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IoT Smart Plant Care and Plant Monitoring System

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Abstract: *This project introduces an innovative ESP32-based system designed for automatic care and comprehensive monitoring of plant environments. The system utilizes an ESP32 microcontroller that integrates with a network of sensors to collect real-time data on essential plant health parameters, including temperature, humidity, and soil moisture levels. This real-time data serves as the foundation for autonomous plant care actions. The system actively manages an air fan to maintain optimal temperatures and controls a water pump for precise soil dampening. All collected sensor data and the current status of actuators are wirelessly transmitted and securely stored on the Firebase cloud platform. This cloud integration facilitates easy remote monitoring and complete oversight via an intuitive mobile application developed using MIT App Inventor. This user-friendly application allows consumers to monitor current plant environments, review historical patterns, and manually control actuators as needed. The implementation of this system promotes healthier plant growth, ensures the efficient use of resources like water and energy, and ultimately provides a convenient and effective method of plant care administration, regardless of the user's physical location. This innovative system represents a significant advancement towards automating and optimizing plant cultivation for both individual hobbyists and large-scale agricultural applications.*

Keywords: Internet of Things, Smart Agriculture, Plant Monitoring, Automated Plant Care, Environmental Sensors

I. INTRODUCTION

Traditional manual plant care often leads to inconsistencies in attention, resulting in suboptimal plant health and significant resource wastage. The increasing accessibility of modern IoT technologies provides an opportunity to address these inefficiencies through automated solutions. This project introduces an intelligent IoT system for automated plant monitoring and management, aiming to reduce manual intervention and optimize resource utilization. The core of this system involves an ESP32 microcontroller interacting with environmental sensors (temperature, humidity, soil moisture) and actuators (fan, water pump) to provide continuous, autonomous adjustments based on predefined or user-defined parameters.

II. METHODOLOGY

The "IoT Smart Plant Care and Plant Monitoring System" employs a robust technical framework centered around the ESP32 microcontroller, serving as the core intelligent unit responsible for real-time data acquisition and dynamic control. This system integrates a comprehensive array of environmental sensors meticulously chosen to monitor critical parameters affecting plant vitality. Specifically, a temperature sensor continuously measures ambient thermal conditions, a humidity sensor tracks the atmospheric moisture, and a soil moisture sensor precisely gauges the dampness of the plant's substrate. The data collected from these sensors forms the basis for the system's automated responses.Based on predefined thresholds and the live sensor readings, the ESP32 initiates actions through interconnected actuators. An air fan is automatically engaged or disengaged to maintain optimal temperature ranges, ensuring the plant thrives within its ideal thermal environment. Concurrently, a water pump is precisely controlled to deliver the necessary amount of water to the soil when the moisture level falls below a specified threshold, preventing

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both under-watering and over-watering. All this crucial sensor data, along with the operational status of the actuators, is wirelessly transmitted via the ESP32's integrated Wi-Fi module and securely logged onto the Firebase cloud platform. This cloud integration facilitates robust data storage, enabling both real-time monitoring and historical data analysis.

III. SYSTEM ARCHITECTURE

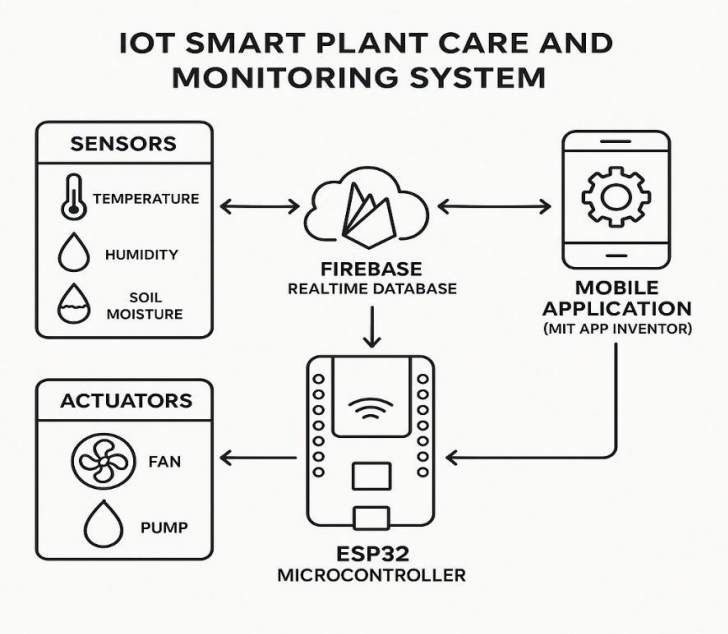

Fig. 1 SYSTEM ARCHITECTURE

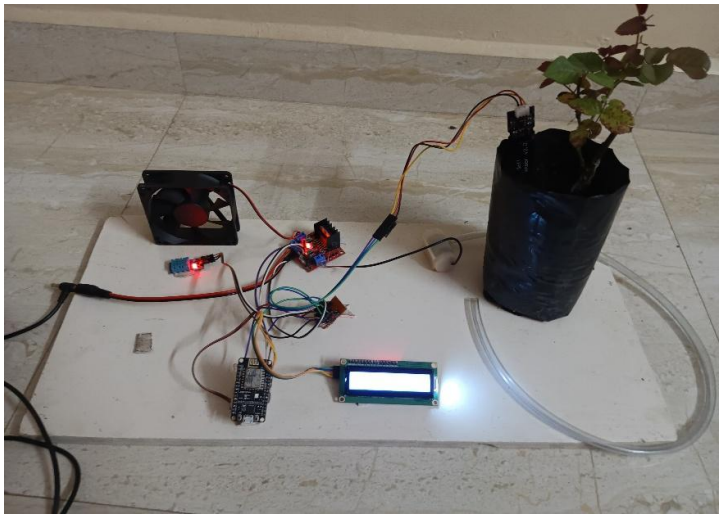

Fig. 2. Experimental Setup of Proposed Systeam

IV. RESULTS

The performance testing results indicate the system's efficiency and responsiveness, with low latency for data transmission and actuator control, and high system uptime. The successful outcomes of the test cases confirm the functionality of both manual and automated controls, as well as reliable connectivity and data logging..

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V. CONCLUSION

This project successfully demonstrates an IoT-based smart plant care and monitoring system that automates plant care and provides remote monitoring capabilities. The system effectively utilizes an ESP32 microcontroller, various sensors, and Firebase cloud integration to collect real-time environmental data and control actuators for optimal plant health. The mobile application developed with MIT App Inventor offers an intuitive interface for users to interact with the system.

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