Central Control Unit for Crop Monitoring with Nutrient Detection System Using IOT

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Abstract- *The main objective of this project is building a control unit for monitoring the crops and farm conditions, if farmer is away from the land to produce sustained healthy crops. The central unit collects the data about humidity, temperature, and soil moisture and soil fertility through various sensors and Raspberry Pi is used to automate the process. A camera is used to capture the animals and other intruders using motion detection and immediately alerts the farmer by the sms through IOT. By the use of electrochemical sensor we determine the deficiency of macronutrients (NPK) in the soil and predict the fertilizer for that deficiency. Raspberry Pi performs all these operations and sends even the graphical representation to the mail of the farmer through IOT.*

Keywords- sensors, humidity, moisture, soil fertility, Raspberry Pi, IOT.

I. INTRODUCTION

griculture provides nearly 19% to the Indian economy. Due to the increase in population density, urbanization and other commercial factors, better cultivation should be done to satisfy the demands of the people. Presently we are facing the shortage of water that is essential to grow crops healthy.

Certain factors that is necessary to develop the crops healthy is by maintaining humidity, moisture of soil, temperature and the nutrients that are present in the soil in required proportions. When the adequate water is not present, automatic irrigation should be done with care and when it is essential.

The method followed for the soil testing is by collecting the samples and test using chemical compounds in laboratories which processes to take at least a few days. The Electrochemical Sensor provides the nutrition levels of the soil with great accuracy.

IOT is such technology which helps the farmer to monitor the farm conditions such as temperature, humidity, moisture and macro nutrients remotely from anywhere and anytime. So this project results in less dependence on man power in agricultural field and very accurate measurements can be available from the field and improvement in yield. With this proposed work, central control unit will decide the action about automatic irrigation (to maintain the moisture in the soil) and prescription of some fertilizers in nutrient deficient case and it will also helpful in capturing the field if any motion of animals are detected using camera, the classifiers are used to classify the datasets into relevant datasets.

II. LITERATURE REVIEW

R.Sindhuja and B.Krithiga proposed an electrochemical sensor system for continuous nutrient determination. The flow injection analysis (FIA) technique is used for detecting the nutrients by the flow-through electrochemical sensor system. For long term applications a reliable and sensitive electrochemical system is used to monitor the soil nutrients [1].

Gurudatta wadakar and Dr. Sanjay Dorle proposed the sample tube which is tested by using sensors array, the electrochemical sensor senses the nutrients from soil, which sense the output in mV and further the signals are given to A/D converter. The main controller will match the mV values with the values in % from look up table and further these values are used to calculate Fertility Characteristic of soil. The output will be displayed on LCD display [2].

Amrutha A, Lekha R, A Sreedevi developed a sensor system based on the principle of calorimetry for estimation of nutrients present in the soil. Dosage for maintaining of fertilizers are developed. Estimation of macronutrients in the soil sample is done by adding colour reagents [3].

DrN.Suma proposed system to monitor the agricultural factors based on GSM module to deploy various sensors like Temperature, Humidity, Moisture and PIR sensors in the PIC Microcontroller. A mobile application is created to show the threshold values to the user. The microcontroller automatically turns on and off, if the value exceeds the

threshold values and sends an alert message to the user through gsm technology [4].

III. BLOCK DIAGRAM

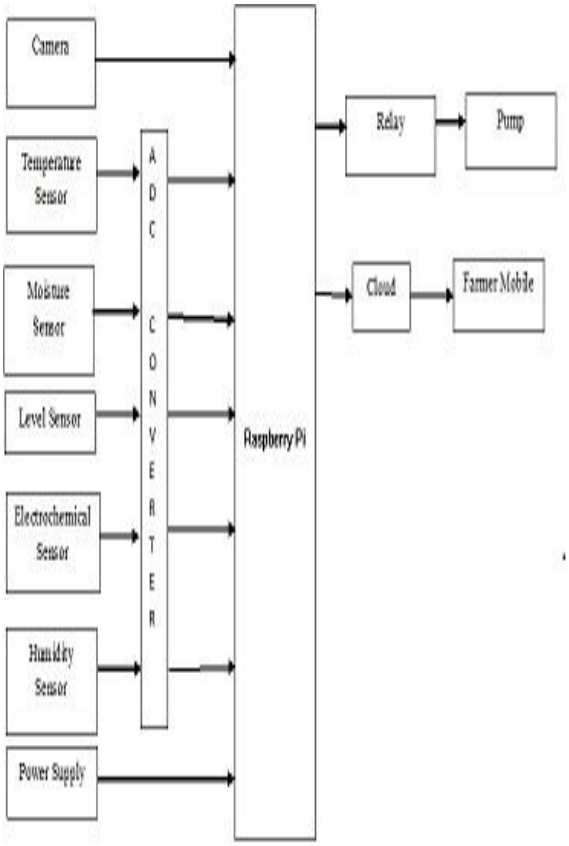


Fig.1 Block Diagram

IV. METHODOLOGY

The system is mainly controlled by the Raspberry PI. Various sensors like Temperature, Humidity, Soil Moisture, Level sensor and Electrochemical Sensors are connected through Raspberry Pi. A motion detecting camera is used to detect the animals and other intruders by detection the motion of the object.

