

## Fungus Detection System

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### Abstract

*This project identifies fungal pathogens in wet soil with sensors and gives an instant result through an Android app. It helps farmers avoid crop loss, increase yield, and encourage eco-friendly farming practices by enabling early detection and evidence-based decision-making for soil health management. Soil condition is most important to agriculture and environmental health. Having fungus in pre-maturity soil analysis can prevent crop damage and increase the yield. This project seeks to develop an application that detects fungus on the ground using available sensors and delivers results through an Android application. The system utilizes a pH sensor and a moisture sensor to read soil data. This data is processed to establish fungal diseases. The results are presented on the Android application in a simple format to enable farmers and users to take action immediately. This is an affordable, time-efficient, and accessible option that is a worthwhile tool for improving farm production and promoting environmentally friendly farming. Soil health plays a crucial role in agriculture, directly impacting crop growth and yield quality. One of the main soil health hazards is fungal infection, which can damage plants, reduce productivity, and cause farmers economic issues. Traditional methods of diagnosing fungal infections in soil are typically lab-tested, costly, and time-consuming. In a bid to combat this issue, our project is set to design a device capable of detecting fungi using sensors to monitor soil conditions and provide instant feedback via an Android application. The system detects and measures corresponding parameters such as moisture levels, pH, temperature, and other variables. The collected data is processed using sensor technology and analytical techniques to determine whether the soil is infected with fungal disease. The results are presented in a simple manner on a mobile app, making it easy for farmers, gardeners, and scientists to respond rapidly and prevent or correct issues.*

**Keywords:** Fungal detection, soil health, waterlogging, sensor technology, IoT, android application, agriculture, crop protection, real-time monitoring, eco-friendly farming

### INTRODUCTION

One of the fundamental features of contemporary agriculture is preserving soil health for optimal crop development. Soil waterlogging provides a suitable habitat for fungal pathogens, which may greatly affect crop yields [1–3]. Early finding and verifying soil conditions are key Important in preventing fungal infections and reducing farm losses.

This project involves the development of Fungus Detection system utilizing sensor technology to detect waterlogged conditions and detect fungal pathogens in the soil. The system integrates real-time collecting and interpreting data, providing rapid results through a simple-to-use Android application [4]. This technology helps

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in taking immediate action, which helps farmers protect their crops and improve overall agricultural sustainability.

Prior to installing the ultimate system, it is critical to provide the accuracy and efficacy of the sensor-based detection technique. The project follows a systematic approach, considering various processes such as sensor calibration and data processing, and mobile app integration for seamless user experience [5].

