBLEM IDENTIFICATION AND DEFINITION

Background: Environmental pollution, stemming from various human activities, poses significant threats to ecosystems and human health. The adverse impacts of pollutants on air and water quality necessitate effective monitoring systems for timely detection and mitigation.

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Problem Statement: Current environmental monitoring systems often face limitations in terms of real-time data acquisition, comprehensive parameter measurements, and automated classification. There is a need for an integrated approach to monitor both air and water quality, utilizing IoT technology, to address the following key challenges:

Water Quality Monitoring Challenges:

Inadequate Monitoring of Industrial Pollution:

- Problem: Existing water quality monitoring systems may not effectively track pollution from industrial activities in real-time.
- Consequence: Delayed detection of pollutants may lead to prolonged environmental damage and potential health risks for communities relying on water sources.
- Limited Parameter Measurements:
- Problem: Some monitoring systems may lack a comprehensive set of parameters, leading to an incomplete understanding of water quality.
- Consequence: Incomplete data may hinder accurate assessments of water quality, making it challenging to enforce relevant standards and regulations.

Manual Data Classification and Analysis:

- Problem: Systems relying on manual classification and analysis may be time-consuming and prone to errors.
- Consequence: Delayed response to water quality issues and potential inaccuracies in classification, impacting the reliability of information provided to stakeholders.
- Air Quality Monitoring Challenges:
- Inadequate Coverage in Unmonitored Areas:
- Problem: Certain regions may lack official air quality monitoring, leaving inhabitants unaware of potential health risks.
- Consequence: Lack of real-time air quality data can impede decision-making for both authorities and the public, leading to unaddressed pollution concerns.

Manual Classification of Air Quality:

- Problem: Systems requiring manual classification of air quality may be subject to delays and subjectivity.
- Consequence: Delayed response to deteriorating air quality conditions and potential discrepancies in classification, impacting public health and regulatory measures.
- Limited Spatial Analysis of Pollution Sources:
- Problem: Existing systems may lack spatial analysis capabilities, hindering the identification of specific sources of air pollution.
- Consequence: Inability to pinpoint pollution sources may impede targeted intervention strategies, leading to inefficient pollution management.

IV. RESULT AND DISCUSSION

This section discusses the implementation results of hardware, web, mobile applications you can observe in figure 4,5,6,7.

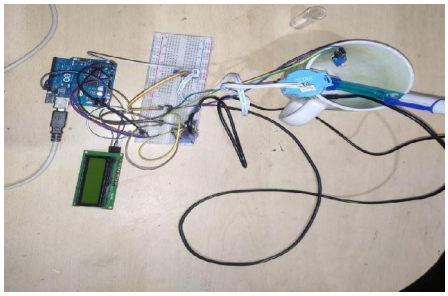

Figure 2: Overall view of the research work

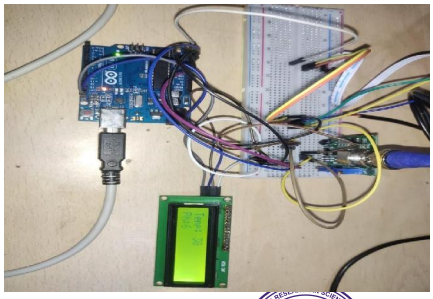

Figure 3: Working Module

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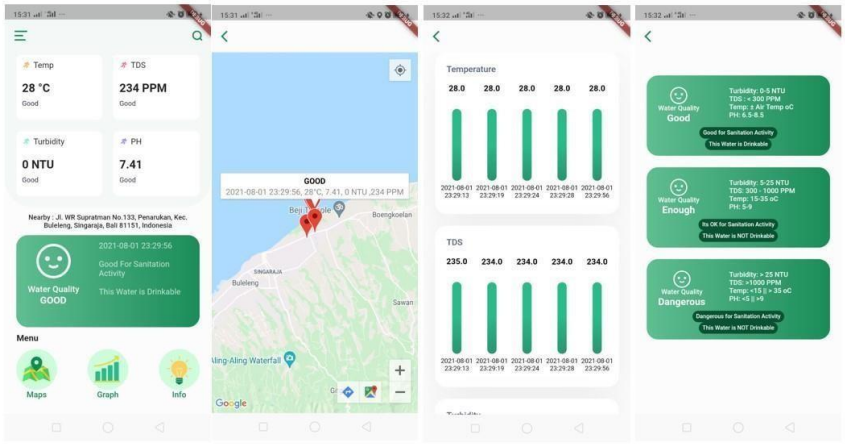

Figure 4: Mobile App for Water sensor

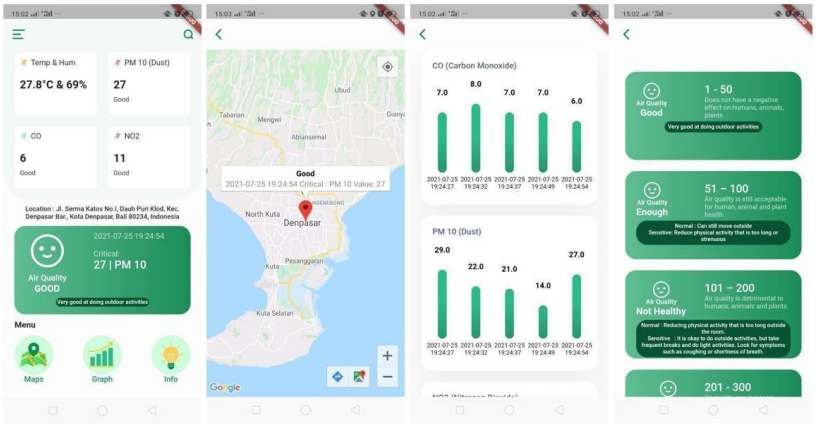

Figure 5: Mobile App for Air sensor

V. CONCLUSION

The creation of the Water and Atmosphere Quality Tracking Solution based on the Internet of Things (IoT) marks a substantial stride towards resolving issues of ecological contamination in Indonesia. The merging of cutting-edge detectors for water and air quality parameters coupled with instantaneous data collection and automated classification algorithms establishes a strong framework for uninterrupted monitoring. The incorporation of a Geographic Information System (GIS) enhances spatial interpretation allowing for strategic interventions in areas of concern. The platform's mobile interface offers easy-to-use and accessible channels for stakeholders to remain updated on environmental conditions. By leveraging IoT technology the system guarantees efficient data transmission and centralized storage facilitating prompt responses to instances of pollution. Moreover, the alerting system adds to the system's efficacy by promptly notifying relevant authorities and users in the event of any water or air quality violations.

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