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An Autonomous Agriculture Robot Using IoT

Linta Joseph[1], Sara Joseph[2*], Sarath H.[3], Shibino P. Abraham[4], Anish George[5]

[1,2,3,4,5]Dept. of Computer Science and Engineering, St Thomas College of Engineering and Technology, APJ Abdul Kalam Technological University, Kerala , India

[*]*Corresponding Author: sarajoseph9928@gmail.com*

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Abstract-About 40 percent of the world's population relies on the agriculture field. Apart from traditional farming, recent years have demanded the application of autonomous vehicles in agriculture. The proposed system aims at designing an autonomous agricultural robot that can be controlled through IoT providing real-time monitoring of the field thereby improving the irrigation system. The system can be controlled by an IoT module. The proposed system aims at reducing the human intervention in farms providing sufficient environmental conditions for the crops with ensuring proper irrigation and efficient utilization of resources. This Agribot can perform the basic functions like monitoring, taking soil parameters, and control the irrigation system accordingly. These robots have a major role in precision farming. The application helped increase investment and using these in real-time. Precision agriculture thus improves agricultural yield and takes precautions in environmental risks demanding the need for agricultural robots. Hence autonomous IoT based agricultural robots are designed to perform the basic elementary functions required to be carried out in fields.

Keywords—Agribot;Irrigation;IoT;Sensors;

I. INTRODUCTION

The main motive for developing Agricultural Automation Technology is decreasing the labor force, a phenomenon common in the developed world. The reasons are the need for improved food quality.Robotics and artificial intelligence achievements offer solutions in precision agriculture to processes related to seeding, harvesting, weed control, grove supervision, chemical applications, etc.to improve productivity and efficiency. The applications of instrumental robotics are spreading every day to cover further domains, as the opportunity of replacing human operators provides effective solutions with return on investment. When more conservative issues are granted by robotics, heavy chemicals or drug dispensers, manure or fertilizer spreaders, etc. are activities more and more concerned by the deployment of unmanned options. All kinds of agricultural robots have been researched and developed to implement several agricultural products in many countries.This Agribot can perform basic elementary functions like spraying the pesticides.The application of agricultural machinery in precision agriculture has experienced an increase in investment and research due to the use of robotics applications in machinery design and task executions. Precision autonomous farming is the operation, guidance, and control of autonomous machines to carry out agricultural tasks.It motivates agricultural robotics.The goal of agricultural robotics is more than just the application of robotics technologies to agriculture. In India approximately 60% of citizens are depending on agriculture, the annual income of citizens obtains from agriculture. In today's digital world many farmers are still using traditional methods in their field so;yield of plants is very less. Applying novel technology in the field will solve the main issues in agriculture.IoT is among the fastest-growing technologies. In the case of plant growth automation is necessary to monitor several environmental conditions. The Proposed system is based on monitoring and watering system for agriculture field based on Internet of Things which help the farmers to apply new modern methods can increase their income with less manual work. Now a day's traditional agriculture is changing modern agriculture. Currently, many agriculture applications have existed which became a business. Improvements in agriculture contribute to national economic growth. An automatic system can apply to all kinds of agriculture fields. Internet of Things is a connection of physical things to operate devices with the help of the Internet. IoT enables to access any information with the help of electronic components. The proposed system mainly works on connecting the Internet to the main system in the plant field, smartphones to check the result. The internet-connected to devices via smartphone which is acts as Wi-Fi to monitor and other devices to see results.

Raspberry pi processor is a computer that can be used for all kinds of projects. It operates under a Linux operating system. Python language is used to dump in the processor. The processor operates at 3.3 v, memory is 1 GB ram. Raspberry pi processor will be applicable for hobby projects, real-time applications, and computer applications. A server-based web application is developed. The application has two-part script & programming and coding. The application shows the same result as monitored by sensors with the help of HTTP protocol. A hypertext

markup language is used to code applications. The back-end language is JavaScript. Results observed when login is done with IP address in the application. Along with results in web application monitor also continuously displaying result until the system shut down. To monitor direct connection with the board in case of laptop putty software has to be installed. More in the speed of the internet makes results observation within a fraction of seconds. Code mounted for server in the flash method.The main aim of this work is to develop monitoring and watering system of agriculture to solve problems faced by farmers in India.

