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Design and Operation of Wi-Fi Agribot Integrated System

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Abstract: In this paper autonomous robot for agriculture (Agri Bot) is a prototype and implemented for performing various agricultural activities like seeding, weeding, spraying of fertilizers, insecticides by using wireless WIFI Technology. Agri Bot is controlled with a Raspberry Pi. The Raspberry Pi is mounted on a robot allowing for access to all of the pins for rapid prototyping. A Camera is interfaced with Raspberry Pi for a live stream on web page and from web server we can control the AgriBot for seeding ,weeding, spraying of fertilizers. On the other hand user can also monitor all the sensors values on the internet even. Here I've uploaded all the sensors values into thing speak using internet. In my project I've introduced two ways which user can control AgriBot by live stream using camera and then control by webpage and monitor the environmental parameters.(Temperature, Rainfall, wind).

Keywords: Agrirobot, Automation, Raspberry Pi, WIFI, Camera.

I. INTRODUCTION

AgriBot is a autonomous robot for agriculture it has been performed to develop harvesters for cherry tomatoes, cucumbers, mushrooms, and other fruits. In horticulture, robots have been introduced to harvest citrus and apples. In this system AgriBot is control by the web server and also controlling the AgriBot is done by wireless by using WIFI technology and AgriBot is controlled by the Raspberry Pi. The Raspberry Pi is mounted on a robot allowing for access to all pins for rapid prototyping. A Camera is mounted on AgriBot with Raspberry Pi and sensor's also interfaced for to monitor environmental parameters. In the above scenario environment parameters control by server Think speak using WIFI, that means monitoring and controlling done by Web server only. This system for who can always stay at web server on PC, and he monitors continuously. In my system, no need to monitor or control at a particular place, you can go anywhere but still you can monitor the environment parameters. In this system, I've taken Raspberry Pi (BCM BCM2837) and to monitor the environment variables I've taken different sensors that can detect the different environmental parameters respectively. I have connected those sensors to ADC(MCP3204)channels and MCP3204 is SPI ADC is communicate by SPI lines with Raspberry Pi and Controlling robot and weeder, seeder, Driller and spraying based on environmental parameters like temperature, rain fall, and wind.

In my proposed solution, I have connected sensors, DC gear motor's and Camera is connected to the Raspberry Pi, user will monitor by camera and control by the wireless using WIFI technology their will be web server to control the robot and other automation for seeding, weeding, spraying for fertilizers. On the other hand user can also monitor all the sensors values on the internet even. Here I've uploaded all the sensors values into thing speak using internet of things. In my project I've introduced two ways which user can control and monitor the environmental parameters. Robotics in agriculture is not a new concept; in controlled environments (green houses), it has a history of over 20 years. Research has been performed to develop harvesters for cherry tomatoes, cucumbers, mushrooms, and other fruits. In horticulture, robots have been introduced to harvest citrus and apples. The automation level in plant factories is so high that over time they may become completely autonomous production facilities. The WIFI agribot is a integrated system with the autonomous production for the agriculture this will be based on the environment like temperature, rain fall and wind the proposed system will work under all these environment conditions. In the proposed project there are two conditions like controlling and monitoring the environment on the think speak server and control by the web sever on PC. communication will establish between your system and a web server by WIFI. environment parameters monitoring system based on wireless communication technology has been developed to control remotely, which realizes the measurement, summary and control of temperature, rain fall, wind parameters.

Monitoring and control the wifi agribot by using the web server by the WIFI technology and while when controlling the weeder, seeder, fertilizer & spraying is done by web sever and monitor by the camera and user can control the robot for interfacing camera with Raspberry Pi using USB port's and communicate by a open CV library. OpenCV is an open source library for image and video analysis, originally introduced more than decade ago by Intel. Since then, a number of programmers have contributed to the most recent library developments. The latest major change took place in 2009 (OpenCV 2) which includes main changes to the C++ interface. Nowadays the library has >;2500 optimized algorithms. It is extensively used around the world, having >;2.5M downloads and >;40K people in the user group. Regardless of whether one is a novice C++ programmer or a professional software developer, unaware of OpenCV, the main library content should be interesting for the graduate students and researchers in image processing and computer vision areas. To master every library element it is necessary to consult many books available on the topic of OpenCV. However, reading such more comprehensive material should be easier after comprehending some basics about OpenCV from this paper.

