PALS – Precision Agriculture using Local Server

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Agriculture plays a vital role in the development of Indian economy, these days many people living in the cities are preferring organic fruits and vegetables, which in turn is creating opportunities for big nurseries to grow fruits and vegetables in the traditional organic method, some people are also growing such plants at their home itself to meet their daily consumption needs. Even though the methodologies used for such farming are very good at providing a good yield, such activities still require a lot of time and man work for efficient output. Such people are starting to rely on some automation and monitoring to as most of the people in such urban localities have very little time to spend on such activities, this has recently become a trend as the sensors used monitor these plants are relatively inexpensive and also usage of such sensors which provide the users with a lot more information which can be used to make dynamic decisions based on various conditions and requirements turns out to be even more efficient as it is not ideal to keep providing the same amount of nutrients and water irrespective of their need, therefore such constant monitoring helps out the users to monitor and decide on what actions to perform such as how much nutrients have to sprayed and how much water needs to be supplied. The only issue in implementing such system arises when we need to use a cloud service to manage all the data which is typically an expensive service and since it is not a one-time expense like the sensors, the users have to keep paying as a monthly/yearly basis for such services. The main aim of this study is to implement a simple and easy to use local server which the user can run on their personal computers or a cheap computation device such as a raspberry pi to avoid the heavy costs of cloud services.

Keywords: IoT , Cloud, Precision Agriculture, Automation.

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1 Introduction

Urban agriculture is the term that is used by the people who are growing plants in the traditional methods in the cities. These days there are so many big nurseries within cities which grow all types of plants and also some people with enough space are preferring to grow these plants at their homes. Since all these people are majorly working, it is difficult for them to constantly monitor and manage them, as a result they depend on IoT based methods to monitor and manage them. The only issue with such implementation is that the cloud service which is used to manage the data from the sensors becomes an expensive service as the users have to keep paying for it as long as they use the service. To overcome such issue people are starting to adapt on IoT based methods to monitor and manage them. IoT for agriculture helps in increasing crop production by managing and controlling the parameters like water management . Sufficient water is a must for agriculture and the crops can be damaged in a of situation of excess of water or in case of low water supply. In areas where there's scarcity of water, IoT can be of a great advantage as it manages the limited water supply efficiently with least amount of water wastage. Such system would be really helpful for the users as they will not have to spend lots of time, they can easily monitor the plants health, its nutritional requirements, which can be really helpful to the user to understand when and if the plants requires any additional nutrients and also such systems also automate the part of water supply, usually a soil moisture sensor is implemented to constantly monitor the moisture level in the soil so that when the moisture level falls below a certain user defined level, the system can automatically start watering the plants and once the soil reaches adequate amount of water the system can automatically turn off the water supply. This project proposes a method to use a local server which can run locally on any light computation device so that the user can eliminate the heavy service charges of using a cloud service and also all the data is locally stored. Here we will be strategically dividing the plants on the basis of their types and similarities and placing the sensors which constantly monitor the parameters such as the soil moisture content, climate temperature and humidity, PH level of the water. All these sensors are managed with the help of a NodeMCU-ESP8266, with the help of its integrated Wi-Fi module, we will be able to send the sensors data wirelessly to the local server.

2 Literature Survey

Urban agriculture is a rapidly growing activity with a huge demand for automation, the idea of smart monitoring began with the basic monitoring of various parameters [1], [3], [4]. It consists of a simple microcontroller which sends the data from its sensors to the cloud from which the user can view that data. Depending on the user's requirement he may also have an option to control a few parameters like turning on/off water supply. "Choosing a local or remote cloud." This study conducted in 2012 was one of the key decision factors in our research as it explains all the aspects of using a local server and a cloud platform and from which we have come to a conclusion to use a local server instead of a cloud platform due to its various features which are beneficiary for our project. "Smart automated home application using IoT with Blynk app." This study was one of the important papers of our research as it projected the usefulness of using the blynk local server instead of a cloud platform, even though this project focused on using the server for an home automation project, we understood the importance of same server in urban agriculture and implemented it in our project. From the above studies we were able to understand the concepts, advantages and limitations of cloud platforms and local servers, it also helped us to understand the usage of both the platforms are not suitable for all kinds of applications and both have their own pros and cons, but we were able to come to a conclusion that using a local server instead of a cloud platform for this project is more efficient and also inexpensive.

There is another study which shows how we can eliminate the usage of cloud with the help of a RaspberryPi to control all these sensors [2]. Here the raspberry pi acts as the computation device which manages all the data from the sensors. By referring all above papers it is found that no such system existed with all integrated features using a local sever but the proposed system includes these all features such as displaying temperature, water PH level, humidity and soil moisture values and also automatic switching on and off of motor by considering soil moisture values through a local blynk server.