II. RELATED WORK

Kerry Taylor, Colin Griffith developed about web application for things in farming. They proposed some challenges and how to overcome from challenges. To overcome these problems, the automation technologies with robots were used in agriculture. The automation in the agriculture could help farmers to reduce their efforts. The robot which performs operation like soil, moisture testing, s, spraying pesticides, which also performs obstacles avoidance operation and metal detection in the path . Agribot integrated system which uses Wi-Fi to communicate between two robots which perform activities like seeding, weeding, spraying of fertilizers and insecticides. It is controlled using Arduino Atmega2560 controller and powerful Raspberry pi minicomputer to control and monitor working of robot. It has hexapod body which can move in any direction as per required. It has ultrasonic proximity sensor to avoid the obstacles in the path, and under-body sensor system to detect that seed is planted or not. It can dig a hole in soil plant seed in it and cover the hole again with soil and necessary pr-emergence fertilizers applies on it, and move on along with communicating with other robot near to it using Wi-Fi . Command based self-guided digging and seed sowing rover, a sensor guided rover for digging, precise seed positioning and sowing has been proposed to reduce the human effort and also to increase the yield. The rover's navigation is performed by remote guiding devices fortified with the positioning system. It uses Arduino Atmega2560 controller and ultrasonic radar sensor for obstacle avoidance. It is controlled using wireless module that can be control by PC/ TAB/ Mobile.

Joaquin Gutierrez discussed about concept developed for automated irrigation system to optimize use of water for agriculture crops. Soil moisture sensor was inserted to measure water content in soil. The system was tested in a sage crop field for 136 days. Web app was developed to see results.

Ibrahim Mat proposed system for agriculture application, i.e. irrigation to save water. The test shows savings of 1500ml of water per day per tree. Interconnection of GSM/GPRS/Wi-Fi module, moisture sensor to Internet concentrated on protection and security like attacks of rodents or accessed by user takes place. Results observed graphically.

III. METHODOLOGY

A. PROPOSED SYSTEM

The proposed system focuses mainly on the design, development and the implementation of the multipurpose agricultural robot with irrigation system and real time monitoring .The sensor probes are installed at various points to measure the parameters of interest. The data is sent to a server and stored in the internal memory. The information is visualized through its web interface and the users can take actions by controlling the irrigation system through the web interface. The block diagram of proposed system is given in the figure 1.

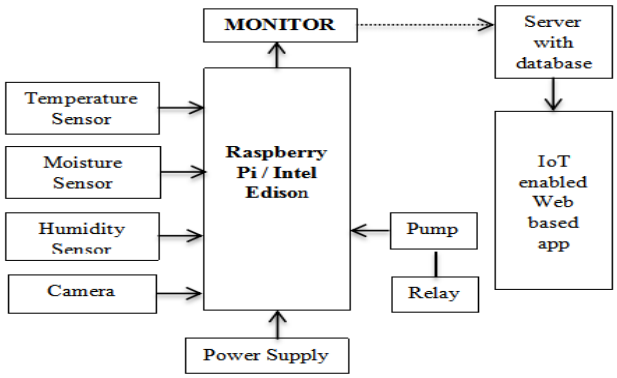

Fig 1 : Block diagram of the proposed system

The whole system of the robot works with the battery. The robot requires 12V battery to operate the system. It uses Raspberry Pi module for the function in the robot. The rover consists of 4 wheels .A leveler is made and water pump sprayer is used for water spraying. The entire mechanism of the system is controlled by IoT module from Android phone. All the components are connected to the Raspberry Pi. The coding is done in the SD card inserted in processor.

A microprocessor is connected to rover. The motors are connected to the microprocessor. We have an app in the phone for the movement of rover (front, back, right, left). When we are giving instructions in the phone these are given to the cloud (Amazon Web Service).From rover, the cloud gets the instructions. The protocol used here for the communication between farmer and irrigation system is MQTT (Message Queuing Telemetry Transport).

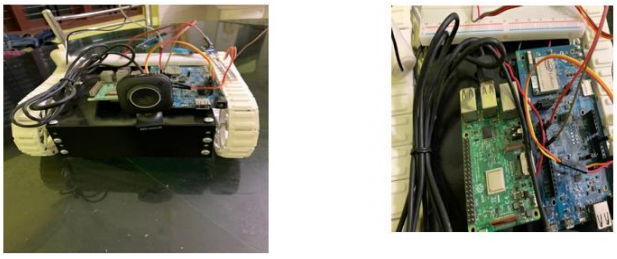

Fig 2: Front view and top view of Proposed System

The measured parameters are entered from sensors to cloud. From the cloud service, the app reads the parameters. The IP address is used to connect the devices. SSH protocol is used. MQTT is implemented in paho library.