II. SYSTEM ARCHITECTURE

The system architecture of this proposed system is following Fig.1.

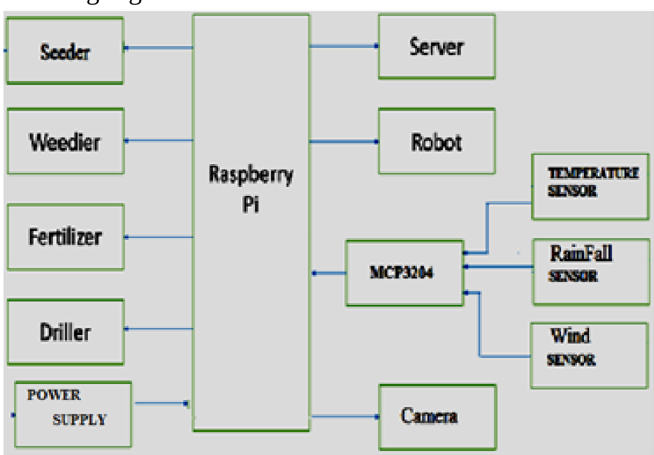

Fig.1. Block Diagram.

Raspberry Pi END: Hardware implementation for This proposed system is shown in above with the blocks. Raspberry Pi is the processor and its relevant components. The ADC(MSP3204)is interface with the Raspberry Pi for sensor's and USB camera module is interfaced to Raspberry Pi's USB port. The camera is mainly use to monitor. Robot is interface with the Raspberry Pi and controlling by the server as WIFI is interface to Raspberry Pi's Port. The required Power supply is from 12v Battery is used for input power supply. Robot, seeder, weeder, fertilizer, driller and proposed system getting from power supply block. sensor's are interfaced with MCP3204(ADC).ADC(MCP3204) is interfaced with Raspberry Pi by SPI communication. Robot(motor's) is interface to the L293D IC. here L293D is motor driver IC for weeder, seeder, driller and Fertilizer.

III. IMPLEMENTATION

A. Hardware

In hardware implementation, Raspberry Pi plays a key role in monitoring and controlling the WIFI agribot. The Raspberry Pi is a small computer, same as the computers with which you're already familiar. It uses a many different kinds of processors, so can't install Microsoft Windows on it. But can install several versions of the Linux operating system that appear and feel very much like Windows. Raspberry Pi is also used to surf the internet, to send an email to write a letter using a word processor, but you can too do so much more. Simple to use but powerful, affordable and in addition difficult to break, Raspberry Pi is the perfect device for aspiring computer scientists. This small computer features amazing HD (high-definition) quality, video playback, also sports high quality audio and has the capability to play 3D games. The device use the ARM processor which does nearly all of the hard work in order to run the Raspberry Pi. The overview of Raspberry Pi has shown below Fig.2.

Fig.2. Block Diagram.

GPIO: One powerful feature of the Raspberry Pi is the row of GPIO (general purpose input/output) pins along the Top edge of the board. These pins are physical interface between the pi and the oust side world. At the simplest Level, You can think of them as switches that you can turn on or off(input) or that the pi can turn on or off(output).Of the 40 pins,26 are GPIO pins and other are power and ground pins. You can program the pins to interact in amazing ways with the real world. Inputs don't have to come from a physical switch. It could be input from a sensor or a signal from another computer or device, for example.the output can also do anything, from turning on LED to sending a signal or data to another device. If the Raspberry Pi is on a network, you can control devices that are attached to it from anywhere and those devices can send data back. Connectivity and control of physical devices over the internet is a powerful and exciting thing, and Raspberry Pi is ideal for this.

