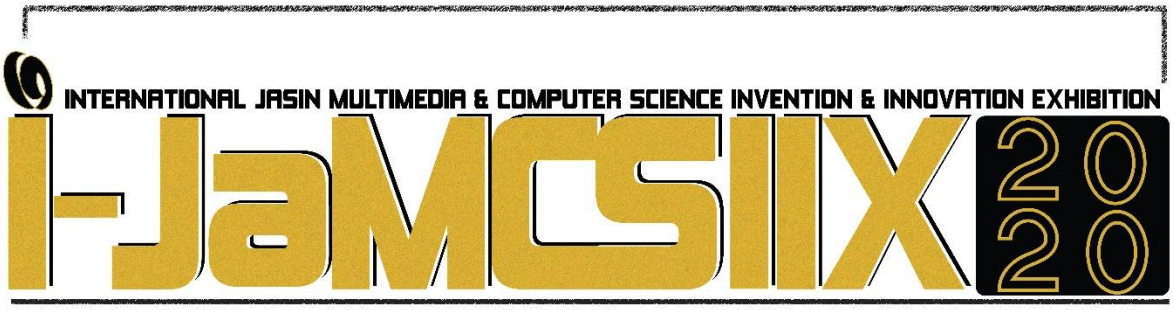

Smart Irrigation System Using Raspberry Pi

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ABSTRACT

Commonly known as IoT, Internet of Things is a demanding area in technology that is growing daily. Millions of devices have been created to make humans life easier. IoT has been largely contribute to home automation where every devices and home appliances can be connected to Internet and interact with each other. Suitable for people who are working but currently leaving plants at home with nobody to take of it. Thus, by applying the IoT concept, this paper provides design and implementation of Smart Irrigation System using Raspberry Pi as their main component. Raspberry Pi, which is a palm-size computer is capable of running a machine learning process within it. The irrigation is automated by using machine learning algorithm that has been implemented on the system. This system uses moisture sensor, humidity and temperature sensor, and ultrasonic sensor. The collected sensors data then is transferred through Firebase database, an online database that used to connect with android application. The sensors data can be viewed by the user through android application in real time. This project can go beyond further from what has been implemented by applying this project into a large scale of crops instead of using it at home only.

KEYWORDS: Irrigation, Raspberry Pi, Android, Machine Learning, Internet of Things (IoT)

1 INTRODUCTION

There is no question that technology is playing a huge part in our daily lives today. Back when computers were introduced in Industrial Revolution 3.0, now the world is going to Industry 4.0, the name given to the growing of traditional manufacturing and industrial platforms and practices with the latest smart technology. Industry 4.0 is focusing on the use of large scale M2M (Machine to Machine) communication and Internet of Things (IoT) application that is tend to speed up productivity, increase automation, improving communication between devices and human as well as intelligent devices that can analyse and predict issues without the need for human intervention [4].

While IoT has been applied in many fields of study, home automation is one of it. According to [2], appliances and devices at home can be connected to control everything at our home. For someone who has a few plants to take care of at their house, it might be trouble for

them to monitor the plant while being outstation. Besides, they also do not even know how much amount of water required for the plant or whether the plant needs water or not during the current time. Hence, Smart Irrigation System is proposed to solve this issue where irrigation process is automated without the human intervention.

This paper is organized as follows: Section 1 addresses the introduction or background of the study. Section 2 addresses the objectives of the study. Section 3 addresses the significances of the study. Section 4 tells about the methodology, hardware, software and technique used in this project. While Section 5 shows the result of the developed system. Conclusion will be given in Section 6.

2 OBJECTIVES

There are three main objectives of this system as stated below:

i. To design an automate irrigation system using Raspberry Pi.
ii. To develop a prediction system to automate the irrigation process and an Android application for monitoring process by end user.
iii. To test the functionality of the system.