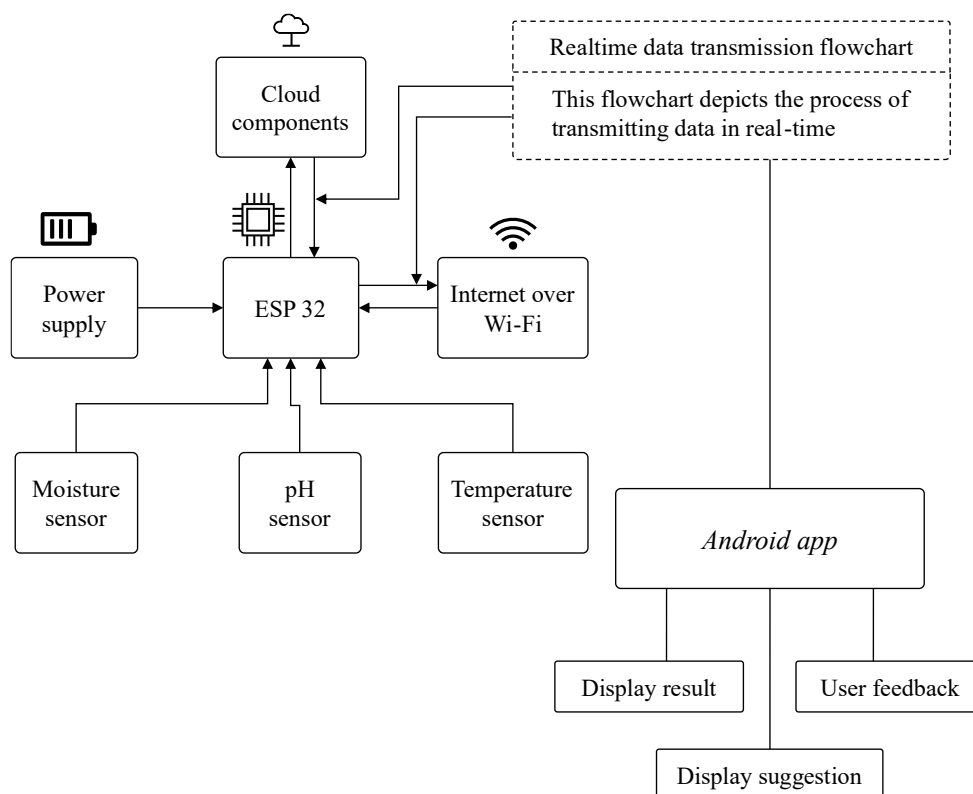
## LITERATURE REVIEW

The first study, titled “Soil moisture as a factor affecting the microbiological and biochemical activity in soil”, was authored by Borowik and Wyzkowska published in February 2016 [6]. Soil moisture plays a critical role in influencing microbiological and biochemical activity within soils, as it directly impacts the availability of water to microorganisms and the chemical processes that occur in the soil [2]. The findings show that the effects of water and soil quality on crop yield involves careful planning to ensure that the data collected is valid and reliable [3, 7].

The second study, titled “Experimental studies on effect of water and soil quality on crop Yield”, was authored by K. R. Suresh and published in 2015. To study the effect of water and soil quality on crop yield, you need a well-structured methodology that ensures reliable and valid results [3, 8]. The findings reveal complex interactions between these factors, significantly influencing agricultural productivity [4].

## PROPOSED SYSTEM

The system we propose utilizes several sensors to scan soil conditions and identify fungal pathogens. These include a moisture sensor to measure how wet the soil is, a pH sensor to measure the pH, and a temperature sensor to measure how hot or cold the soil is [2]. All of these are important to identify conditions to encourage fungi to grow, as there are specific moisture, pH, and temperatures that encourage the growth of fungi [2, 9]. Figure 1 shows the proposed system architecture for real-time soil data monitoring.



**Figure 1.** Proposed system architecture for real-time soil data monitoring.

The sensors gather data that is processed by an ESP32 microcontroller, the system's core component. The ESP32 receives raw data from the sensors, processes and structures it, and gets ready to send it in real-time. This allows the information to be analysed correctly before it can be reused [4].

The processed data is transmitted instantly using Wi-Fi. The app sends the data through the internet for storage and analysis in cloud storage or to an Android app to provide instant feedback. Cloud entities are crucial for safely storing data and performing in-depth analysis, which will subsequently be used for monitoring soil health trends.

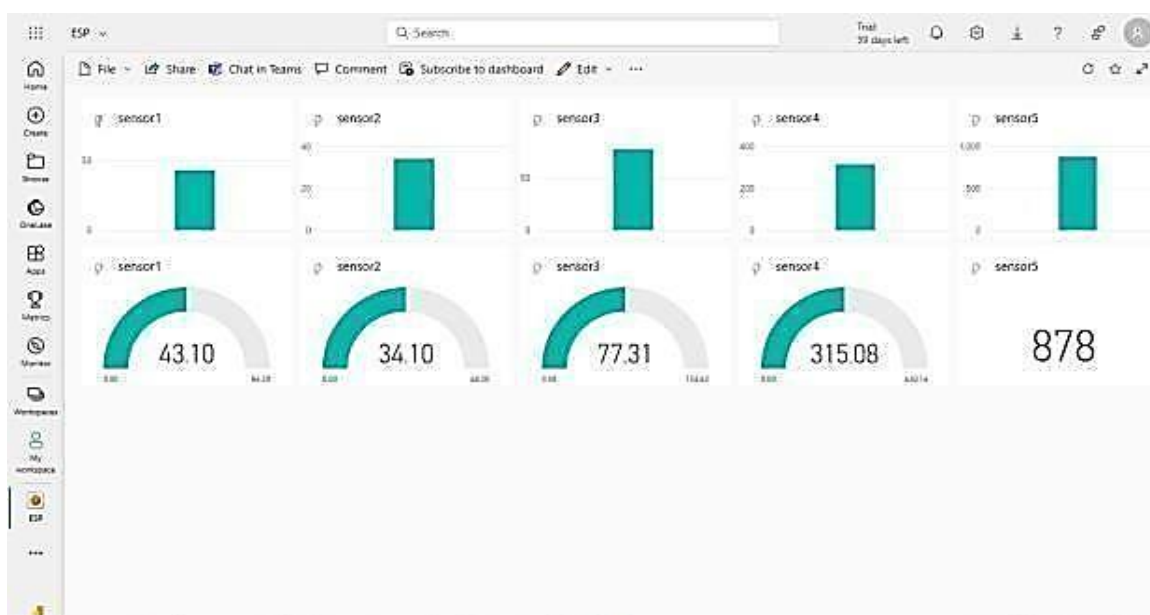
An Android application is how the users are able to interact with the system. It is user friendly for the users such as farmers, gardeners, or scientists. The application provides output in real time in a format that is easy to read and provides useful recommendations depending on the data, such as altering the watering or fungicide application. The application also provides users with the ability to provide feedback, which assists in enhancing the system's recommendations. This integration combines hardware (microcontroller and sensors), internet, cloud storage, and software (Android app) into a low cost and easy solution [4, 6]. By helping detect the fungal attack at an early stage and giving useful information, the system allows the users to increase crop yields, lower losses, and enable sustainable agricultural practices [10].

