Implementation of Internet of Things in The Field of Agriculture AGRIBOT 1.0

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Abstract

Use of technology in different areas to get numerous benefits is itself a valuable research. But, use of sensor-based tech in the area of agriculture is not a new one. Due to the different weather, soil, water and land conditions; diverse models, methods of analysis and solutions are required. Some different ways specifically for agriculture is required in developing solution for different conditions. The concept of Smart agricultural tech and their use towards the agriculture domain is way too greater and it is done by IOT and Raspberry pi. AGRIBOT 1.0 is a robot designed for agricultural purposes and to minimize the labor of farmers in addition to increasing the speed and accuracy of the work. It performs the elementary functions involved in farming i.e. observation of the crops, examining the fertility and recording all the conditions in the soil. The robot is autonomous and provides the facility for online feed of the field with user interface through an android mobile application for the farmers. This will bring more flexibility and reliability; this trend is likely to continue into the future of smarter way of doing agriculture.

Keywords — *IoT, UI, RFID, Raspberry pi, Wi-Fi, HD, ARM, BLE, LAN, LDR, Soil moisture, Temperature, Humidity, Rain fall, Light intensity, Raspbian OS, Python.*

I. INTRODUCTION

India is an Argo-based backboned Economic country with the percentage of 60.45% which is nearly 159.7 million hectares (394.6 million acres) according to the records of world bank 2017. Now-a-days, modern ways of yielding Argo products have changed the mundane ways of agriculture in our world and the increasing population has met the need to feeding all the people in the global. Some change is needed to be carried out in the way of doing agriculture to make it in order to complete our needs of future generation. To make agriculture way too smart and also get the yield much more profitable for farmers. The increasing rate of using IOT based tech prompt us to make our lifestyle much easier than anyone can do. In agriculture, the monitoring of water content, soil fertility level, rain detection, growth detection, temperature-humidity value, light intensity, production predict etc. These are some important matters when we are about to cultivate any variety of crop. Raspberry pi3 is a low cost, palm-sized computer that can be used to compute all the data, which has an in-built wi-fi which guarantees us to use in the IOT applications. With the help of sensors and camera we can monitor the all the principle components of the agriculture to make the smart way of doing agriculture.

II. EXISTING SYSTEM

The multi-purpose agriculture robot [1] is generally used in the concepts of auto and manual modes with the help of some microcontroller which are not mostly suitable for the terrain like the agricultural field. Also, the relay is used for the computed implement on the field by the robot. They also might get damaged due to high switching speed and high voltage inputs. Arduino based robot are capable for some limited amounts of data processing and their capacity are less when we consider with the raspberry pi. It works with the basic operation like irrigation and checking the fertilization. It also based on the solar panel charging battery for the working of the robot. It needs some man power like watch over the robot, manually operating it and it can't observe the proper growth of the plant which are in the fields. It only used in the initial stages of the agricultural methods and it begins useless at the time of growth till cultivation of that crop. It only moves in the row sides of the field so the remaining parts of the field are remains undiscovered by the robot i.e. so many blind spots on the fields. It needs some man power. The main disadvantages of the existing system are listed below:

- It only used at some of the initial stages of the agriculture.
- It is having low efficiency to predict the terrain.
- It is based on the relay which might get damaged due to electrical isolation.
- Limitation number of uses.
- Even though the present of the robot, there is a need of some man power to watch over the crops.
- There is no proper communication between the farmers and the robot.
- Row to Row watching, it results leads to many blind spots on the field.

- There is no proper user interface in the robot.