3 SIGNIFICANCES

The significances of this project are:

i. The system is easy to configure.
ii. The system makes the user's job easier to monitor the plant growth.
iii. The system has user-friendly interface.
iv. The system is suitable for small scale crops.
v. The system does not rely on user to predict irrigation time.

4 METHODOLOGY/TECHNIQUE

According to [1], methodology consists of procedures, principles, and practices that organizes research. Its aim to come up with a work plan of research. The methodology is chosen from the software development life cycle (SDLC) models. A model that has been chosen from SDLC is Waterfall model. Waterfall model consist of six phases. The six phases are requirements, system design, implementation, integration and testing, deployment of system and lastly maintenance. This project is focusing from the first phase until the fourth phase only, which is from requirements phase until testing phase.

This project requires three different sensors which consists of soil moisture sensor (yl-60), temperature and humidity sensor (DHT11), and ultrasonic sensor (HC-SR04) to measure water level inside the tank. These sensors are connected to Raspberry Pi for machine learning process and send the data gathered from the sensors to firebase database. Finally, the data from the database will be given to user to monitor the process as shown in Fig. 1.

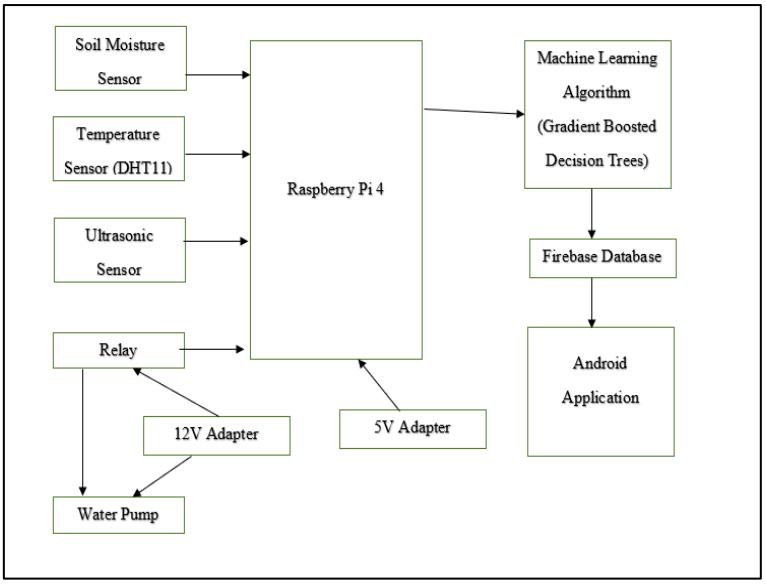

Fig. 1: The block diagram of the proposed project

Since this project require an automation for the irrigation process, a machine learning algorithm has been applied. Machine learning technique is a computational process that takes input data to do a specific task without being literally programmed to produce an outcome [3]. From many algorithms inside the machine learning, one algorithm has been chosen. The algorithm is called Gradient Boosted Decision Trees. This algorithm uses a particular model ensemble technique called gradient boosting, which iteratively builds a model, while improving the performance of the previous iteration model. By using data gathered from moisture sensor, humidity and temperature sensor, the data is save into .csv file to be used to train the model.

The implementation of algorithm is using Python Programming Language because it already has libraries related with Gradient Boosted Decision Trees. While for the Android application, Java programming language is used by using Android Studio software.

5 RESULT

Since the irrigation is an automated process, the user can only view the sensors data, they do not need to determine the time to irrigate the plant. The data is sent to firebase database and then through Android application as shown in Fig. 2 and Fig. 3, respectively.

