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AMIGO
(Agriculture Modifier with Integrated Growth Observer)

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Abstract *- In India, around 80% of population depends upon farming and one third of the nation's economy is based on farming. In areas like plantation, nursery, house gardens etc, watering of plants at regular interval matters. The proposed irrigation system will be very efficient and cost effective in these. This paper presents a farm automation system which is based on Raspberry pi and Arduino microcontroller. Raspberry pi acts as the control block to the automatic irrigation system in controlling the watering by sensing the current environment of the plant, i.e. by sensing the growth of the plant, atmospheric humidity, temperature, and soil moisture. With the help of Image processing and IoT, it senses plant growth, detects the leaf diseases, detects the fruits (or flowers) and communicate these information to the farmer through a web page. It also includes PIR based intruder detection for the security of the farm.*

Keywords**: *Raspberry pi, Arduino UNO, IoT, Image processing, Soil moisture sensor, humidity sensor, PIR.***

1. INTRODUCTION

Irrigation is an artificial method of supplying water to the roots the plant. There are many automatic irrigation control systems. AMIGO is very much different from its preceders. Issues such as diseases, unexpected climate changes concerning agriculture have always being hurdles in the development of the country. The best solution for these issues is replacing the current traditional methods of agriculture with smart agriculture methods. Hence we aim at making agriculture bit more smart using automation, image processing and IoT technologies. The major highlighting features of this system includes the automatic as well as manually controllable mobile robot, by which it provide more care to each plant, keeping more vigilance etc. Secondly, it includes an irrigation system with smart control and intelligent decision making based on accurate real time field data. Thirdly, it has a smart fruit sensing and counting system for picking them at proper time. Controlling of all these operations will be through any remote smart device or computer connected to Internet. These operations are performed by interfacing sensors, Wi-Fi, camera and actuators along with arduino and raspberry pi.

2. RESEARCH SURVEY

To cooperate with the current scenario of decreasing water level and unpredictable climate variations people developed many irrigation systems based on raspberry pi. In automated irrigation system using a wireless sensor network and GPRS module, Joaquin Gutie'rrez, make use of an algorithm with threshold values of temperature and soil moisture sensors to operate the irrigation system [1]. In Automization of agriculture irrigation system using Raspberry pi and Android app, Nilesh Shamarao describes an irrigation system which can be controlled by an android app [2]. Nikhil Agarwal explains a smart irrigation system which can be controlled by the email and the irrigation is controlled by soil moisture and the temperature [3]. All the above systems are designed only for single purpose, i.e. irrigation. But in case of IoT based Smart Agriculture, Nikesh Gondchawar includes a moving vehicle to surveillance, in addition with the irrigation system based on the temperature and soil moisture [4]. All the smart irrigation systems mentioned here works only based on the threshold values of temperature and soil moisture, but the size or growth of the plant and humidity is also a parameter for the irrigation.

3. PROPOSED MODEL

The block diagram of the proposed system consists of the raspberry pi and Arduino. It also includes the sensors such as humidity sensor, soil moisture sensor, temperature sensor and a camera (pi camera) for image capturing.

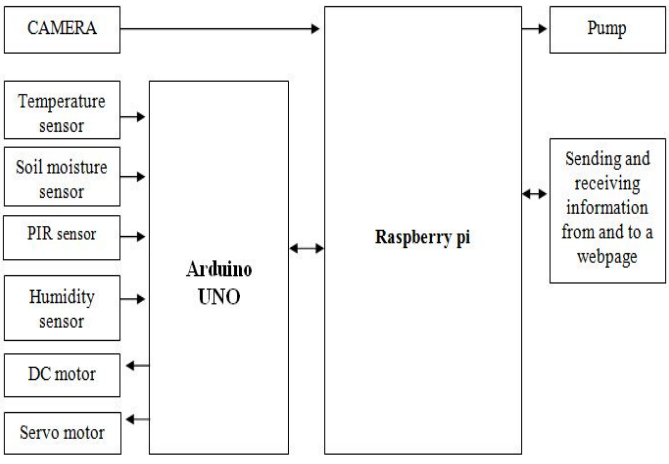

Fig -1: Block diagram of AMIGO

3.1 Hardware Description

a) Raspberry pi: The Raspberry Pi is small pocket size computer used to do small computing and networking operations. It is the main element in the field of internet of things. Raspberry Pi is available in various versions. Here, model Pi 3 model B is used and it has quad-core ARM Cortex-A53 CPU of 1.2 GHz, and RAM of 1GB. it also has: 40 GPIO pins, Full HDMI port, 4 USB ports, Ethernet port, 3.5mm audio jack, video Camera interface (CSI), the Display interface (DSI), and Micro SD card slot.[5]

b) Arduino UNO: Arduino Uno is a development board based on the ATmega328. It consist of 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a power jack, a USB connection, and a reset button.[6]

c) Soil moisture sensor: Soil moisture sensor measures the water content in soil. It uses the property of the electrical resistance of the soil. The relationship among the measured property and soil moisture is calibrated and it may vary depending on environmental factors such as temperature, soil type, or electric conductivity [4].

d) Pi Cam: Pi cam is a Camera Board, which is capable of taking HD videos and stills. It has a 5 MP fixed-focus camera that supports 1080p30, 720p60 and VGA90 videos, and still captures. It can be accessed through MMAL and V4L APIs. It connects to Pi through a ribbon cable at the CSI port. Here we use pi cam v2 [7][8].

e) DHT 11: it's a low cost package of temperature and humidity sensors. It is good for 20-80% humidity readings with ±5% accuracy and good for 0-50°C temperature readings ±2°C accuracy [6].

f) PIR sensor: Detects heat radiations in the form of IR radiation of the moving body, such as human being, animals and birds etc [6].