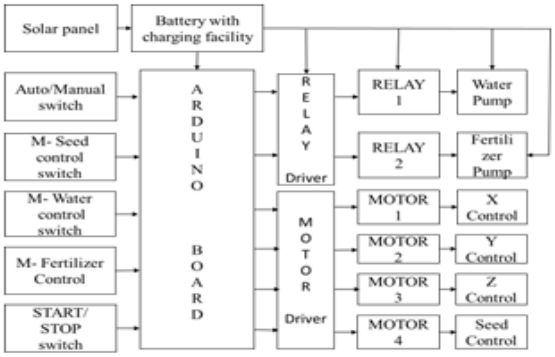

Fig. 1: Block diagram of the Existing System

III.RELATED WORK

IoT and raspberry pi-based system are relatively advisory in the recent days of the modern life. For agriculture, IoT have already made a step into the field. Author in [6] have proposed Precision Monitoring of Horticultural Crops – A Case-study on Cabbage and Capsicum based on the IoT. The IOT based monitoring of horticultural to find the level of pesticide in the crops and It involves monitoring the whole ecosystem concerned with the crop starting from preparation of the soil, plantation, and growth till the harvest in order to provide precise intervention at the proper time. Farmers can also monitor the farms from anywhere with the help of systems with various sensors for light, humidity, temperature, soil moisture etc. and also automate the irrigation systems. Author in [7] have proposed a Smart-Config Wi-Fi Technology Using ESP8266 for Low-Cost Wireless Sensor Networks. By observing the drawbacks of traditional wireless networks, a new topology is proposed based on smart-config Wi-Fi chip using ESP8266. Smart-config capability to connect to a specific Wi-Fi network is implemented, supporting both TCP and UDP protocols. Performance comparisons between our approach and a state-of-the-art wireless network based on Zigbee technology. A complete low-cost solution for monitoring applications based on sparse wireless sensor networks.

The relatively on other project uses Atmel ATMEGA2560 microcontroller is used which acts as a master and Atmel ATMEGA8 acts as a Slave. It has a Firebird V Robot is used to move on the field. The camera is used for monitoring the plant growth.IR sensor is used to detect the insect in the plant, if found. The software required is AVR ATMEL STUDIO 6.0 and AVR Boot loader it has been proposed by the author in [8]. The author in [9] has proposed an Android Application for Monitoring Soil Moisture Using Raspberry Pi. The results of design and creating Android application for monitoring soil moisture using Raspberry Pi, it can be concluded that Application can convert analog data from sensor to percentage using comparison of similar tools. So, the minimum and maximum can be taken from each class to be changed to percentage Android application can take percentage data from the server within a certain period or manually pressed by the user. Application can turn on the LED indicator from Android by sending LED data to the server. The indicator data from the server is taken by Raspberry Pi 3 and read to turn on the light. In the project proposed by the author in [10] Agriculture greenhouse production environment measurement and control system is an example of IOT technology application in agriculture. The critical temperature, humidity and soil signals are collected real-time in the agriculture production process, which is transmitted by wireless networks through machine to machine support platform. It is to gain real-time data of agriculture production environment using SMS, web, wireless application protocol pattern, so that the terminal can master the information to guide the production.

IV.PROPOSED SYSTEM

The proposed system is mainly based on the concept of Internet of Things which brings a new way of doing agriculture. The raspberry pi can compute all kind of data which are sensed by the precited sensor on the field and also with the help of the camera. The data like temperature, humidity, rain fall level, soil moisture, light intensity is playing a vital role in the prediction of the growth and the yield of the crops. These data can be computed with the help of raspberry pi to get better observation on the crops. There is a live feed of each and every inches of the field to the farmers via the user interface application and it gives more time consumption of watching over the fields.

It covers the whole fields in the form of circle around the field and report every detail to the farmers at the instant with more precited values. It can adjust to any type of crops and with the help of IOT it is reliable for the controlling everything in the field. It is also more reliable. It can also use in the night time to watch over the growth of the crops due to the rechargeable battery and it can be recharged even by using solar panels.

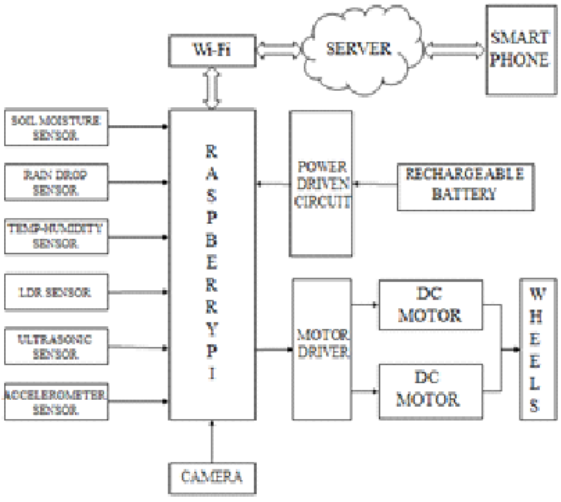

Fig. 2: Block diagram of Proposed System.

