IOT BASED PLANT HEALTH MONITORING, AUTOMATED FERTILIZATION AND IRRIGATION USING RASPBERRY PI

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ABSTRACT- *Now-a-days plant health monitoring is the most important tasks in all agriculture based environment. In today's world Automatic systems are being preferred over manual system. With the rapid increase in the number of users of internet over the past decade has made Internet a part and parcel of life, and IOT is the latest and emerging internet technology. This paper proposes that the agriculture monitoring by using Temperature sensor, Moisture Sensor values to read the value and monitoring via IOT. The aim of this paper is to monitor using NoIR camera and do calculations based on the images captured by the camera and then compare those values with the NDVI values. Based on the results the nature of the plant is known and the fertilization is added when the plant is unhealthy. Also the humidity and temperature sensors are used for automatic irrigation of the plant.*

Keywords: Plant Health, Automation, Internet of Things, Raspberry Pi, Camera, NDVI, Sensors.

1. INTRODUCTION

The Internet of Things is regarded as the third wave of information technology after Internet and mobile communication network, which is characterized by more thorough sense and measure, more comprehensive interoperability and intelligence. IOT Consumes the time and monitoring the exact situation in fields. The NOIR camera is used to capture the image and it is interfaced with the raspberry pi to calculate the value and it is then compared with the NDVI Values. NDVI values are used to differentiate between the healthy and non-healthy plants. Thus enabling farmers to specifically check the health of individual plant. Now the framer is able check health of each plant easily and be able to yield more crops from the field. And the based on the NDVI values weather the fertilizers are to be added or not is decided and then if it is to be added the robot will automatically added the fertilizers to the plant and the mail will be sent to the farmer. Also it checks for temperature and humidity and then it automatically irrigates the plant based on the threshold value.

2. SYSTEM BLOCK DIAGRAM

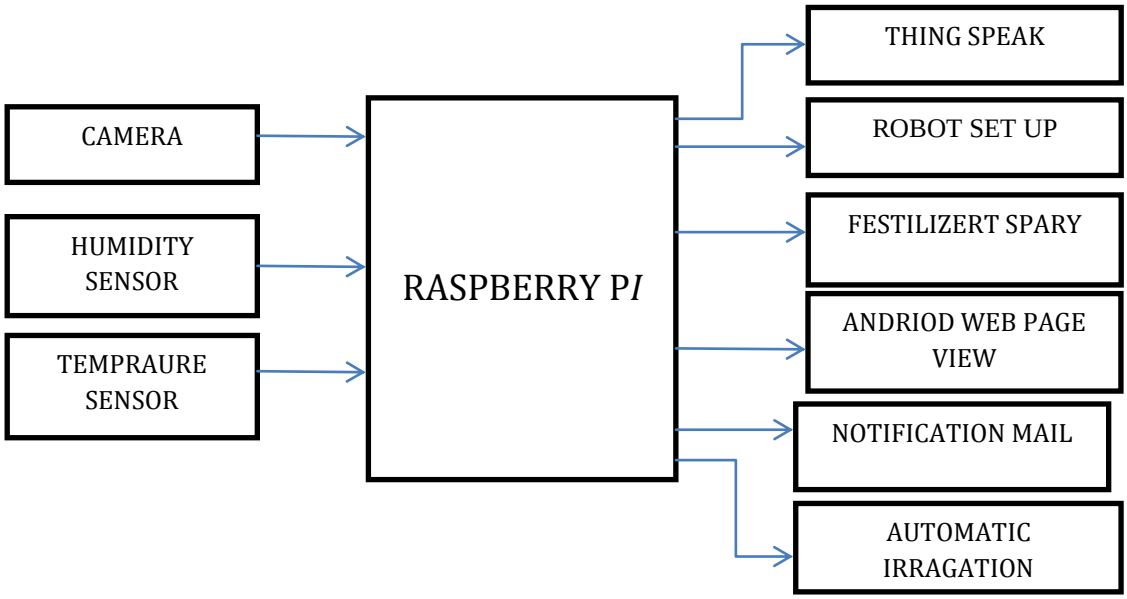

FIG 1: SYSTEM BLOCK DIAGRAM

3. DESIGN METHODOLOGY

3.1. NoIR Camera: The raspberry pi NoIR camera module is a custom designed add on for raspberry pi that does not have an 'IR cut filter' installed. Like the regular pi camera, it attaches to raspberry pi by way of one of the two small sockets on the board upper surface. It has been used to do cool creative photography and can even be used to monitor the health of green plants, also able to use the raspberry NoIR camera for surveillance system.