Temperature Sensor: The temperature sensor will give a variable output voltage with respect to the temperature variation. LM-35 is used as temperature sensor which is a precision integrated-circuit temperature sensor, Calibrated directly in ° Celsius (Centigrade), Linear + 10.0 mV/oC scale factor with accuracy O.soC (at +25°C) with rated for full -55° to +150°C range. Here we will set the minimum temperature value to 20° C and maximum temperature values to 30° C (for demo purpose, in real time the settings will vary with respect to plantation in the greenhouse). The

Temperature Sensor which I have used in this project has shown below Fig.3:

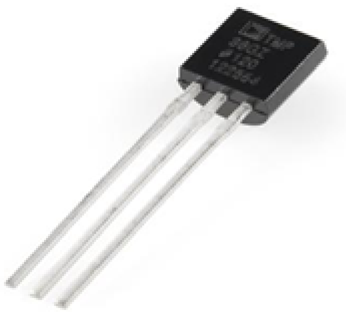

Fig.3.Temperature Sensor.

Rain Fall Sensor: The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity though a potentiometer. The analog output is used in detection of drops in the amount of rainfall. Connected to 5V power supply, the LED will turn on when induction board has no rain drop, and DO output is high. When dropping a little amount water, DO output is low, the switch indicator will turn on Brush off the water droplets, and when restored to the initial state, outputs high level. Adopts high quality of RF-04 double sided material. Area: 5cm x 4cm nickel plate on side. Anti-oxidation, anti-conductivity, with long use time. Comparator output signal clean waveform is good, driving ability, over 15mA. Potentiometer adjust the sensitivity Output format: Digital switching output (0 and 1) and analog voltage output AO. The Rain Fall Sensor which I have used in this project has shown below Fig.4:

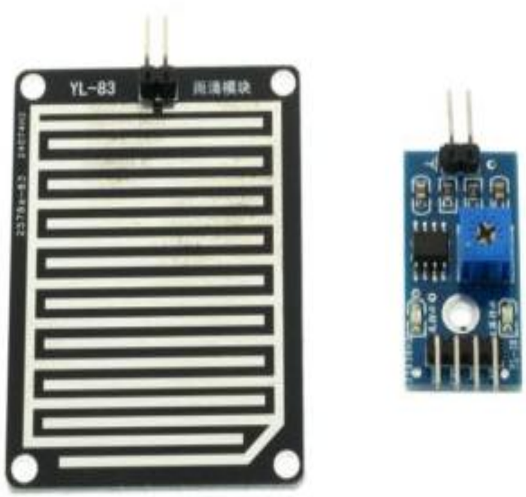

Fig.4. Rain Fall Sensor.

Wind Sensor: The wind sensor will give a variable output voltage with respect to the wind variation. The analog output is used in detection of wind sensor in the form of wind. Connected to 5V power supply as shown in Fig.5.

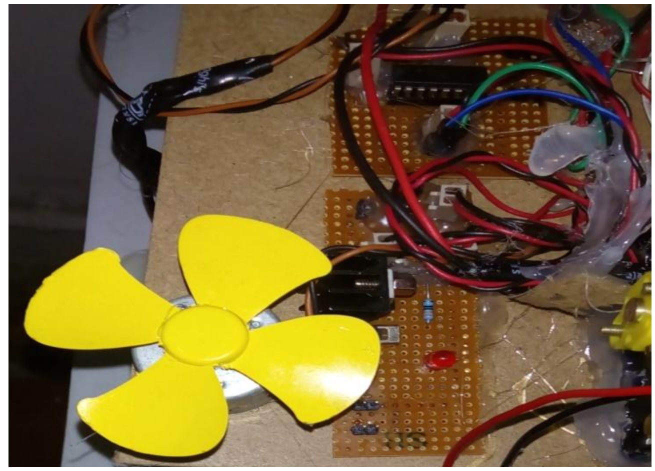

Fig.5.Wind Sensor.