A. *Internet of Things (IoT)*

Internet of Things made an eco-system of all the possible physical, mechanical, and the electronics devices which can be accessible by connected them with the internet. It can also do some possible things like Big Data management tools, predictive analytics, AI and machine learning. It helps us to make things simpler and easier than we imagine. The concept of the proposed system is the Implementation of IoT in the Agricultural Fields.

V. DESIGN OF PROPOSED HARDWARE SYSTEM

A. *Raspberry pi*

The raspberry pi 3 model B is a series of small single board of components which can equally works as the minicomputer with 1.4 GHz, 64/32-bit Quad-core ARM v7 and has a gigabytes of RAM. It has a wireless LAN, Bluetooth 4.4/BLE, Faster Ethernet and power over ethernet support. Its plays a main role in the proposed system for the implementation of IoT and computation of all the data from the field. The figure.3 shows the circuit diagram of Raspberry pi.

The big upgrade of raspberry pi BCM2837 increases the processor speed and efficiency allow us to develops a new way of implementing the IoT. The ports of the raspberry pi help us to connect all the sensor with the board of the robot.

Fig. 3: Raspberry pi 3 model B board.

B. *Wi-Fi*

The wireless fidelity which takes the vital role in the implementation of IoT in the proposed system. The IEEE 802.11X is used to provide a high-speed internet to the robot to connect with the user. The established wireless network allows the robot to transmits the collected data to the server and to the UI application on the smart mobiles.

C. *Soil Moisture Sensor*

The soil moisture sensor is to detect the soil moisture content. There are two probes in the sensor which is inserted into the soil. When the sensor switched on and offer a low resistance and passes the high current. The variable resistance detected by the soil moisture is taken into the raspberry pi.

D. *Rain Drop Sensor*

The rain drop sensor is an easy tool for rain detection. It switches when then the rain falls on the board.it can also find the rain intensity and sends all the value to the analog to digital convertor connected with it.

E. *Temperature-Humidity Sensor*

The temperature-Humidity Sensor DHT11is used to detect both the temperature and humidity value.it has the capacitive humidity sensor and a thermistor to measure all the surroundings values from the air. It has two electrodes to measure an electrical resistance.

F. *LDR Sensor*

The Light Dependent Resistor is used to detect the light intensity by producing variable resistance that changes with light intensity that falls on it and it is used as the sensing device in the proposed system.

G. *Ultrasonic Sensor*

The ultrasonic sensor used to detect the range of the obstacle in the path of the robot. The basic working principle of the sensor is to generates the specific spectrum of frequencies which is end by the sensor in the forward direction to find any obstacles on the way, when it finds anything it reflects back to the sensor. The range of the ultrasonic sensor within a 3 cm to 3m range.

H. *Accelerometer Sensor*

The accelerometer sensor used for finding the stability of the robot in the field. The basic principle of the sensor is the displacement of a small proof mass etched into the silicon surface of the integrated circuit in the sensor and it is been suspended by small beams. So, it is also called as Micro-Electro-Mechanical Sensor.

I. *HD camera*

The HD camera is used to capture all the things which are happening in the field and fed it in the application on the mobile for the user. It provides with the basic elements of digital camera used to capture the photos and videos.

J. *Motor Driver*

The motor driver is used to driven the DC motor which are connected to the wheels. It is a current amplifier, that controls the power given to the motor and it also turns low current signal into the high current signal to drive the motor and vice versa

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K. *Power Driven circuit*

The power driver circuit is used to control the level of DC voltage that leaves from the battery to the circuit. It also used to control the level of the current into the circuit.

L. DC Motor

The Dc motor is an electrical machine that converts the electrical energy into the mechanical energy. The basic components behind the DC motor is a current carrying armature which is connected to the supply with the commutator and the brushes. It works on the principle of "current carrying conductor placed in the magnetic field, it experiences a mechanical force".