3 Proposed Method

This model will consist of various stages which includes the hardware stage, the local server and the mobile app. Here we will be making use of an existing IoT application which is known as "Blynk". We will be using a NodeMCU-ESP8266 to control/manage the sensors, and a RaspberryPi/Computer to run the local server.

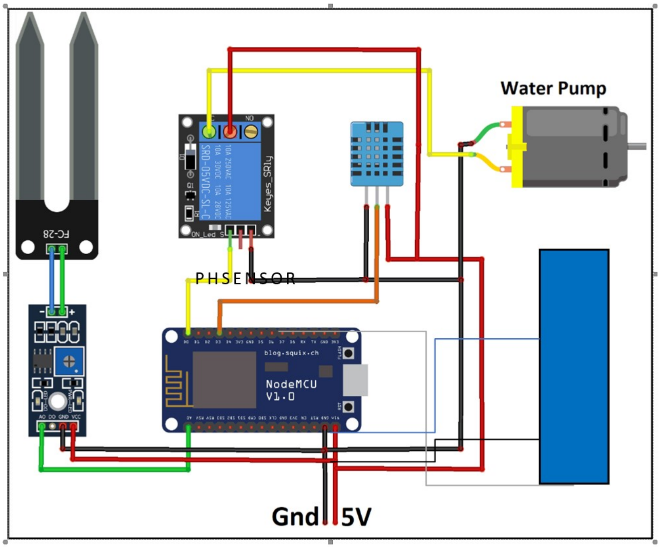

Figure 1: Produced Interface

The application shall import data from the local server and display it to the user in the form of values/graphs. The parameters such as temperature, humidity, moisture are obtained from the local servers and displayed on the mobile app. Also, the user will have an option to manually turn on/off the motor

4 Procedure

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4.1 Hardware Layer

The key component of the hardware layer is the NodeMCU, the reason for choosing it is because it is small enough to easily be mounted anywhere, consumes

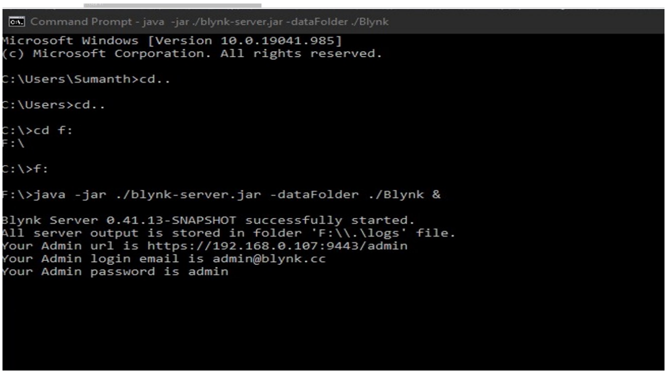

Figure 2: Deploying the server from command prompt

very less power, has sufficient amount of I/O pins to connect all our sensors and it also has an integrated Wi-Fi module on it so that it would be easy for us to transmit the data through it. The hardware layer also consists of the sensors, for this project we will be using a DHT11 sensor which is used to measure the Humidity and Temperature of the climate, then we have the soil moisture module, this sensor is inserted into the soil so that it can measure the moisture level in the soil. We also use a PH sensor to monitor the PH level of the water that is used for the plant, this is important as it necessary to ensure that the water being supplied is at a neutral level else it may damage the crops.

4.2 Local Server

In this project we will be using the help of an application called “Blynk”, it is an open source software and the main advantage of this application is that it requires very little computation power, so that it can even run on a RaspberryPi, in this project we will be deploying this server application on a windows PC. From the command prompt we run the .jar server file which deploys the server locally and also displays the Admin URL, Admin Username and the Admin Password, all these credentials are generated by default which the user can change from the dashboard later. When we enter the admin URL in a browser we will receive this page where the user is required to enter the credentials in order to login (Note: Once we run the blynk server from command prompt, the server is already running and will start to send/receive data, this step is only for admin to login and make any changes.) The above screenshot is the main dashboard page the users gets when he is logged in, it shows the users that currently have access to