Camera:

Fig.6. USB Camera.

The USB camera Module is interfaced to the Raspberry Pi's USB port as shown in Fig.6. The camera is mainly used to captured the changes in the environment i.e. Motions. The required power supply to operate USB camera will get it from Raspberry Pi only.

L293D: The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo- Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications. On the

L293, external high-speed output clamp diodes should be used for inductive transient suppression. L293D pin diagram has shown below Fig.7:

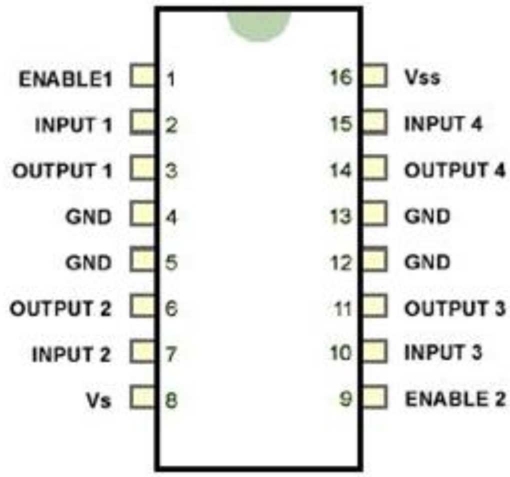

Fig.7. L293D Pin diagram.

MCP3204: MCP3204/3208 devices are successive approximation 12-bit Analogto-Digital (A/D) Converters with on-board sample and hold circuitry. The MCP3204 is programmable to provide two pseudo-differential input pairs or four single-ended inputs. Communication with the devices is accomplished using a simple serial interface compatible with the SPI protocol. The devices are capable of conversion rates of up to 100 ksps. The MCP3204/3208 devices operate over a broad voltage range (2.7V - 5.5V). Low current design permits operation with typical standby and active currents of only 500 nA and 320 µA, respectively. The MCP3204 is offered in 14-pin PDIPMCP3204 pin diagram has shown below Fig.8:

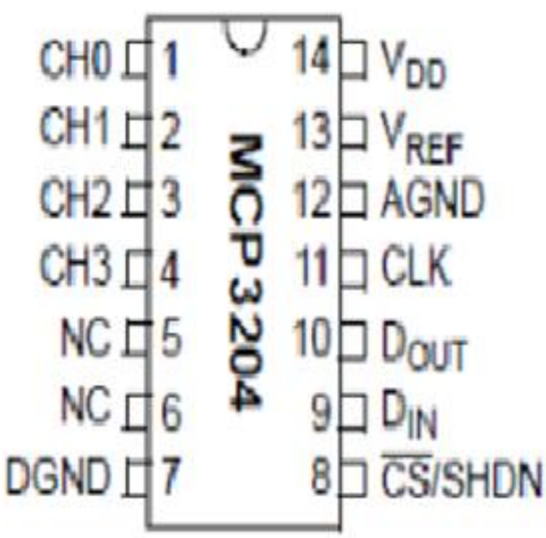

Fig.8.MCP3204 Pin diagram.

Software: Here, to program Raspberry Python was used. And the image processing will be done with the help of the Open CV. Final Schematic Diagram of this Project has shown below Fig.9:

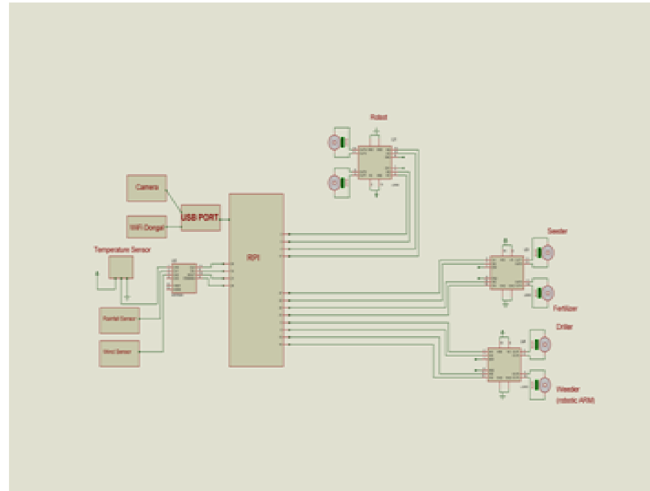

Fig.9. Schematic Diagram.