All the above sensors sense their own data present in the farm and then process them to Raspberry Pi .To convert digital values for Raspberry Pi, ADC converter is used or Arduino is used.

The data processed from Raspberry Pi is send to the IOT Server. We used unlicensed ubidots server to store the data on cloud. The alert system is send to the farmer mobile phone directly from these IOT server. We can also send graphical representation of crops growth and images of farm land to the mail of the registered user easily.

The parameters like humidity, moisture and temperature sensor has threshold values in the server. Beyond this threshold values, the farmer get alerted immediately through the message.

The delay taken for the farmer to test the fertility of soil and the farm conditions are remotely sensed. So the presence of the farmer is not essential. The soil results can also be send to the soil experts in a graphical manner that makes the job easier for the soil experts to analyse and provide solutions to the farmer immediately So this technology makes the farmer, farm land and the soil experts analyse and makes the crops to grow in a suitable conditions for a good healthy crop.

V. HARDWARE USED

1. RASPBERRY PI:

The Raspberry Pi is a special hardware that performs all the operations of a system. This little board is of low cost, easily accessible, simple use. It has 40 GPIO pins, full HDMI video output, 4 USB ports for interfacing keyboard, mouse and the Ethernet port which makes easier to connect the internet. A USB camera can also be connected besides the default web cam in raspberry PI. It has a Broadcom BCM2835 system on a chip which includes an ARMl176JZF -S 700 MHz processor, Video Core IV GPU, and an SD card. The GPU is capable of Blue ray quality playback, using H.264 at 40MBits/s. It has a fast 3D core accessed using the supplied OpenGL ES2.0 and Open VG libraries. The chip specifically provides HDMI and there is no VGA support.

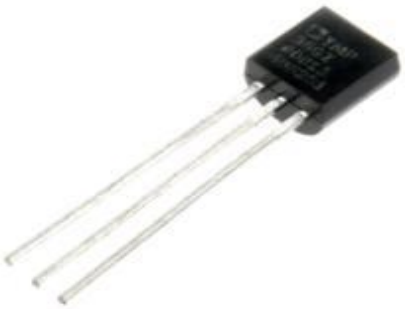
Linux kernel based os is present in Raspberry PI. Python was chosen as the main programming language, as it is easy to learn and a programming language that is suitable for real world applications. With the addition of Num Py, Sci Py, Matplotlib, I Python, and PyLab, Python can be used more

effectively for computational mathematics as well as for the analysis of experimental data or control systems purposes.

2 .**TEMPERATURE SENSOR:**

Temperature sensing can be done in either direct contact. Some of the examples for temperature sensors are Thermocouples, Resistance Temperature Detectors (RTDs), Thermistors, Infrared, and Semiconductor sensors.

Nominal IC temperature range of -55°C to +150°C. In analog-to-digital converter (ADC) temperature is measured continuously and can be read at desired time. If temperature is exceeding a threshold value which is programmed to an experimental and accurate value, the raspberry pi process the sensor to monitor temperature and makes an output pin high. Below the threshold temperature can also be programmed and the raspberry pi notifies when temperature is gone below this programmed threshold.



3. SOIL MOISTURE SENSOR:

Soil moisture sensor is a sensor which senses the moisture content of the soil. The sensor has both the analog and the digital output. The digital output is fixed and the analog output threshold can be varied. It works on the principle of open and short circuit. The output is high or low indicated by the LED. When the soil is dry, the current will not pass through it and so it will act as open circuit. Hence the output is will be maximum. When the soil is wet, the current will pass from one terminal to the other and the circuit is said to be short and the output will be zero. The range of sensing and efficiency is high in platinum coated sensor.

4. HUMIDITY SENSOR:

Humidity moisture uses the humidity sensing component in which moisture holding substrate is in between the two electrodes. The conductivity of the substrate changes or the resistance between these electrodes changes due to the change in the humidity and results in analog values. But Raspberry pi reads the digital value only. So this change in resistance is measured and processed by the IC and given to the ADC converter or Arduino board to convert analog value to digital values.

