Development of IOT based Agribot for Farm Monitoring

[1]Tejaswini B N, [2] Srinivasachar G

[1]Student, [2]Assistant Professor

[1]Computer Science and Engineering,

[1]Atria Institute of Technology, Bangalore, India.

Abstract: Agriculture is the backbone of the Indian economy. Around 70% of people in India depend on agriculture for their livelihood. It is difficult for farmers to practice agriculture without implementing modern technologies like IoT, Big Data, etc. The Internet of Things (IoT) consists of interrelated computing devices and it can transfer data over a network without requiring human intervention. Using this technology, we are coming up with Agribot which helps to monitor various functions in the field of agriculture. Agribot is a robotic vehicle of considerable power and great soil clearing capacity. This multipurpose system helps to monitor the level of water, temperature, humidity and soil moisture. This machine is used to cultivate the farm depending on the distance between the crops. The Agribot is controlled by connecting it to the Android smartphone through ESP8266. The whole process calculation, processing, monitoring is designed with motors & components interfaced with a microcontroller.

IndexTerms **-IOT, Agriculture, Sensors, Arduino UNO, ESP8266 Medium.**

I. INTRODUCTION

Farming is one of the major occupations practiced by millions of people in India. The development of smart agriculture is directly proportional to the capital income of the country. Agriculturists face many problems such as lack of mechanization, low soil fertility, climate change, small and fragmented land holdings, agricultural marketing, various crop diseases, increased labor, and unpredictable natural disasters. Conditions become worse due to the non-availability of skilled labor and increased labor wages. The government has implemented an enormous number of schemes to help farmers. Indian Government has also introduced loan schemes that are used by the farmers to buy fertilizers, seeds, modern machines, etc. Major problems like 16.84% failure of crops, 0.88% failure of bore wells and other issues lead to the national catastrophe of farmers committing suicide. To overcome these challenges and increase productivity, the Internet of Things (IoT) is used to monitor the agriculture field. Internet of things (IoT) is used to create a network in which all the physical objects also referred to as smart devices are connected and use the internet for communication. These smart devices are web-enabled and they are used to perform various activities on the data they acquire from their surrounding environment. IoT was first developed in 1999 by Kevin Ashton who is also known as father as IoT for his immense contribution to this field. The system developed has major functions such as sowing, C02 sensor, temperature sensor, humidity sensor, NPK sensor, and cultivator. The above functions make the system efficient and help farmers to increase productivity. The system is built on a metal chassis and is connected to an android app. NPK sensor is interfaced because crop growth completely depends on the nutrients present in the soil. Temperature and humidity influence agricultural production and hence the respective sensors are used. Seed sowing technology is used in the system which is the most effective method to grow crops.

II. EXISTING SYSTEM

Agriculture has its own significance in the development of the country and about one-third of the nation's capital income comes from farming. Enormous research work carried out in the field of agriculture show various problems like lack of water, unpredictable weather, lack of skilled labor and many other major issues. To overcome these problems the Internet of Things (IoT) is used which helps to monitor water, soil and carries out many functions without human intervention. Monitoring environmental factors are done for the betterment of farmers and increase productivity. Status, Challenges, Policies, and Strategies in agriculture is proposed in [1] which deals with market size, demand for agricultural commodities, and growth in agriculture. Research work is carried out in [2] find fertilizers required and the amount of crop water. Smart Trickle Irrigation System for Green Agriculture is proposed in [3] which focuses on measuring temperature and humidity and uses the ARM 11 processor.

III. PROPOSED SYSTEM

The system renders support to all the farmers to make agriculture more sustainable and productive. Modern technologies are introduced to feed the increasing population. Various sensors are interfaced with Arduino UNO to monitor temperature, humidity, soil moisture, water level and perform activities like cutting, seed sowing and cultivating. This multipurpose irrigation vehicle fabricated is connected to an android smartphone application to control the vehicle. The below architecture diagram, Fig-1 shows the components interfaced in the given system.

3.1 Hardware Section

Agribot performs the required functions by using the below hardware components and sensors.