IV. ALGORITHM & FLOWCHART

Algorithm:

Step – 1: Initialize Raspberry Pi, Camera.
Step – 2: Robot is operated through web server.
Step – 3: seeded, driller, fertilizer, weeder also control by web server.
Step – 4: sensor data is uploaded in to think speak server.
Step – 5: user can monitor via internet and live streaming is recorded by camera.
Step – 6: System operates until it goes power off.

Flowchart: The flowchart of this paper is shown below Fig.10.

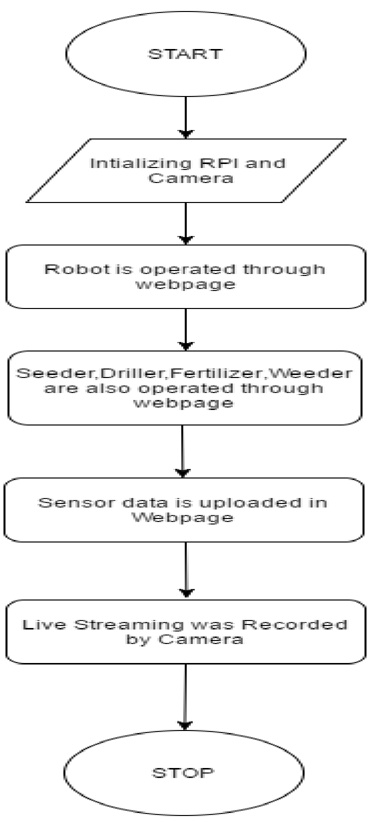

Fig.10. Flow Chart.

V. RESULTS

Results of this paper is as shown in bellow Figs.11 to 15.

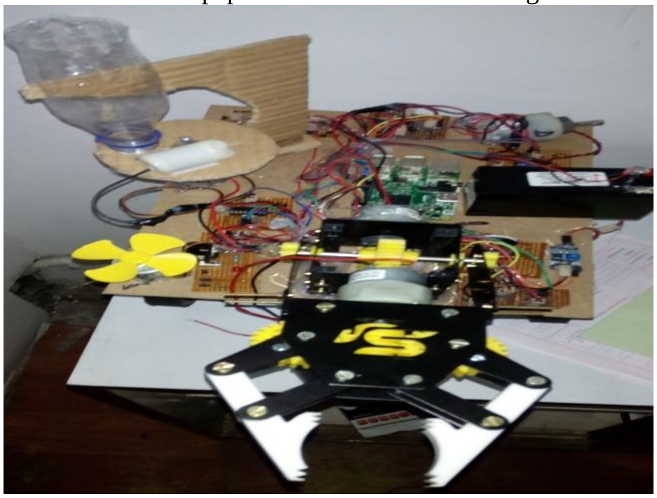

Fig.11. Final Prototype.

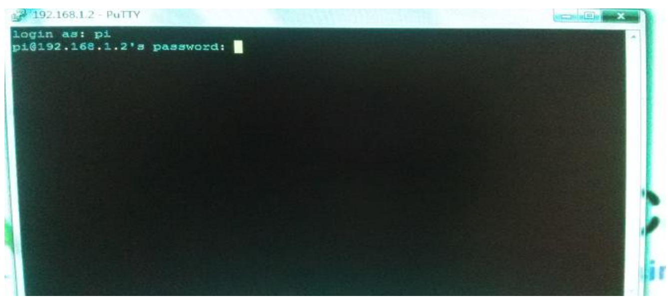

Fig. 12. Login into Raspberry Pi.

