Internet-Based Remote Control Mobile Application for Plant Monitoring System Using Wireless Sensor Networks

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ABSTRACT

Due to lack of technology in farming, farmers still do the usual way and method of farming. To resolve this, the proponents will make a system that is capable of automating the work in farming. The proponents will make an internet-based mobile application, which is capable of controlling the sensors and the camera module in the system using wireless fidelity (Wi-Fi). The general objective of the project is to design and develop a Internet-Based Remote Control Mobile Application for Plant Monitoring System using Wireless Sensor Network. Specifically, this study aims to: (1). Design a smart farm mobile application using Java in Android Studio that will help the farmers in: a. Measuring the temperature and humidity of the plantation using sensors. b. Alerting the user if the measuring of the temperature and humidity has been completed. (2). Interface the mobile application to the Raspberry Pi using Wireless Sensor Network. (3). Test the functionality, accuracy and reliability of the mobile application.

Keywords: *Smart Farm System, WSN, mobile application, Java, Android, Raspberry Pi*

1. Introduction

This chapter aims to discuss the procedure and motivation of the study. This chapter contains the research background and the problem statement. This chapter also has a list of objectives and scopes of the project as well as emphasis on its significance. This chapter would set as a basis in describing the effectiveness of the study.

1.1 Background of the Study

A mobile application is a software application created specifically for use on smart phones and tablets, rather than to use desktop or laptop computers [1]. One important mobile application to access a sensor is a remote control mobile application because this concept helps by means of convenience in terms of lesser effort and easy access from a distance. The Smart Farm system helps the farmers to apply the right amount of fertilizers and water at the right place and time [2]. The exactness cultivating is a profitable device for precise soil concoction structure and dampness control. The smart farm can wisely work pumps/valves in view of the information gathered from the field and the arranging programs accessible in the controller. The idea of a remote control helps the farmer to gain access and monitor the plantation by the flick of the thumb, using the following tools of some advanced software for android programming and creating its own application that can control the settings and actions of the system and identify or notify the condition of the farm itself.

This study aims to develop a user friendly mobile application that can be easily used by the users. The defenders will utilize Android studio which is the valid coordinated advancement environment (IDE) for Android application improvement. Android studio

depended on IntelliJ IDEA. Android studio offers much more component that will upgrade the profitability of its client when building Android applications, for example, (1) An adaptable Gradle-based form framework, (2) Build variations and different Android application bundle (APK) document era, (3) Code formats that will help Fabricating ordinary provision highlights, (4) A comfortable design article director which has support for move and redo theme changing, (5) Build up mechanical assemblies that gets execution, usability, adaptation correlation, and distinctive issues [3]. The proponents will also make a design for the mobile application. The proponents will use Material Design for Android in making the User Interface (UI) of the mobile application. Material Designis a complete guide for graphic, motion, and communication design in all platforms and devices. Support has been added in Android for material design. Android has provided the following elements to be used for material design apps: (1) another subject, (2) New gadgets for complex perspectives, (3) New APIs for custom shadows and activities [4].

This study will be using WSN based Wi-Fi technology. Once connected, it can start transferring commands from the mobile application to the sensors of the system. Notifications are also sent to the mobile phones when the devices are connected to each other. The proponents will connect the mobile application via Wi-Fi in the Raspberry Pi Microcontroller of the sensors.

Agriculturists are confronted with new difficulties and opportunities consistently from sustaining a growing worldwide populace while meeting strict new discharges necessities, to creating more sustenance on less sections of land while minimizing their ecological impression [7].

1.2 Objectives of the Study

The general objective of the project is to design and establish a WSN-Based Remote Control Mobile Application for Smart Farm System.

Specifically, this study aims to:

1. Design a smart farm mobile application using Java in Android Studio that will help the farmers in:
   a. Measuring the temperature and humidity of the plantation using sensors.
   b. Alerting the user if the measuring of the temperature and humidity has been completed.
2. Interface the mobile application to the Raspberry Pi using Wireless Sensor Network.
3. Test the functionality, accuracy and reliability of the mobile application.

1.3 Significance of the Study

The mobile application software for smart farm system helps to monitor and easily remote access the sensors from the farm using wireless fidelity network. This application has information that farmers needed. The benefit of this system for

farmers is helpful in their work. The application is user friendly and has an interactive UI that anyone can understand. This application is designed especially for company farms that are required to have mobile phones.

Wi-Fi is a wireless networking technology that uses radio signals in communication with other Wi-Fi compatible systems. Wi-Fi can be used without wires that connect the transmitter and the receiver. The proponents shall use Wi-Fi technology because of its benefits. Many wireless devices today use Wi-Fi as the medium in communicating remotely. Wi-Fi certified devices is supported and can use Wi-Fi as the communication tool [10]. The 802.11 IEEE wireless LAN standards is the standard that is used by Wi-Fi in connecting devices with respect to the compatibilities of the devices. There are several types of 802.11 standard but the proponents shall use the common standard that is used by the other devices to avoid conflicts in compatibilities.

This application uses an online internet connection so that it can access the farm and use the application anywhere that has an internet service. This application has the function to alert the application if the commands have been successfully finished. It helps the farmers to view the crops using the camera sensors that are attached in the farm. This research project can guide and give more information for the future researchers for further improvements. This research is open for anyone who is willing to improve this study.

1.4 Scope and Limitation of the Study

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2. Review of Related Literature

This chapter discusses other related researchers which is similar to this proposed study. The proponents have researched about the functionality of the system and how it can be further improved by taking into consideration of the following existing researches:

The synthesis of the studies discusses the related literatures that were used in the system. The related studies discussed were about the usage of the Android programming and Bluetooth technology. According to the review of related literature, there are different methods and techniques in designing and implementing the system. Most of the study conducted and implemented use of sensors.The researches about this study deals with the functionality of Android and the wide range of possible use of Android for future studies.