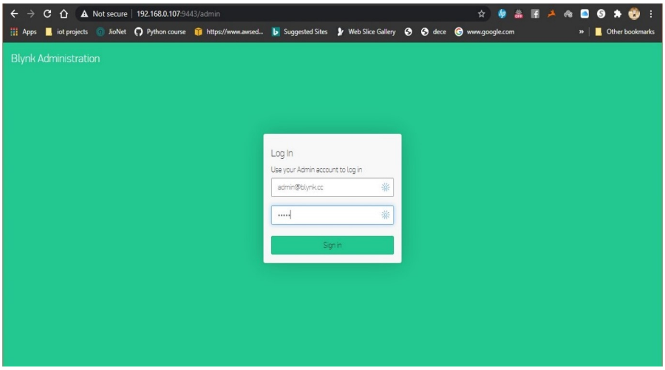

Figure 3: Login Page of Developed Server

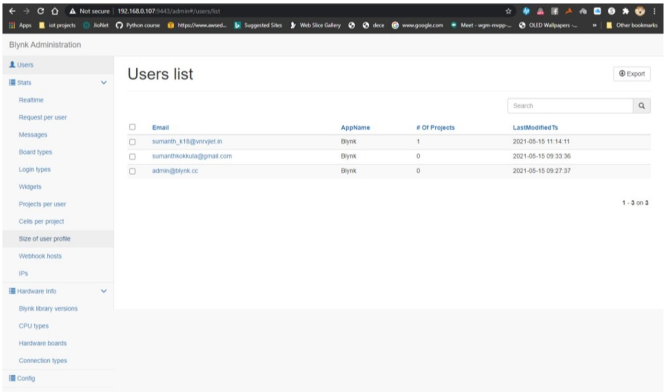

Figure 4: Blynk Administration Dashboard

this server. You can also see various options to the left side, the user has access to the ongoing projects, users, data, stats etc.

4.3 Mobile Interface

The mobile app is the Blynk Mobile app, it is available for both iOS and android, it is very easy to setup this app to work with the local server so that it can fetch data from it. The user also has access to customise various layouts on how he wants to see the data and also can easily add any new parameter for further upgradability. One of the key features of Blynk server is that it provides a mobile application for both iOS and android and when we use the blynk server instead of the blynk cloud it provides full abilities of the mobile app for free where as if

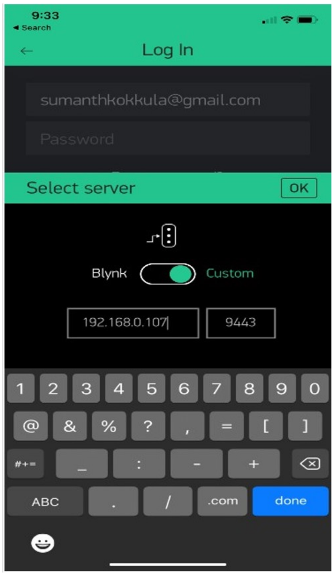

Figure 5: Login Page of Developed Model

you use the blynk cloud, it charges the user for using the app in a way to charge for the cloud service. Once you install and open the blynk app you will see an option to log in, before logging in we must select the server, in the select server tab the user shall enter the IP address provided for the admin URL and then login with the registered username and password. After that the user shall customise and organise which data to be shown and how it must be represented.

5 Result

Mobile Application interface where all the parameters can be represented in terms of values as well as a graph, in the bottom the user has an option to toggle a switch to turn on/off the water pump manually.

6 Conclusion and Future Work

This project mainly focuses on the part of using a local server instead of a cloud as we already have many studies regarding automating such processes. Thus ensuring that the user may not end paying lots of money. For time being and due to unavailability we were not able to use a NPK sensor, which is also one

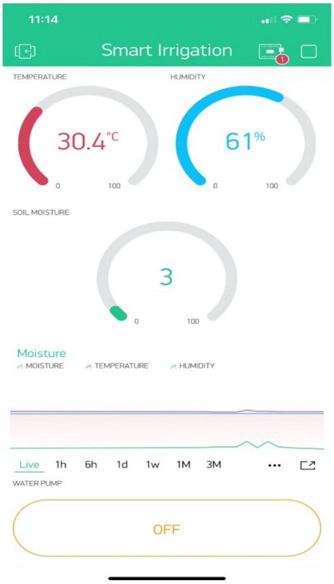

Figure 6: Result Mobile Application

of the important sensor as it provides the levels of Nitrogen, Phosphorus and Potassium in the soil, when available this sensor can be easily integrated as there are sufficient I/O ports in the NodeMCU.

In future, we would like to add some more features to this project like addition an option to provide suggestions based on the parameters provided by the sensors, but such feature will require a large dataset with a long timeline duration. Also such project can be very useful to implement in places like educational institutions and offices, where such modern application is easier to implement as often such places maintain plants throughout the area, and already have a local server/computer where this application can be deployed and also most of such places already have a Wi-Fi network throughout the area, therefore, it is easy to place the sensors anywhere. We would like to explore any such opportunities to implement this project in a place, like mentioned above, an educational institute with plenty of plantations would be an ideal place to implement our project as such institutions already have a Wi-Fi network throughout so that we can easily implement and also they will have computation resources like college servers which run 24/7 which can be used to deploy the local blynk server.

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