IoT Based System for Monitoring Plant Environments - Proposal

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High Concept

This artefact is an Internet of Things (IoT) based monitoring system with a specialised application implemented for monitoring miniature greenhouses and their plants. The artefact utilises three sensors, monitoring sunlight exposure, temperature, and moisture levels which are then sent and displayed within a mobile application. This system provides proof of concept for implementing an enclosed IoT-based plant monitoring system like a miniature greenhouse.

Artefact Specialism

My artefact fits under the IoT specialism, focusing on the implementation and communication of devices via the internet. IoT systems provide great enhancements within data transmission, allowing for simple implementation of sensors and other peripherals. Using this in my artefact has allowed for simple communication and a dynamic system that can add or remove peripherals as needed.

The Problem

"Either directly or indirectly, most plant problems are caused by environmental stress" [1]. This identification from the Oregon State University defines environmental stress and the factors that cause it. These factors are insufficient growth variables quantities, such as water, temperature, sunlight exposure, air humidity, and even Co2 levels. This is because vital information about the plant is often hard to interpret, as supported by a study from OnePoll who determined that, of 2000 millennials, 46% said the most challenging part of taking care of plants is how much water is needed [2]. Using this artefact, the current environment values can be gathered and displayed, helping reduce this problem.

Background

There are many systems previously made and implemented for ecology and conservation biology. A paper by J. J. Lahoz-Monfort and M. J. L. Magrath titled ‘A Comprehensive Overview of Technologies for Species and Habitat Monitoring and Conservation’ discusses the systems already implemented within ecology [3]. However, the implementations discussed in this paper are for larger scales such as habitats, dissimilar to this artefact. In terms of small-scale projects, M. Salazar et al. have also implemented another plant monitoring system in the form of a ‘smart plant pot’ [4]. This system utilises sensors, a display, a water pump, and a mobile application.

Typically, greenhouse monitors are developed for large scale versions, not miniature. A good example of this is M.Danita et al. ‘IoT Based Automated Greenhouse Monitoring System’ [5]. An example of miniature greenhouse monitoring however, is BMonster Laboratory [6] who utilise sensors within a closed environment and display the information via a screen.

This artefact aims to combine certain aspects of these previous works, implementing the main premise but with different execution. This artefact stays similar to BMonster Laboratory's miniature greenhouse monitoring system [6] but differs in the data presentation.

Research and Devlopment

The artefact will be made using multiple languages: C++ for the components, JavaScript for the API, SQLite for the database, and React Native for the application. The API and database will be containerised using Docker and pushed to Docker hub. The application will use a library called Expo for easier development and the components will use the Adafruit library for managing the Adafruit peripherals.

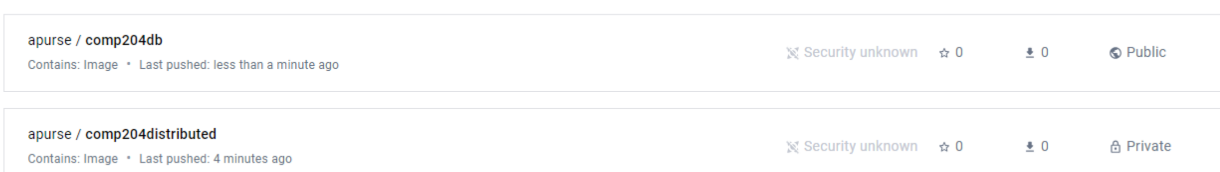

Figure 1Docker Registry

With this artefact, there are minimal ethical issues as the data managed is only the environment values. The user supplies no data other than the plant they manage, resulting in a lack of GDPR concerns.

To manage the development, a consistent solo agile management method will be implemented, comprising of weekly sprints and scrums and the use of a kanban board. Sprints will manage the workload while scrums will allow me to review changes and adapt accordingly.

Functionality

The IoT system is comprised of multiple sensors, measuring different environmental variables, and storing the values. The application will call the IoT system, which gathers the values from the peripherals. Once gathered, the values will be sent to and stored in a dockerised API and database. This API is then accessed by the application, which retrieves the values and displays them to the user.

