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Water Level Monitoring System with Vertical Farming using IoT

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Abstract- The field Internet of Things has become one of the most important technologies of the century. The reason behind the rapid growth of this technology is the ability to connect and transfer data over a network without requiring human to human or human to computer interaction. In the proposed system which is based on IoT, is a fully automated system which can be used as a monitoring system for water level in the overhead tank and also for monitoring various parameters required for better and healthy growth of the crops such as the intensity of light in the cabin, moisture of the soil in vertical farming module, etc. This system can be used as monitoring system within home or workplace to keep a track on the parameters. With the use of various sensors, the system monitors various parameters dynamically. The provided values from various sensors are analyzed by Raspberry pi and accordingly the action was taken with the help of various actuators. The proposed system can be use used in agriculture because in the field of Agriculture, it is very important to monitor various key growing conditions that plants require such as temperature, light, water, etc. Along with all this we also need to have a major concern about the monitoring of water in the upper head water tank to minimize the water wastage due to over flow. Monitoring these isn't possible manually because of the human unreliability and inaccuracy.

Keywords- Water level monitoring, Vertical farming, IoT, Raspberry Pi.

I.INTRODUCTION

Due to the growing population and peak developments in the region, alternative options for feeding the masses are being pursued, while minimizing the land used. Water and land are both classified as a finite resource. We don't know how much we are going to lose in next 40 years. Increasing food demand and water due to growing population along with ever decreasing arable lands and ground water poses great challenges.

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To overcome these challenges, we can monitor and control the level of water to minimize the wastage of water and can employ vertical farming to meet the food demand by using less arable land. The plants in vertical farms and level of water in water tank require extensive care around the clock. Factors like accuracy of level of water in tank and humidity, temperature, intensity of sunlight in vertical farming plays a huge role. The problem comes here is that while practicing vertical farming, there must be continuous monitoring of the farming conditions which isn't possible manually because of human unreliability and inaccuracy. So, by automating various stages of the whole process can benefit excessively. The factors can easily be kept in check by deploying various sensors strategically in the vertical farming. There are several varieties of crops and plants and the requirement of light intensity, temperature and moisture of these plants may vary. Therefore, deploying various sensors for continuous monitoring these factors and fulfilling the requirement an improve the process. The sensors will monitor the intensity of sunlight, moisture at the roots and the temperature and humidity of the cabin continuously. The automation of both water level monitoring system and vertical farming module results in a biggest advantage. Since monitoring of the plants and water level require large manpower, automation cam provide cost efficient and effective system for it.

II.SYSTEM MODEL

We are humans, and the most common problem faced by us is the continuous monitoring of the water in the upper head water tank and also in case of vertical farming where continuous monitoring and maintaining various conditions for the better and healthy growth of the crops like watering these crops time to time, supplying them with sufficient light and also keeping humidity, temperature and moisture of the soil to optimal level is itself a difficult task. It takes a toll on the yield due to continuous human intervention required in this process. The proposed system is implemented using the IoT to overcome these problems. The motivation behind implementation of this system is to solve all the issues which were faced in the existing or manual system. Implementing this system will reduce the human intervention by automating the level of water in the upper head tank and various parameters needed for the cultivation of crops. The system is consisting of different ranges of parameter for different crops because different crops need different climate conditions for the growth. So, we just need to select the crop from the dashboard and the range of various parameter is selected automatically and the whole system will work according to these measures only.

This will significantly increase the yield of the plants and its growth will be much more efficient.

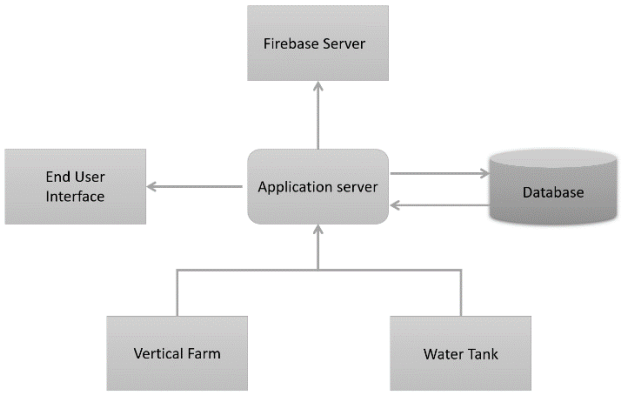

Figure.1. System Model

III.LITERATURE SURVEY

A traditional list of immediate "Basic Needs" is food which includes water, shelter and clothes.