B. SYSTEM REQUIREMENTS

a) HARDWARE REQUIREMENTS

- Raspberry Pi/ Intel Edison
- Sensors : Temperature , Moisture and Light sensors
- Actuators :Relay and motor
- Power supply of 9v
- Internet Connectivity
- Android mobile

b) SOFTWARE REQUIREMENTS

- Linux Operating system for Edison
- Language : JavaScript , Python
- Windows 7 and above operating system
- Android Studio
- IoT protocols: MQTT , SSH, HTTP

C. Data Flow Diagrams:

Also known as DFD, Data flow diagrams are used to graphically represent the flow of data in a business information system. DFD describes the processes that are involved in a system to transfer data from the input to the file storage and reports generation.

Data flow diagrams can be divided into logical and physical. The logical data flow diagram describes flow of data through a system to perform certain functionality of a business. The physical data flow diagram describes the implementation of the logical data flow.DFD graphically representing the functions, or processes, which capture, manipulate, store, and distribute data between a system and its environment and between components of a system. The visual representation makes it a good communication tool between User and System designer. Structure of DFD allows starting from a broad overview and expand it to a hierarchy of detailed diagrams.

The DFD level classification is classified as:

Level 0 DFD

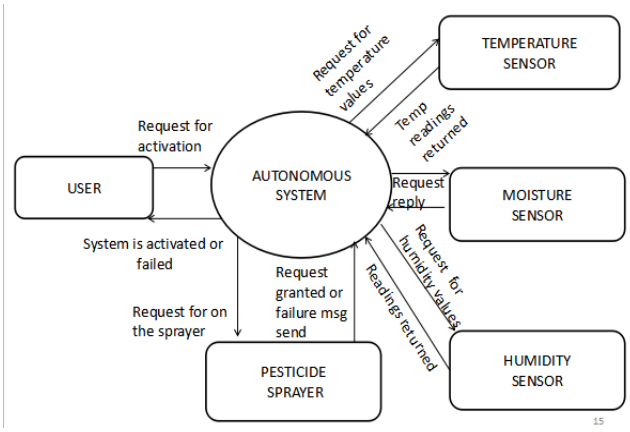

Fig 3 : Level 0 DFD

Level 1 DFD

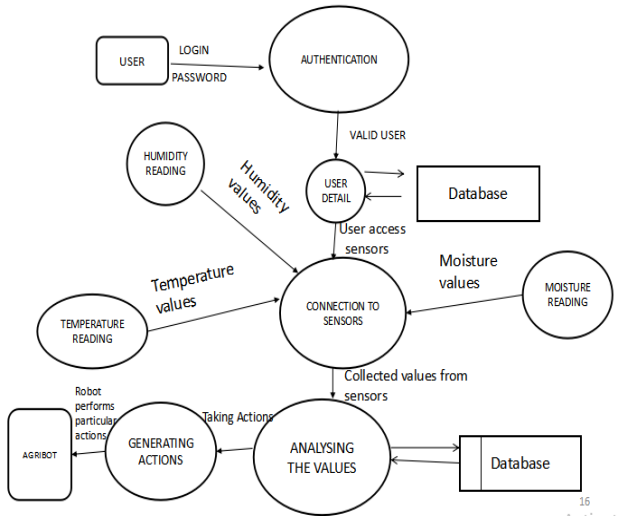

Fig 4 : Level 1 DFD

D. Flow Chart

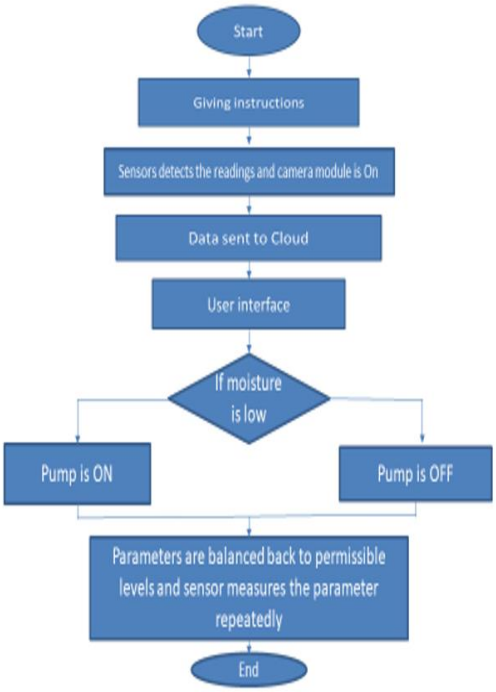

Fig 5: Flow Chart

IV. RESULTS AND DISCUSSION

The prototype of model is developed, which is kept in garden. The same prototype can also fit for agricultural applications based on which sensor required. Each sensor with its unique identity can access changes in the Environment continuously.Sensor captures information when login take place. It provides a secured and safe communication. The image of login page in monitor.The web app includes select motor operation either on or off. This helps in agricultural field when immediate motor operation takes place.

It shows to click login in web app enter secured user id and password in page, the screen shot of login page shown in the figure.

Fig 6: Readings in Android App

V.CONCLUSION AND FUTURE SCOPE

"Multipurpose autonomous agricultural robot",has successfully implemented and tested for water spraying. It was developed by integrating agricultural robot. Various parameters like soil condition, area covered by the robot and weight of the material for leveling are analyzed for different motors. The advantages of multipurpose agricultural robots are reducing human intervention, ensuring proper irrigation and efficient utilization of resources. These robots are mainly useful in automated weed control; usage of fertilizers based on soil condition, soil sensors for drip irrigation in rain feed areas. The proposed system is mainly used for crop establishment, plant care and selective harvesting. In future, It can be extended by using ultrasonic sensors and cameras for performing the same operations without human operator