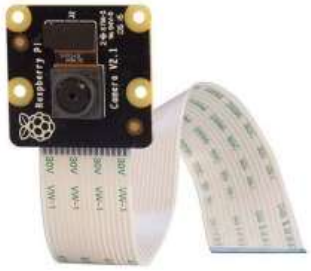

Fig 2: NoIR camera

3.2 Raspberry Pi: Raspberry Pi board is a miniature marvel, packing considerable computing power into a footprint no larger than a credit card. It's capable of some amazing things, but there are a few things you're going to need to know before you plunge head-first into the bramble patch. The Raspberry Pi, by contrast, is designed to run an operating system called GNU/Linux—hereafter referred to simply as Linux. Unlike Windows or OS X, Linux is open source: it's possible to download the source code for the entire operating system and make whatever changes you desire. Nothing is hidden, and all changes are made in full view of the public. This open source development ethos has allowed Linux to be quickly altered to run on the Raspberry Pi, a process known as porting. At the time of this writing, several versions of Linux—known as distributions—have been ported to the Raspberry Pi's BCM2837 chip, including Debian, Fedora Remix and Arch Linux.

Fig 3: Raspberry Pi

3.3 Humidity Sensor: Humidity Sensor or hygrometer senses, measures and reports both moisture and air temperature. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity. Relative humidity becomes an important factor when looking for comfort. Humidity sensor work by detecting changes that alter electrical currents or temperature in the air. There are three basic types of humidity sensors, they are capacitive, resistive, thermal humidity sensors.

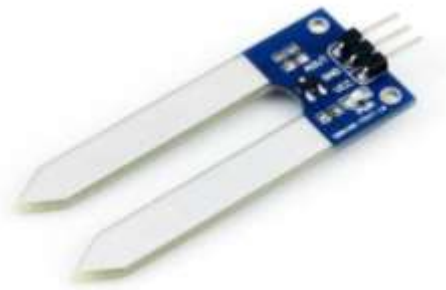

Fig 4: Humidity Sensor

3.4 Temperature Sensor: A Temperature Sensor is a device, typically, a thermocouple or RTD, that provides for temperature measurement through an electrical signal. A thermocouple (T/C) is made from two dissimilar metals that generate electrical voltage in direct proportion to change in temperature. This type of sensors consists of material that performs the operation according to temperature to vary the resistance. This change of resistance is sensed by circuit and it calculates temperature.

Fig 5: Temperature Sensor

4. RESULTS AND DISCUSSION:

To determine the density of green area on a patch of land, distinct colors (wavelengths) of visible and NIR sunlight must reflect by plants must be observed. When sunlight strikes the objects, certain amount of wavelength of light is absorbed and some are reflected. The pigment in plant leaves, chlorophyll strongly absorbs visible light (from 0.4 to 0.7 μm) for the use in photosynthesis. The cell structure of the leaves strongly reflects near infrared light (from 0.7 to 0.11 μm). Healthier a plant is more intensity of NIR band is reflected. The NDVI is calculated from the visible and NIR light reflected by vegetation. Healthy vegetation absorbs most of the visible light and reflects large portion of the NIR light whereas unhealthy vegetation shows vice versa. NDVI of dense green vegetation will tend to positive values (0.3 to 0.8).Soils and dead or dry leaves generally exhibits small positive NDVI values (0.1 to 0.2).Moderate values represent shrubs and grasslands (0.2 to 0.3).Rock, sand or snow will show very low values (below 0.1).

NDVI is calculated as

$$NDVI = \frac{NIR-VIS}{NIR+VIS}$$

- NIR is known as Non Infra-Red images.
- VIS is known as Visual Images.

Calculation of NDVI for given pixel, results in a number that ranges from -1 to +1. However no green leaves give a value close to 0 .0 means no vegetation and close to +1 indicates high density of green area. The NDVI values of each pixel are taken and

thus the average NDVI (table1) is obtained. This value will help to determine the status of the plant health and thus is classified as healthy, unhealthy and dead.

TABLE -1: Comparison Table of plant health

TYPE OF PLANT	AVERAGE NDVI VALUE
HEALTHY	0.96
UNHEALTHY	0.42
DEAD	-0.02

- When the NDVI value is greater than the 0.5 to 0.96 then the plant is healthy plant.
- When the NDVI value is less than 0.42 then the plant is said to be unhealthy plant.
- When the NDVI value is below -0.02 then the plant is considered to be dead plant.

Based on the above values when the plant is unhealthy the fertilizers to be added list are sent to the user mail id and if those fertilizers are available, then it automatically sprays to the plant. Also automatically irrigation is also monitored based on the temperature and humidity value.

5. CONCLUSION

A model based on the calculation of NDVI values of the healthy and non-healthy plants is presented through the wireless method of plant health monitoring system and automated fertilization and irrigation is done. It works on a control system based on raspberry pi and NoIR camera. The design of wireless network over VNC Viewer software is used for the easy accessed to the live streaming of the area in observation and thus capturing the images. This method focuses on individual plant thus helping farmers to determine the health of the plant. It uses basic hardware materials thus making it cost efficient.

6. References:

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