## RESULTS

The Fungus Detection System effectively detects fungal pathogens of waterlogged soil with sensor technology. The ESP32 microcontroller, with a Smart ELEX Soil Moisture Sensor and Soil pH Sensor, detects excess fungal changes in moisture and pH presence. The information is processed by the Arduino IDE and transmitted to an Android application, giving real-time updates. Figure 2 represents the power BI dashboard for sensor data monitoring.

Table 1 shows soil conditions as recorded and corresponding fungal levels of risk depending on sensors. The findings indicate that long-term waterlogging promotes fungal growth impacting plant growth and soil health [5].

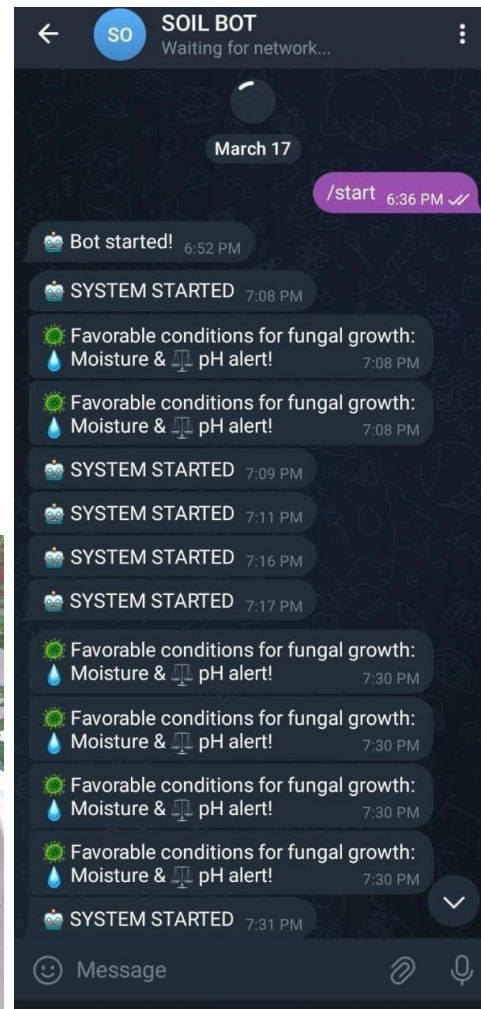
1. *Detection accuracy:* Sensor readings validate a positive correlation between fungal growth and waterlogging. Soil samples with greater than 50% water content and a pH of less than 6.0 showed significant fungal activity [5].



**Figure 2.** Power BI dashboard for sensor data monitoring.

**Table 1.** Soil conditions and fungal risk assessment.

Soil moisture level (%)	Soil pH	Fungal risk level
Below 30%	6.5–7.5	Low
30–50%	6.0–6.4	Moderate
Above 50%	Below 6.0	High

**Figure 3.** Actual implementation of soil fungus detection system.**Figure 4.** Soil bot alert system for fungal growth monitoring.

2. *Comparison with existing systems:* Unlike existing systems like Soil Bio and Cropio, which focus on general soil health, our system specializes in waterlogged fungal detection, making it particularly useful for farmers in flood-prone regions [6, 8].
3. *Problems and restrictions:* Sensor calibration is required for precision; defective calibration can cause positive or negative false readings. Soil composition changes may influence pH measurements, necessitating regular calibration. The Android app must be constantly optimized to process the data quicker and provide easy-to-use visualization [7, 9].

## DISCUSSION

The system accurately detects fungal pathogens in soil and delivers actionable information to farmers through a mobile platform. The Android application enables users to monitor soil health in real time and get instant notifications of possible fungal infections (Figure 3). Furthermore, Figure 4 showcases the soil Bot alert system for fungal growth monitoring.

## CONCLUSION

The use of a sensor-driven system for fungal detection with an Android app has been shown to be a novel approach towards managing soilborne fungal diseases, especially in waterlogged situations. Through the use of sensors to detect key soil parameters like moisture, pH, and temperature, the system gives real-time and precise information regarding soil health. The incorporation of a fungal spore detector adds to its capacity to detect probable fungal infections in the early stage, hence preventing major crop loss and enhancing agricultural productivity.

The use of supervised machine learning algorithms integrated into the system ensures accurate soil condition classification, with high accuracy and reliability being shown through experimental validation. The integration of the detection system into an easy-to-use Android application provides farmers and agricultural professionals with a useful real-time monitoring tool to make data-based decisions to improve crop management and sustainable farming.

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