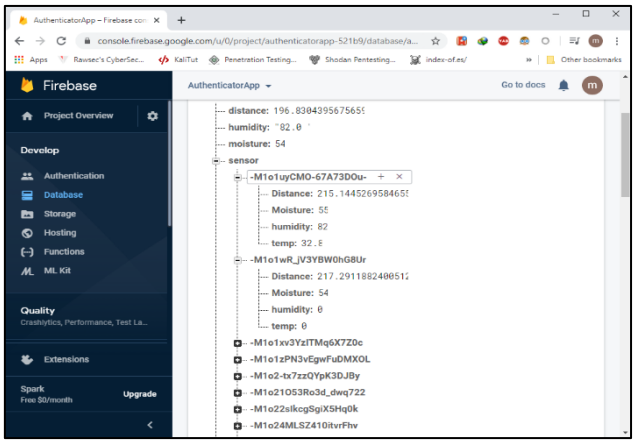

Fig. 2: Sensors data on the firebase database

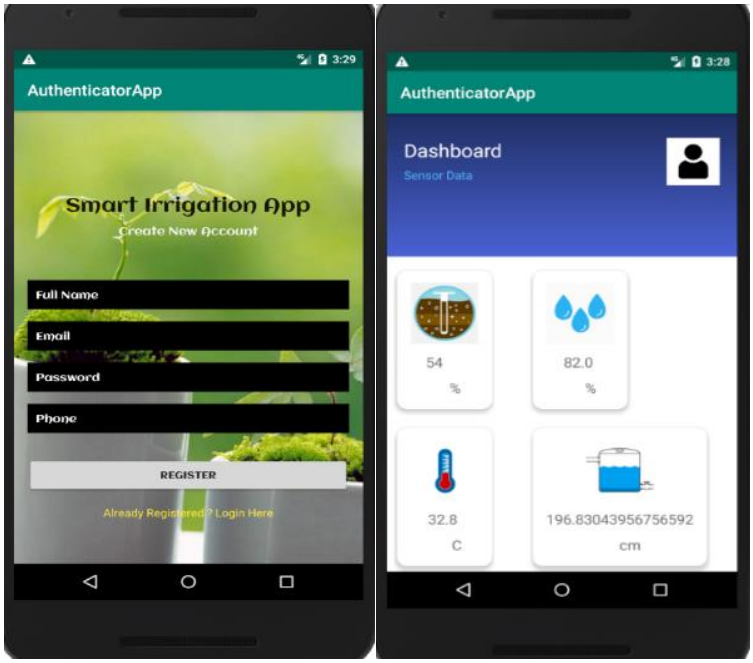

Fig. 3: Android application interface for user to view the sensor data

6 CONCLUSION

A Smart Irrigation System has been proposed to predict the irrigation time in small scale crops. The system mainly consists of three type sensors, which is moisture sensor, temperature sensor and ultrasonic sensor to measure the level of water inside the tank. Firebase databases is used to store all the sensors data and integrate it with mobile application for user to view the real-time data. The data consist of moisture data, humidity data, temperature data and tank water level data. If water level is low, a short message service (SMS) is sent to user to remind them to fill the tank with water in order to complete the irrigation process. For further studies, this project can be used for large scale of crops by configuring new hardware despite using the same code and system. Furthermore, besides displaying real time data through android application, a web app could be developed to visualize historical data of the plant. By using some framework for visualization of data such D3.js or ChartJS, historical data can be visualized for user in an interactive way. Lastly, a platform for user to download historical data can be implement by using email platform to upload the data from the database and send it to the user's email.

REFERENCES

[1] Hoda, R., Salleh, N., Grundy, J., & Tee, H. M. (2017). Systematic literature reviews in agile software development: A tertiary study. *Information and Software Technology*, *85*, 60–70. https://doi.org/10.1016/j.infsof.2017.01.007

[2] Lee, I., & Lee, K. (2015). The Internet of Things (IoT): Applications, investments, and challenges for enterprises. Business Horizons, 58(4), 431–440.

[3] Naqa, I. El, & Murphy, M. J. (2015). What Is Machine Learning ? *Machine Learning in Radiation Oncology: Theory and Applications*, 3–11. https://doi.org/10.1007/978-3-319-18305-3

[4] Statistics, L. (2019). What is Industry 4 . 0 ? Everything you need to know. Retrieved March 25, 2020, from https://www.techradar.com/sg/news/what-is-industry-40-everything-you-need-to-know