VI. SOFTWARE DESIGN

In the raspberry pi, we are use a Raspbian OS as the operating system which is the Unix based operating system and it is coming from the family of the raspberry pi single-board computers.

In the proposed system, we chose of programming language is python because of its reliability and flexibility in the IoT.

A. Raspbian OS

Raspbian is founded by the Raspberry pi Foundation and it is belonging to the Unix-like type of OS family.it is given as an open source model and it is monolithic in the kernel type. It is used for the ARM versions platforms.

Raspbian provides the Pi improved X-window Environment, light weighted desktop for the easy use of the OS. It is still under development for further improvement to access the ARM processor. The below figure.4 shows the Raspbian OS desktop.

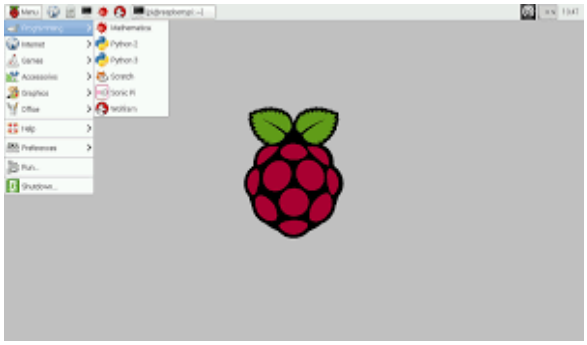

Fig. 4: Raspbian OS desktop

B. Python

Python is a widely using programming Language now in the worldwide. It is easier as the server programming language. The main advantage of the language is the minimum number of program code lines in the programming of any system.

It is founded by the python software foundation at 1990 by the Guido Van Rossum. It is a multi-paradigm with functional, imperative, object oriented one. It also provides the standard library files for the programmers. It is an open source software so it can accessible by anyone. The below figure.5 shows the python program used in the programming the Agribot 1.0.

C. Mobile Application

All the collected data from the field are used to shown in the user interface application on the mobile phone. It is a software application used to designed and runs on the mobile phone. It shows all the details of the field over the application.

VII. WORKING OF THE PROPOSED SYSTEM

In the proposed system, the main aim of the robot is to observe, collect the data's, compute them, transmits to server, and send it to the UI application on the smart mobiles. The working modal diagram of the proposed system is given on the figure.7.

A. Observation of the agricultural field

The main purpose of the proposed system is to monitoring the field during the growth of the crops from its root level till the time of the yielding of the crops. After the sowing of the seeds in the field the farmers can use the Agribot to observe the field at the mean time of doing other works. The precisely fixed sensor on the top of the bot collect all the important data that are oriented to the growth of the crops. The HD camera in the robot capture all the live activity on the field without any blind spot on the any part of the field. Due to the grid wise watching of the robot, there is no more blind spots. The Agribot divided the field into the Grid form and running around the field as the supportive partner to the farmers. There is nothing can miss from the surveillance of the Agribot 1.0 in the Agricultural field.

B. Fetching and computation of the data

In the agribot, all the sensor which are used to fetch the data from the surrounding collects all the data and send to the Raspberry pi for the computation of all the data together. The sensor and HD camera work together to get all the possible data from the field. The sensor is used to collect data like Soil moisture, light intensity, Temperature of the air, Humidity content of the air and rain indication surrounding the field. The other sensor like ultrasonic and accelerometer sensor is used for the stability control of the Agribot in the field. It can also alert the farmer if there is any problem arise in that terrain. All the data which are collected by the agribot are send to the raspberry pi for the computation of all the data together and acts as the common point of data storage.

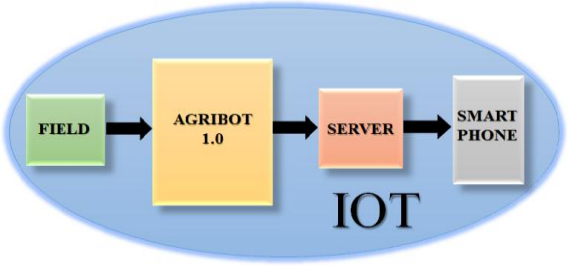

Fig. 7: Working Model of the Proposed system.