Humidity sensor uses the thermistor. Thermistor is like a variable resistor in which resistance changes accordingly to the temperature. Negative temperature coefficient states that resistance is indirectly proportional to the temperature i.e. when temperature increases, resistance reduces.

5. ELECTROCHEMICALSENSOR:

Electrochemical sensors are primarily used to detect nitrogen, potassium and phosphorous. Electrochemical sensors are the fuel cells consists of inert metal electrodes inserted in an electrolyte solution. The electrolyte composed of strong inorganic acidic aqueous solution. When any gas is detected a small current proportional to the concentration of the gas.is liberated by the cell.The electrochemical sensor has the

advantage of good linearity, better selectivity and excellent repeatability.

6. LEVEL SENSOR:

Water level sensor senses the water level present in the object like tank or bottle that stores the water. When the water level is less than the threshold voltage, sensor sends signal to the Raspberry Pi.

7. RELAY:

A relay acts as electromagnetic switch to turn on or off a large electric current by using a small amount of electric current. The basic principle of a relay is an electromagnet where electricity flows through a coil of wire than it becomes a temporary magnet.

A Relay can act both as switch or amplifiers to turn on or off the bigger devices using a smaller electric potential since sensors are sensitive electronic components and produce only smaller currents. Most of the times we need to drive large potentials to activate larger ones. In our project Raspberry pi Produces 5v volt and potential need to drive for pump is 12v. So Relay bridges the gap to drive 12v to pump from 5v output of Raspberry Pi.

8. CAMERA:

A USB camera is connected to the usb ports of the Raspberry pi. It detects the motion of an object intruding like animals and birds within line of sight. When there is any motion detected, the camera captures the object and sends as an attachment to the mail of the farmer and a sms to the farmer. Thus unknown intruders can also be detected by this process.

VI .SOFTWARE USED

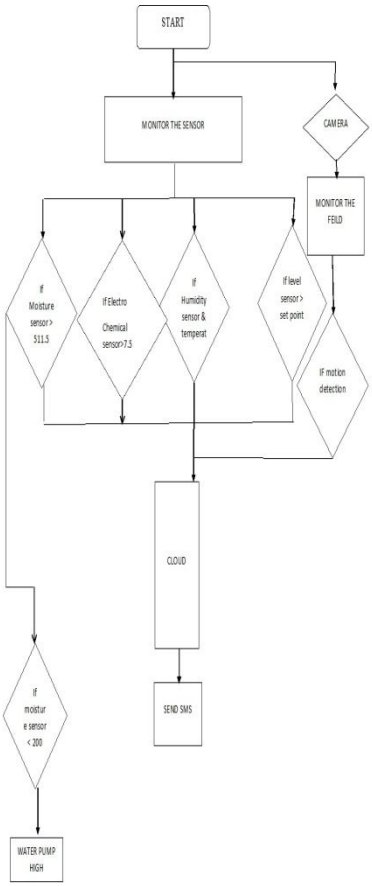
1. UBIDOTS:

Ubidots provides a platform that enables the developers to easily capture the sensor data and turn it into useful information. With the use of Ubidots platform data is send to the cloud from any Internet-enabled device. You can then configure actions and alerts based on your real-time data and unlock the value of your data through visual tools. Ubidots offers a REST API that allows you to read and write data to the resources available: data sources, variables, values, events, and insights. The API supports both HTTP and HTTPS and an API Key is required.

2. Raspbian OS:

Raspberry os is used in raspberry pi. The main language used in the Raspbian os is the python, since it is easy and have suitable libraries like open CV which makes this project simpler and cost effective.

VII. ALGORITHM



VIII. RESULTS AND CONCLUSION

Output graph showing moisture, temperature and humidity results via ubidots**:**

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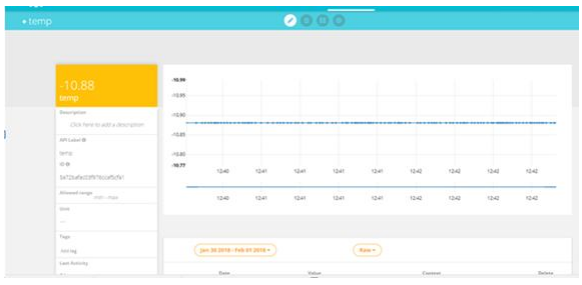

HARDWARE SETUP OF THE PRELIMINARY DESIGN

IX. FUTURE WORKS AND CONCLUSION

The hardware is interfaced with all the sensors in the board. The hardware components include the Raspberry Pi, relay, ADC converter and all the sensors interfaced. The ubidots unlicensed IOT software communicates with the owner and the recorded values. The works may be done as future development is alerting the farmer by a voice message. So that some illiterate farmers can understand what is happening and be creating a duplex communication between the farmer and system interfaced.

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