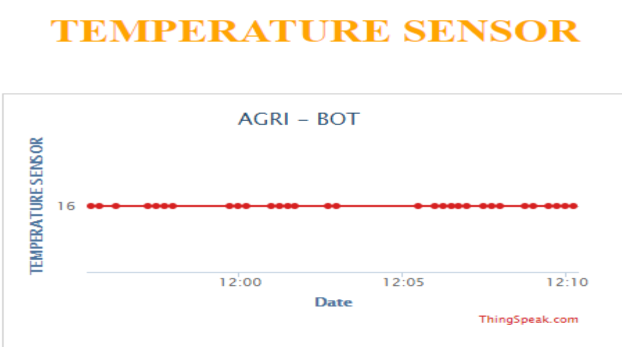

Fig. 13. Temperature sensor graph on think speak.

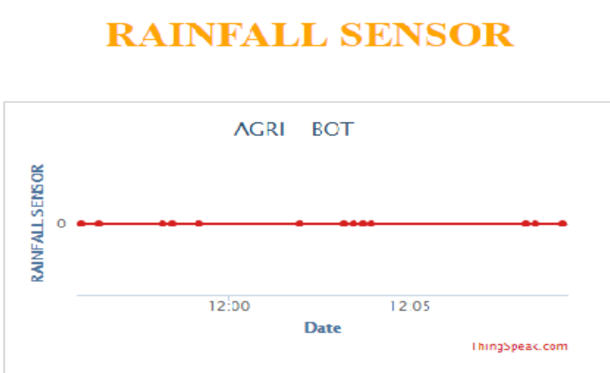

Fig. 14. RainFall sensor graph on think speak.

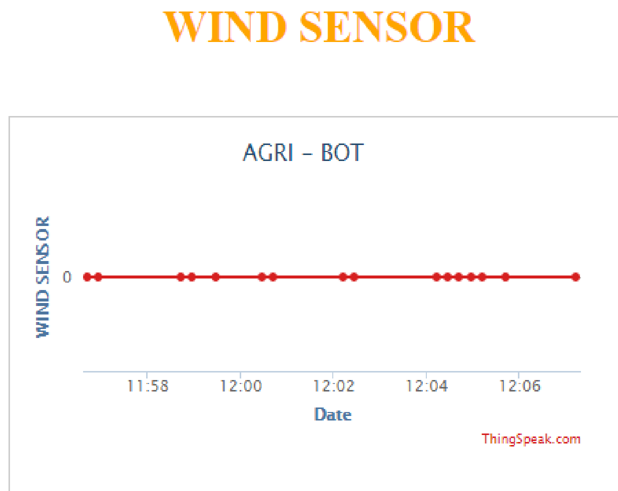

Fig .15. Wind sensor graph on think speak.

VI. CONCLUSION

Finally we have made an autonomous robot for performing all sorts of agricultural activities like drilling, seeding, weeding, and spraying of fertilizers. This bot has ability to work over half an acre. Drilling action uses a simple DC motor and a drill bit. Seed tank is placed on the bot to place the seed after drilling. Fertilizer tank is placed to pray the chemical after seeding operation. This robot also performs weeding operation when required. It communicates through Wi -Fi with the operator and fellow robots. The on going process can captured and viewed through a camera attached on it. Walking mechanism was perfect on a flat surface. Then implementation was done on a rough surface and then on the field. In basic robotics we design machines to do the specified tasks and in the advanced version of it robots are designed to be adaptive, that is, respond according to the changing environment and even autonomous, that is, capable to make decisions on their own. While designing a robot the most important thing to be taken in consideration is, obviously, the function to be performed. AgriBot is limited to work for small piece of land say half an acre due its design and structure. We have designed under limited assumption and worked upon it task by task. Having control on leg movements and using Wi-Fi triangulation method precision for different operations was obtained. This basic design of autonomous robot can have advance changes and can be designed to work for large area of field. Much efficient agricultural activities can be performed.

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