In an analytical study, it has been revealed that there has been a substantial increase in the wastage of water due to numerous reasons. According to ASSOCHAM, the percentage of water wasted has been increased to an alarming 40% as compared to the previous year.

As water is one of the basic need of humans or living being it must always be present. But the major issues now a days is the continuous wastage of water which will leads to water scarcity.

The most common water wastage is the overflow control used to prevent exceeding the maximum level that a storage water tank can hold. There are some systems which were developed to control this water wastage.

There is various automated water level control system that are currently present to minimize the wastage of water. Some of the water level monitoring systems are:

[1] In this paper, Water level monitoring system which makes use of IR sensor and LED switches to detect the level of water. In this system four levels are defined at 20, 40, 60, 85 and whenever water reaches to the respective level the LED at that level glow.

[2] In this paper, it deals with brief explanation of using Arduino Uno to automate the water level. This system makes use of five electrodes to sense the water level in the tank. The electrodes were placed at five different levels to sense the level of water. In the circuit, one wire of 5V supply is placed at the bottom of the tank. So, when water reaches to the lower level electrode the 5V supply wire and the electrode at low level will short and the circuit will complete and motor will turn on.

Another basic need of Human is food. Due to the increase in the population there is increase in food demand and decrease in the arable land. So, we need more production from agriculture systems to meet the growing food demands. This problem built an idea of Smart Vertical Farming which is a latest technology introduced in agriculture field to diminish the land used issue.

There are some vertical farming systems which are currently present are:

[3] In this paper, Smart vertical farming makes use of several hardware devices that monitor agricultural variables such as soil moisture, temperature, humidity, light exposure, intruder detection and are integrated with software design and other technology services. These integrations are accomplished through IoT, cloud computing and basic digital communication. Smart vertical farming makes use of an AT89C52 microcontroller which is responsible to take the data from the various sensors and take the proper actions that are required. The system has a mobile application which is used to inform the user about the variations that occurs in the vertical farm fields.

[4] Based on the actual agricultural system, the sensor technology and wireless network in combination with IoT have been studied and evaluated in this paper. Here a distributed wireless network of sensors is used to collect the data of the various environmental parameters in real time. The method includes the technique of image processing to classify the leaf diseases.

The microcontroller handles this data and triggers the actuators to regulate the water quantity, based on the threshold specified for a specific crop. Bluetooth module performs wireless data transfer. An android program is for remote control of this device.

IV.RESEARCH METHODOLOGY

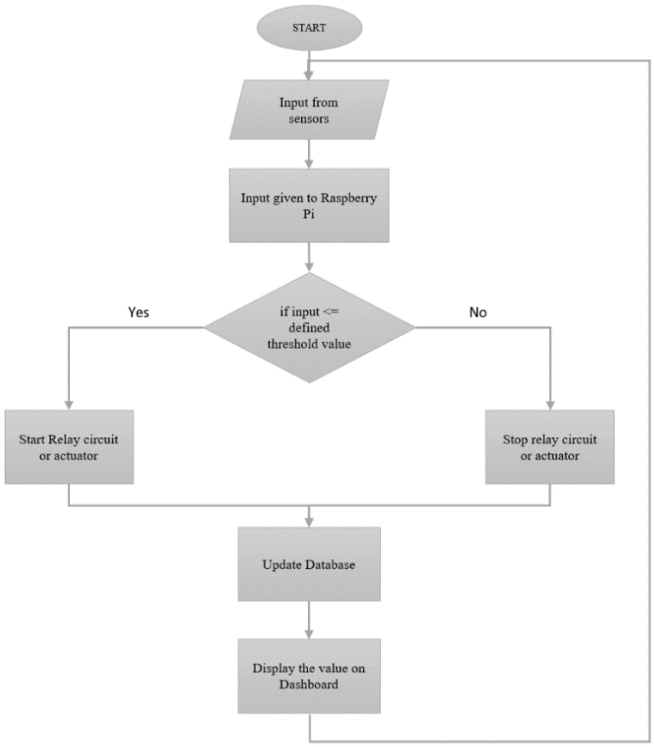

Figure.2. Data Flow Diagram

The Raspberry pi 3 Model B is a single board computer used here and it is responsible to take the data from various sensors and take the action as defined. Ultrasonic sensor HC-SR04 can be used for measuring distance or sensing objects. It provides a precise distance as an output in centimeter. So, it can be used in the proposed system to measure the level of water and the output of which is provided to raspberry pi and the raspberry pi will function accordingly. The distance can be calculated with the following formula:

$$Distance\ L = ½ \times T \times C$$

Where L is the distance, T is the time between the emission and reception, and C is the sonic speed that is 340 m/s. (The value is multiplied by ½ because It is the time for go-and-return distance.)