C. Transmission of all data to server.

All the collected data from the field are send to the sever using the Wi-Fi which is provided to the raspberry pi. Data are sent to the server are computed by the raspberry pi. Data send to the sever includes the soil moisture value, temperature, Humidity level, Light intensity and Rain Detection are also included in that data.

D. Server to the UI application

Now, all the data from the Raspberry pi is stored in server database. The application software starts to fetches the data from the server database and shows the continue value of all the parameters which is collected from the field and represented as a graphical form of it in the application. There is also a live coverage of field in the application. so, there is no need of user(farmer) in the field.

VIII. FLOWCHART FOR THE PROPOSED SYSTEM

The flowchart of the proposed system shown below at the figure.8.

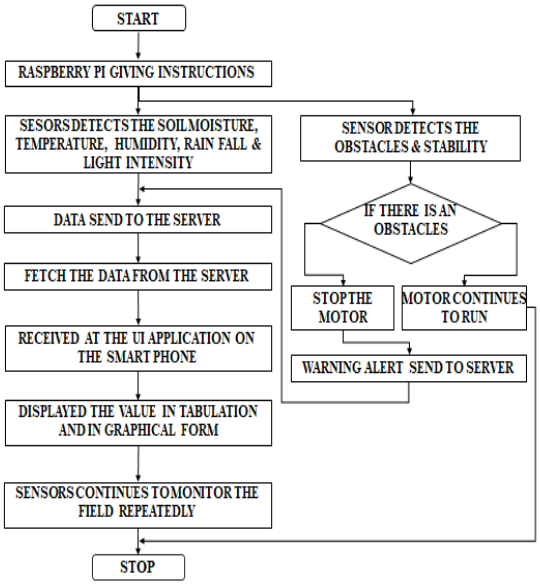

Fig.8 Flowchart of the proposed system

IX. RESULT FOR THE PROPOSED SYSTEM

The result of the proposed system is given as the comparison of all the collect data from the field by the Agribot 1.0 with the Existing system. The comparison table between the proposed system and the existing system is given in the table.1.

TABLE.1 Comparison between the existing system and the proposed system

Sl. No.	Parameters	Existing system	Proposed system
1.	Speed	moderate	Very high
2.	Manpower	high	Very less
3.	Time consumption	less	Very high
4.	Energy required	less	Very less
5.	Reliability	low	High
6.	performance	low	high

X. APPLICATION OF THE PROPOSED SYSTEM

The applications of our proposed system are listed as below:

- It is used as a Monitoring bot in the agricultural fields.
- It can also use in the Green house farming and in nursery.
- It can alter to any type of crops in the fields.
- It is cost efficient and highly reliable one.

VIII. ADVANTAGES OF THE PROPOSED SYSTEM

The advantages of the proposed system are given as follows:

- It is a Multi-purpose Monitoring Agribot & it doesn't need man power.
- It has high efficiency and Time consumption is greater.
- Data are collected by sensors and processed without any Relays.
- The processed data are sent to the farmers through UI app in mobile.
- With more precision sensor and HD camera can feed a live to our application.
- Farmers presence is not required due to the live cover of the field.
- It can be used for any type of crops.
- It covers all the area of the field and watch over every inch growth of the crops.

IX. CONCLUSIONS

From the above study of IoT technology application and the implementing it on the field with the help of the raspberry pi 3 model with the proper monitoring system of sensors and HD camera combined together make an efficient proposed system. The precision monitoring and collecting data from the surroundings using IoT made a greater improvement in the way of doing farming. Valuable data are collected by the sensor and camera are used well at the same time using the proper Server as the System Data Management unit and send the data to the UI application. And the proposed system offers a good user interface, easy way for implementation and also real time environment in the farming. Also, have a good reliability, high performances and improve the environmental monitoring in the field of farming. Our paper also optimizes the laboring cost for the farmers and it conserves the valuable time to invest in some other things like Dairy Farming, Poultry farming etc. It is way too economically efficient and also used in the real time agricultural field. With the help of the UI application, it is very much easier. So, the agriculture can be made more efficient and in

accurate manner with the help of Agribot 1.0. Finally, we conclude that our proposed one will change the mundane ways of doing the farming and led to arose a new era in the future.

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