for measuring the various parameters like soil condition, area covered by the robot and weight of the material for leveling.Our major goal is to offer an architecture which should help in improving the productivity of the crops, specifically for the Indian farmers. By using robots in agricultural field, human labour can reduced to a main extend.Easily controlled by a mobile phone.IoT sensors capable of providing farmers with information about crop yields, rainfall, pest infestation, and soil nutrition are invaluable to production and offer precise data which can be used to improve farming techniques over time by pairing data-collecting software with robotics to fertilize the corn, apply seed cover-crops, and collect information in order to both maximize yields and minimize waste.

ADVANTAGES

- It can save water and time as you do not have to personally go to the farm to do watering.
- The watering system supplies the right amount for the plants as excessive watering may affect the growth of plants

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AUTHORS PROFILE

Ms. Linta Joseph an innovative thinker, initiative talker, and multi dimensional professional who is currently pursuing her Bachelor's degree in Computer Science and Engineering at St.Thomas College of Engineering and Technology, Kerala, India under APJ Abdul Kalam Technological University. She possesses strong motivational and leadership skills and also able to deal with confidential information. Her main research work focuses on networking and coding. After graduation, she plans to go abroad for her higher studies.

Ms. Sara Joseph is currently pursuing her Bachelor's degree in Computer Science and Engineering St.Thomas College of Engineering and Technology, Kerala, India under APJ Abdul Kalam Technological University. After graduation, she plans for her masters.

Mr. Sarath H is currently pursuing his Bachelor's degree in Computer Science and Engineering at St. Thomas College of Engineering and Technology, Kerala, India under APJ Abdul Kalam Technological University He is an ambitious person who has a developed nature and a responsible approach to undertake any tasks. He is excellent at working with others to achieve a certain objective on time and with excellence.

Ms. Shibino P Abraham, currently pursuing a Bachelor of Technology in Computer Science and Engineering at St.Thomas College of Engineering and Technology, Kerala, India under APJ Abdul Kalam Technological University. She is a compassionate and dedicated person. After graduation, she plans to pursue a job in the IT field. She is having interests in web designing.

Mr. Anish George pursued in bachelor of science and master of science from New Jersey Institute of Technology, the USA in the year 2003. He is currently working as an assistant professor in the Computer Science department at St.Thomas College of Engineering and Technology, Kerala Technical University, Kerala, India. He has attended several international conferences and seminars. His research areas are software engineering and Artificial Intelligence. He has two years of teaching experience and seventeen years of industry experience in IT.