The Soil moisture sensor sense the moisture in the soil and if it is below the threshold value then it will notify the raspberry pi, then raspberry pi will sent the signal to servo motor to rotate the nob so that the water can flow through the pipe to the crops and maintain the moisture level.

BH1750FVI light intensity sensor is made of a highly resistant semiconductor. If the intensity of light of the surrounding doesn't matches the range which is defined, then LED lights will be turned on or off. DHT11 which is a sensor is used to measure the temperature and provides the output in degree Celsius. This sensor is capable of sensing the temperature and humidity. As we know that the humidity changes with temperature, if the temperature increases the humidity level in the environment also increases. It uses a thermistor to measure the surrounding air and splits out a digital signal on the data pin.

The values from various sensors are received at a defined time gap multiple times and the average of these values are calculated and fed to the Data center. The data from all the sensors are collected and the average value were calculated from these data. After that the resultant values were compared with the threshold values and accordingly controls the various actuators such as Motor pump, Servo motor and LED lamps.

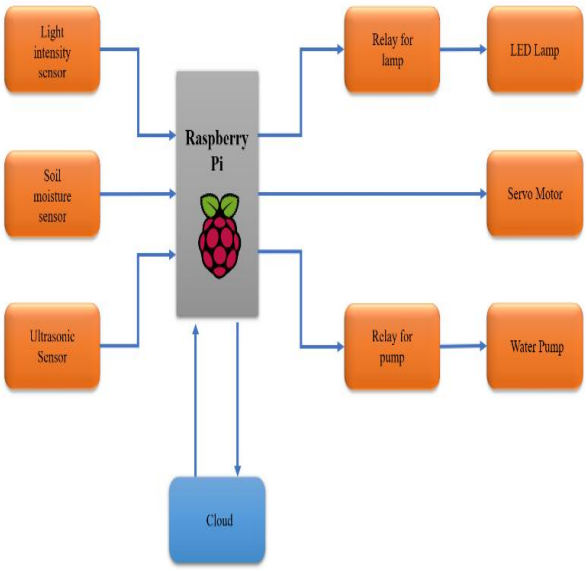

Figure.3. System Hardware Implementation

V.RESULT AND DISCUSSION

As per the data collected from various sources it was observed that out of the total amount of water being utilized in different farming and agricultural techniques, only 40-50% water was actually required by the plants and crops, the excess water either caused moisture problem in roots and stems or got wasted. Therefore, the developed system is fully capable of ensuring that there is no harm to crops and keeps water utilization under check and avoids any overflow or water wastage. The system composes of 2 modes manual and automatic which facilitates the user to adjust the operation of the system as per the their convenience wherein the first mode that is manual the user can operate the system totally under their control manually and in the second mode the operation of system is totally automatic which ease the user efforts and doesn't require continuous user monitoring. In addition, the system also includes a module which ensures availability of light with proper intensity in absence of natural sunlight, to support the proper and timely growth of plants in vertical farming. The light sensitive module is very useful at the times there is cloudy weather or no sunlight for many days. Therefore, both the systems modes and the additional light sensing module together makes the system robust and flexible in operation from the user's aspect. Moreover, the design of the system and the interface is extremely simple and economical making it affordable and reachable to everyone and in this way this system can ensure smart consumption of natural resources and better nourishment of plants/crops effectively.

VI.CONCLUSION

Water Level Monitoring System with Vertical Farming helps to develop a system which can minimize the wastage of water which is due to the overflow. On the other hand, it also makes it possible to produce more better and healthy crops in less space. As the system is fully automated, it completely eliminates the possibility of human error or poor yield due to bad weather, bad conditions, etc. From light intensity required, temperature required to watering, every detail is taken care of by the system.

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