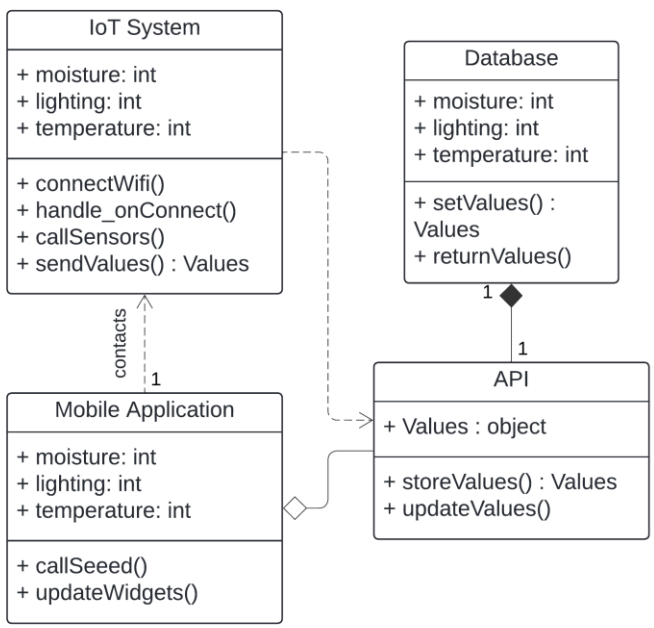

Figure 2 UML Class Diagram

Scope and Practice based Research

With the development time of approximately three months, the artefact should be fully functional within an enclosed environment. By four months, the artefact should detect more variables such as Co2 and air humidity. This will be achieved by using more sensors built into the system, gathering the values, and sending them to the dockerised API.

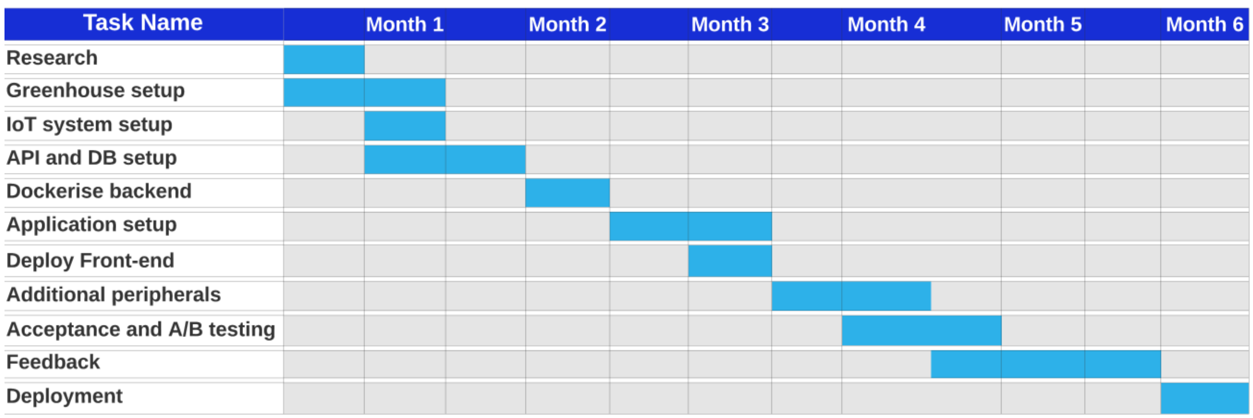

Figure 3 Development Gantt Chart

At month four, the artefact will undergo acceptance testing on different levels including functionality, integration, experience and so forth evaluating its domestic use. After which, the artefact will be A/B tested, against M. Salazar et. al's ‘Monitoring System for Plants Based on a Smart Plant Pot’ as their implementation does not include an enclosed environment [4] [7]. These systems will be tested over a period using G*Power to determine the number of iterations until the best statistical power has been reached.

References:

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