3.2 Work description

Technologies used here are

a) Image processing
b) Internet of Things (IoT)

Image processing is the method of converting image into digital form, in order to get some data from it. Here we use image processing to detect the plant growth, leaf diseases and fruits in a plant.

IoT inter-networking of physical device with embedded system to exchange their data. Here we use IoT, to access the data and control the whole system from a remote place.

The overall working of the amigo is as per the following flowchart,

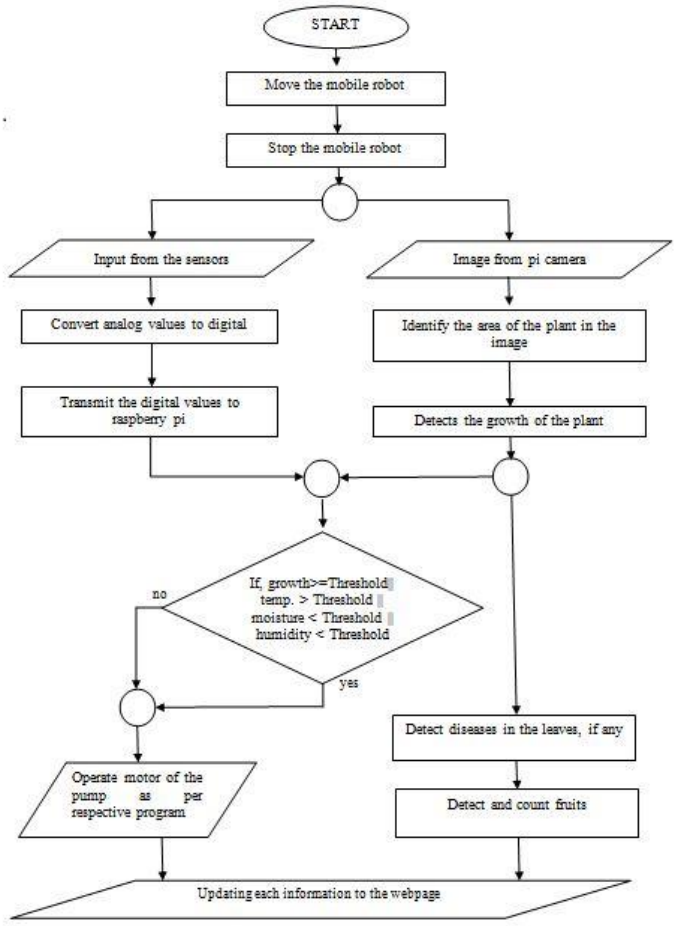

Fig.2 AMIGO flowchart

It consists of mainly 4 sensors, in which three are used for the purpose of analysis of the plant and its environment and one is for the security of the plant. Soil moisture sensor, temperature sensor, humidity sensor, are used to determine the environmental conditions and PIR sensor is used to detect the presence of any animals or birds in its field of sight.

We can classify the whole system into two,

- Master unit
- Slave unit

The master unit includes a raspberry pi, pi camera and the slave unit has the sensors (temperature sensor, humidity sensor, soil moisture sensor and PIR sensor), arduino UNO and the output units (dc motors, pump, servo motor).

In the master unit raspberry pi, does the image processing to detect the growth of the plant, presence of the fruits, and leaf condition. It also coordinates and controls all the activities and uploads this information to the webpage and also takes the information from the user through webpage. The slave unit does all the processes such as accepting the data from the sensors, and sending these data to the raspberry pi through serial communication ports.

Since the complete system is integrated into a mobile-bot, AMIGO starts moving and stop in front of the plant and pi camera captures the image of the plant for collecting the data. At the same time the arduino UNO collects the data from the sensors and process it there and send them to raspberry pi. The values from the sensors are compared with the preset threshold values and actions are taken on behalf of the comparison the pump is get on and o_. According to the plant variety and the environmental conditions, the threshold value should be change in the program. If the PIR sensor senses any living body, then an alarm is blown in such a way that it can scare the animal or bird or it can inform the nearby person that there is an intruder. In case of any emergencies, there is also an option to move the mobile bot manually too through the webpage.

4. FUTURESCOPE

In future, we are planning to AMIGO V2.0 which includes a seeder (for sawing the land and placing the seed), and a weed detection system and spot spraying irrigation system with 'fertigation' (ie addition of adequate fertilizer to the water for irrigation. We are also planning for an additional surveillance camera in such a way that it can access the camera to detect the path it travel. And it can also used for the security of the field or land.

5. CONCLUSION

In this work, we successfully develop a smart and intelligent irrigation system by analyzing the plant growth and the various environmental parameters and fruit counter and leaf disease detector. This work is mainly focused for the farmers and gardeners who don't have enough time to care their plant. Since it is of small in size and is mobile its ideal for the polyfarms and greenhouses. Since the system only supplies the water which is needed for plant, we can reduce the wastage of water and over irrigation, which may reduce the soil fertility. By providing web interface to the farmer, one can easily monitor their field from any distance. Moreover a farmer can reduce labour charges for the irrigation.

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