SmartGarden: IoT for Indoor Plant Care

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Indoor plants improve well-being but often suffer from inconsistent care. Many existing smart solutions are costly, cloud-dependent, or proprietary. SmartGarden was developed as an affordable, offline-first IoT system that automates monitoring and irrigation while keeping users in full control.

System Architecture

The SmartGarden system is built on an ESP32 microcontroller connected to multiple sensors: a soil moisture probe, an SHT21 for temperature and humidity, a BH1750 for light intensity, an MQ-135 for air quality, and an ultrasonic sensor for tank water level. Irrigation is handled by a submersible pump controlled through a driver module. Data is transmitted via Wi-Fi to an ASP.NET Core backend that secures communication with JWT and stores readings in SQLite or SQL Server.

The mobile application, developed in .NET MAUI, enables users to register and manage plants, view live and historical readings, calibrate sensors, and control watering either manually or automatically. Offline-first functionality ensures that irrigation continues even during connectivity losses, with data synchronized once the network is restored.

Figure 1 illustrates the physical setup of the SmartGarden prototype.

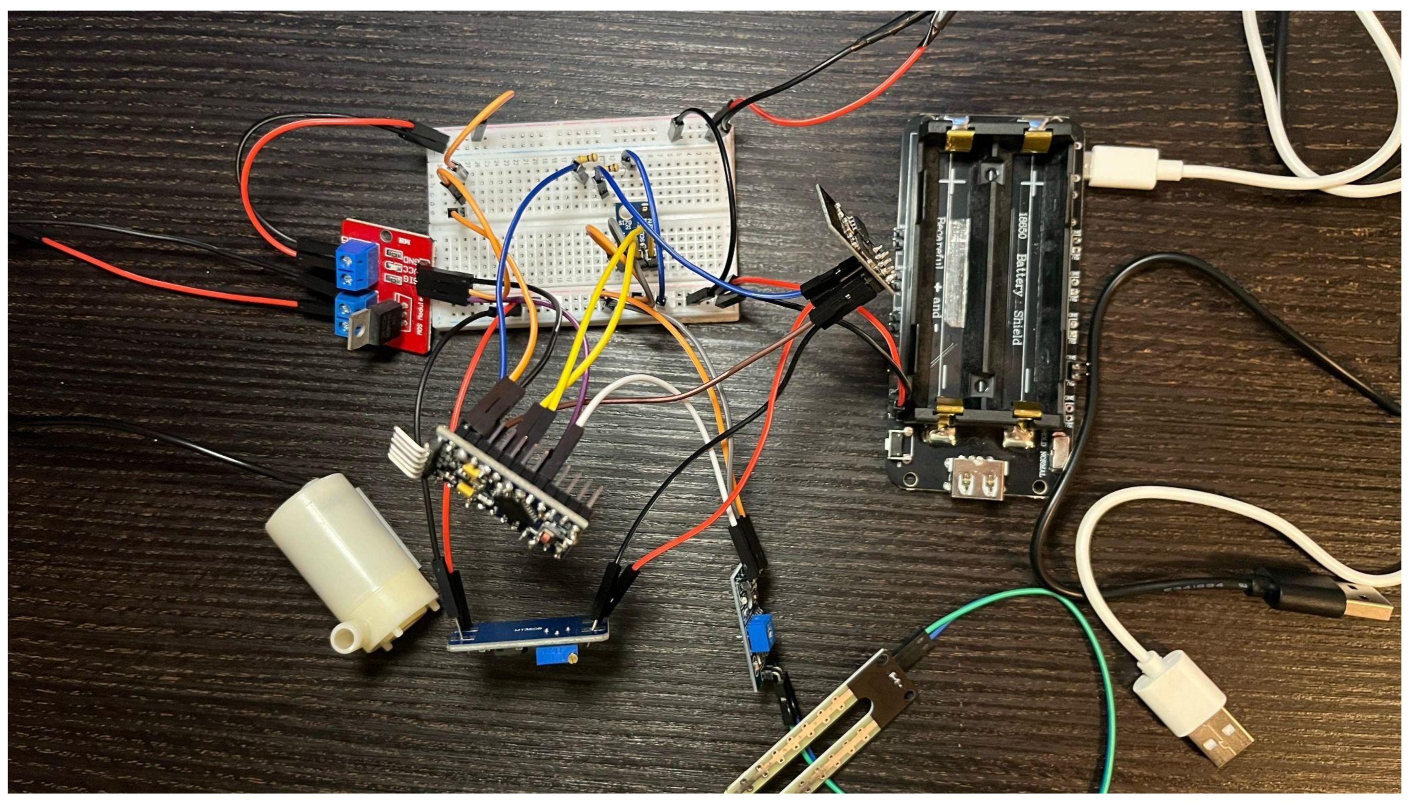

Figure 1: Physical Setup

Key Features

SmartGarden emphasizes affordability and autonomy. All irrigation decisions are made locally, guaranteeing operation during outages. The system supports both automatic and manual watering, offers calibration tools to improve sensor accuracy, and provides timely alerts about soil moisture, air quality, and water tank levels. These features make the platform reliable, adaptable, and user-friendly.

Mobile Application

The SmartGarden mobile app, built with .NET MAUI, lets users monitor plant conditions in real time and manage irrigation with ease. It shows live sensor data, supports adding and editing plants, and allows both automatic and manual watering. A calibration wizard ensures accurate readings, while charts display weekly trends. Notifications alert users when soil is too dry or the water tank is low. With offline-first caching, the app remains functional even without internet access, making it a reliable tool for everyday plant care.

Experimental Results

The prototype was tested on a peace lily (*Spathiphyllum wallisii*) and a monstera (*Monstera deliciosa*) for two weeks. The peace lily was automatically watered five times and the monstera three times, maintaining soil moisture in healthy ranges with only about two liters of water consumed in total. When Wi-Fi was disconnected for a day, irrigation continued normally and buffered data was synchronized afterward. Manual measurements confirmed sensor accuracy within three percent, and both plants remained healthy throughout the trial.

Conclusion and Future Work

SmartGarden demonstrates that an economical IoT solution can provide dependable plant care without relying on expensive or cloud-based systems. Future work will explore additional sensors, AI-based predictive irrigation, support for multiple plants, and optional cloud synchronization for remote access.

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