Home Plant Care System

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***Abstract*—This document provides the design and implementation details of a home plant care system that allows the user to track several environmental factors used to determine watering schedule and plant placement in order to grow and maintain healthy home plants. Competitor solutions such as Xiaomi Mi's HuaHuaCaoCao presents negative feedback, especially on the reliability of the humidity sensor and the connection between the app and the sensors. We aim to provide a reliable intelligent tool that allows to trace the history of data, to alert in real time by notifications on a mobile application and to adapt the different sensors thresholds to the specificities of the plant.**

***Index Terms*—cloud, device, edge, IoT, plant, smart home**

I. Introduction

Our objective is to offer users, a way to easily track and monitor their indoor plants, through a small device inserted in the flower pot and a mobile application. It is sometimes hard to know how well a specific plant is doing and which type of environment suits its healthy development. With the help of a community database and accurate sensor monitoring we will help guide users to maintain prosperous houseplants. This Product Specification document will aim to document and track the necessary information required to effectively define architecture and system design of the Home Plant Care System (HPCS).

II. Market study

A. Competitors and similar products

There are a few available options on the market that somewhat match the product we have in mind, such as:

- Huahuacaocao Flower Care Smart Monitor 31.64
- WANFEI Intelligent 4 in 1 Plant Monitor 30.63
- OLLIVAN Plant Monitor Smart Plan 27.80

Unfortunately these options present some non negligible disadvantages. They all have the exact same design and characteristics and are sold on websites such as Aliexpress and Amazon.

The Huahuacaocao is a Xiaomi product and perhaps the most reliable of them all. However customer product review are mainly negative, and focus on both sensor inaccuracy and software usability, but also mentions connectivity issues between the device and the app. The table below identifies all characteristics found in this product.

TABLE I: Market product functionalities

Description	***Sensors***	***Performance***
Size: 120.5 x 24.5 x 12.5 mm Weight: 18.14g Battery: CR2032 button cell battery Wireless connectivity: Bluetooth 4.1	Moisture: long black strip sensor (EC5 standard) Light: light intensity up to 100,000LUX with accuracy of 100LUX Temperature: accuracy of the temperature can go up to 0.5 Nutrients: 4 EC sensors (stainless steel)	Database: 3000 different types of plants Operating voltage: 3V Battery duration: 365 days CMIIT ID: 2016DP0940

B. Target customers

Due to all this negative feedback of the products on the market there is no real solution out there capable of satisfying the customers needs.

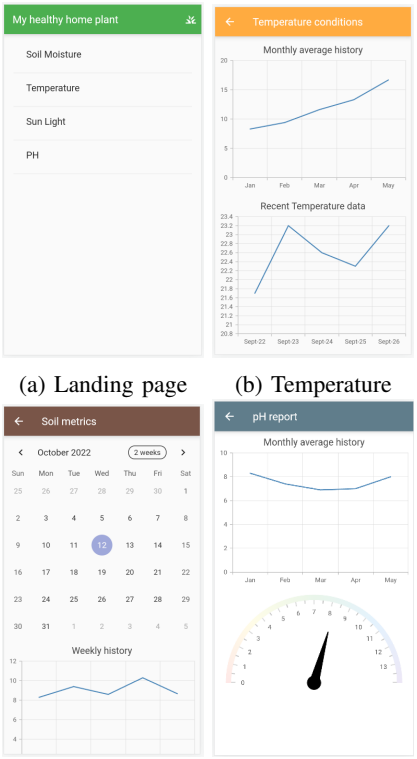
Therefore we are hoping with our product to help people who have been struggling at maintaining a healthy home plant. Either by getting them organized with a watering schedule, or by warning them of potential environmental risks the plant may encounter. But it is also an opportunity for plant enthusiast to monitor their plant and become a part of the plant profile community to learn and share about the best living conditions of their home plants.

III. Functional specifications

A. User interfaces

In this subsection we will present all functional specifications of the user interfaces included in the different aspects of our product.

1) Mobile application: The main user interface will be the Mobile application, it will reflect all necessary data that could be useful for the user and for any data analysis required.
The landing page will display buttons to give, to the user, access to all the sensor data as well as the plant's profile. Through the help of graphics the data from the sensors will be displayed as it is, and more graphs will show data history and offer some analysis such as a calendar to maintain a proper watering schedule for instance.
Some example of the final app display are as follows:

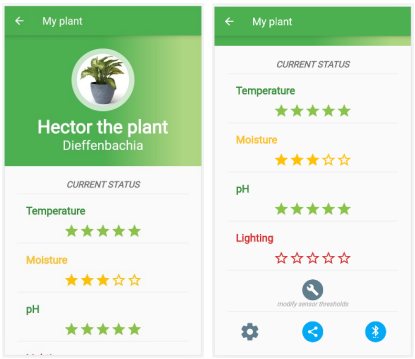


(a) Landing page (b) Temperature

(c) Soil (d) pH Page

Fig. 1: Examples of displayed data from sensors

The plant profile will exhibit an overview of the plant's current state in relation to the previously set thresholds. It is also from this page that the user will be able to manually update and modify the thresholds as well as editing the profile's information. Through the share button users will be able to exchange plant data and threshold settings.



(a) Plant status (b) Profile settings

Fig. 2: Plant Profile Page

2) Physical device: Most plants like a soil with a pH between 6.0 and 7.5. If the soil is not acidic enough for a crop, nutrients may be present in the soil, but the plant will not be able to absorb them properly. The acidity of a soil is determined by the amount of limestone it contains. The more limestone a soil contains, the more alkaline it is; conversely, the less limestone it contains, the more acidic it is. This measure will be satisfied with a **pH sensor**.

The ideal temperature for an indoor plant is between 15 and 19C. It is important to maintain a constant atmosphere throughout the day. In order to meet this requirement, the device will incorporate a **temperature sensor**.

Most plants need a minimum amount of light in order to carry out the process of photosynthesis which allows them to live and develop, and which also gives the leaves their colour. This is ensured by a **light sensor**.

Humidity has an important impact on the proper development of plants by allowing them to carry out their transpiration process. Transpiration allows plants to control their temperature, the circulation of nutrients by promoting the absorption by the roots and the absorption of CO2 contained in the air. This measurement is provided by a **humidity sensor**.

The measurements taken by these four sensors will have to be collected by the mobile application on the smartphone that acts as the Edge in this system. To ensure this transmission, a **wireless connection** is required.

The device requires a continuous power supply. For long service life (approx. 365 days), a **lithium button cell battery** (such as CR2032) will be required.

To meet these functional requirements, the device must be moisture proof, therefore it is **certified IPX5** : it can resist a sustained, low-pressure water jet spray. This means that it cannot be immersed in water for a long period of time, nor be exposed to rain. It is therefore suitable for indoor use.

The smartphone that serves as the Edge and runs the mobile application must support at least an **Android 4.1** or **IOS 11.0** system (according to the requirements of the Flutter framework) for the system to work.

The data transfer from the application (edge) to the database for storage (cloud) is done via **internet**. Once the data is in the cloud, it will be linked to the user's profile. Calculations are applied to the collected data and allow the user to receive the necessary statistics for the growing of his plants. In this way, the user visualizes the crop growth as presented in the previous section. /sectionPerformance requirements The device uses a wireless technology that enables low-power, short-range communication between the four sensors and the smartphone: **Bluetooth Low Energy** (BLE).

REFERENCES