3. Research Methodology

This section presents and discusses the steps and method that the proponents needed to follow in designing the system. It presents the conceptual and theoretical framework as well as the proposed design to be used in developing the system. Moreover, this includes, but not limited to processes, tools and equipment used in implementing and developing the software and hardware of the project.

3.1 Conceptual Framework

Table 1. IPO Chart of the System

INPUT	PROCESS	OUTPUT
Start Application	Load application	Show connect menu
Choose connect via Wi-Fi	Search for the farm sensors	Connected to the system. Show main menu
• Monitor the area • Measure Temp	Mobile will send command to the camera module to Monitor the area Mobile will send command to the sensor of	The camera module will capture an image of the plant. The temperature sensor will measure the temperature in the plantation

era tur e	the farm to measure temperat ure	The humidity sensor will measure the humidity in the plantation
• Me asu re Hu mid ity	Mobile will send command to the sensor of the farm to measure Humidity	

Table 1 shows the IPO chart of the system. The user will start the application then the application will load. After loading, the connect menu will show. In the connect menu, there is an option wherein the user will connect to the farm sensors via Bluetooth. After connecting, main menu will show and there are three choices: (1) Monitor the area, (2) Measure the Temperature, (3) Measure the Humidity, and (4) Send Message. Selecting Monitor the area will command the camera module to live stream the plant. Measuring temperature and humidity is also possible by choosing the Measure Temperature and Humidity selection. Lastly, the send message button will go to a menu that will able the user to send the message to the LCD Monitor. The application can easily be terminated by pressing the back button.

3.2 Theoretical Framework

3.21 Android Studio and Mobile Phones

Mobile application can be created using different Java IDE but the proponents will use Android Studio as the main tool for programming the mobile application. Android Studio has different modules with source code files and resource files. Of course, Android studio shows the venture records in the Android endeavor view [3]. Mobile phones that will be used in installing the application should be compatible to the application to avoid compatibility and stability issues. The design of the application will be made on Material configuration. Material configuration is a design language that was developed by Google. Material outline can be used in Android version 2.1 and newer [19].

3.2.2 Internet Connection

The proponents will be using internet connection to connect through mobile application so that the sensor can be access in home or anywhere else where there is internet service available.

3.2.3 Wi-Fi Connection

In the field of communication of devices, the proponents will use Wi-Fi technology. Wi-Fi is better in range, bandwidth, security, and transfer rate over Bluetooth. The downside of Wi-Fi is the cost and its power consumption over mobile devices [17]. Wi-Fi also has a security feature wherein you can add password to

the devices to prevent anyone from using it; Only authorized person only will able to use such application.

3.2.4 Wireless sensor Networks

Raspberry Pi will be used in making the wireless sensor networks. Temperature and Humidity sensor will be used as a measuring tool of the system and Camera module will be used as the monitoring tool of the system. WSN contains several technical components. It includes, radio, batteries, microcontroller, analog circuit, and sensor interface.
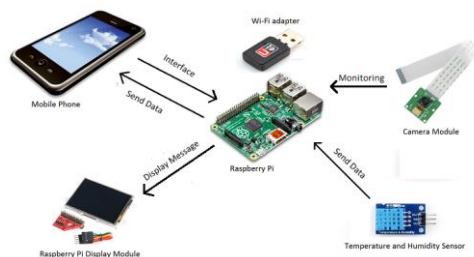
3.3 Proposed Design

Figure 1. Relationship Diagram

Figure 1 shows the relationship diagram of the system. The mobile phone will be interfaced to the Raspberry pi. The connection between the mobile phone and raspberry pi will be via Wi-Fi. The Raspberry pi will send data to the mobile phone after gathering data from the sensors and the camera module. The Raspberry Pi will connect to the camera module to monitor the plants. The temperature and humidity sensor will gather data from the plantation and send the data back to the Raspberry pi.

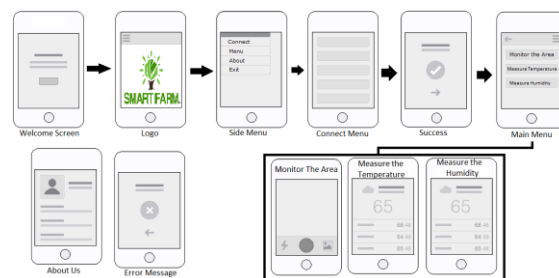The Raspberry pi can also display the message composed from the mobile phone.

Figure 2. The Application Flow Chart

Figure 2 shows the flow of the Application. After opening the application, a Welcome screen will show up and a button will also show up to continue to the application. Continuing the application will bring you to the Logo window where the logo of the application can be seen. In the logo window, there is a side panel that can be opened. Once opened, the side menu will show up and four selection be selected. About will show the profile of the developer of the app, its version, and the date the application was created. The connect button will show a window wherein the user can choose from a list of possible spots to connect to. Once connected, the application will now go to the Main menu wherein the user can see the four options to choose. Monitor the area will show a live camera that can be seen thru the phone. Measure temperature will show a window wherein the temperature is measured. Measure the Humidity will show a window that will give information of the humidity of the plantation.

Figure 3. Sample Design of the Application

Figure 3 shows the sample design of the Application. The proponents may use green color for the theme of the project. The design is subject to change. There are a lot of possibilities in changing the color, design, and position of the buttons of the application.

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