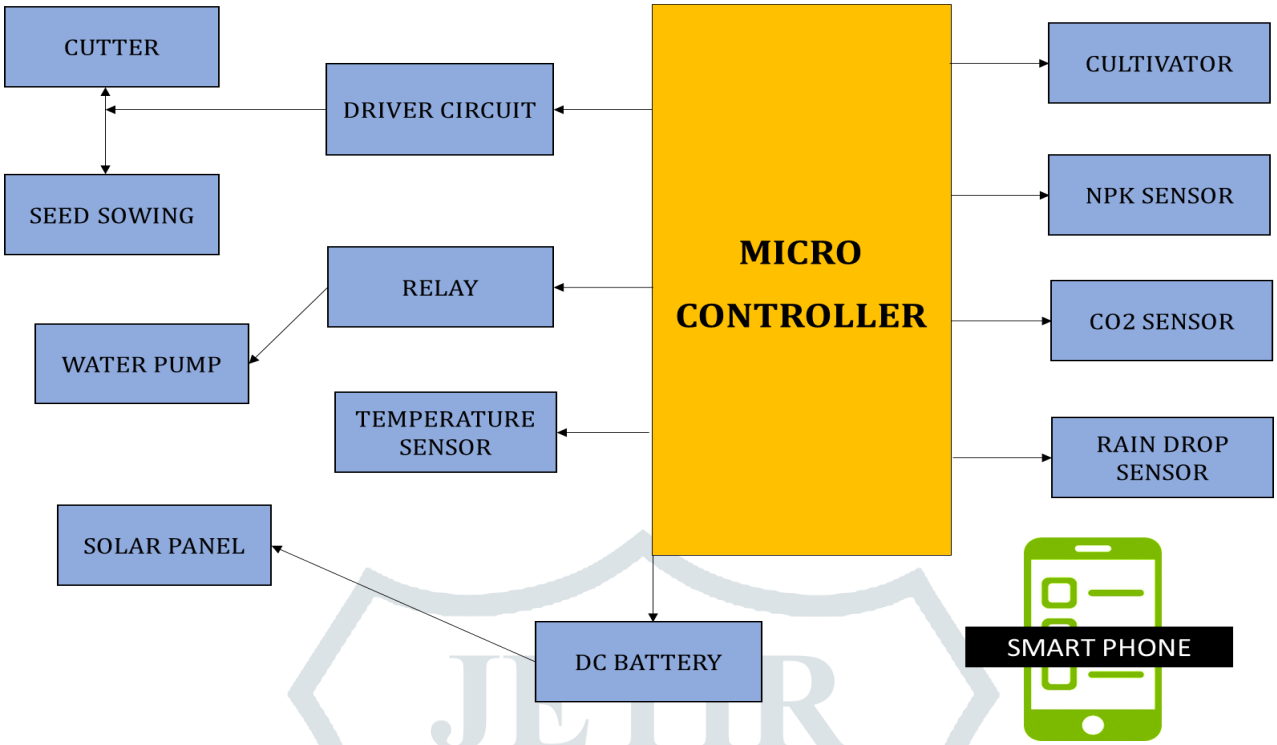

Fig.1- Architecture of the Agribot

3.1.1 Temperature Sensor

The sensor is used to collect temperature data and converts it into a form understandable by the user. Respiration, microbial activity, photosynthesis, transpiration, the water potential of the soil and several other activities are affected by temperature. Germination is affected by temperature and plant growth declines if it is extremely cold or hot. Hence temperature is monitored to grow healthier crops and increase efficiency.

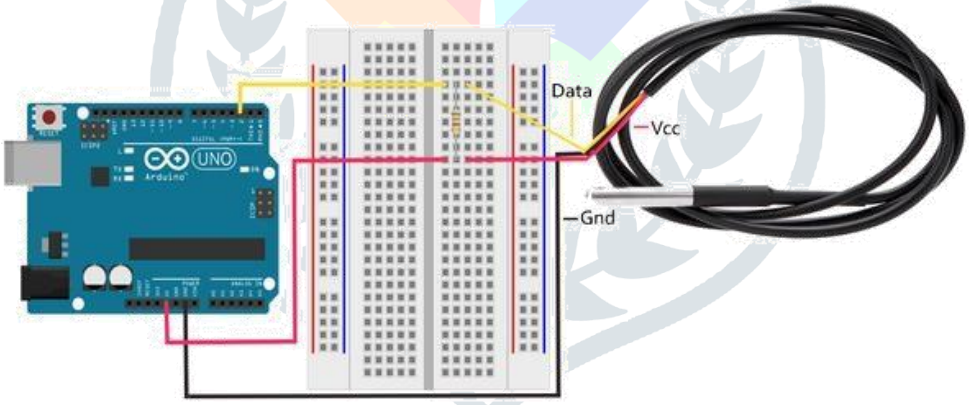

Fig.2- Temperature sensor

3.1.2 NPK Sensor

This sensor uses an optical transducer to detect nitrogen (N), phosphorous, and potassium nutrients of the soil. The 3 macro-nutrients utilized by the plants are represented as three numbers on fertilizers. Nitrogen is measured because it contributes to the growth of plants. Potassium contributes to the overall plant health. Phosphorous is used to improve fruit production, flower production, and leaf growth.

Fig.3- NPK Sensor

3.1.3 Humidity Sensor

A humidity sensor or hygrometer is a device that collects temperature data and converts it into a form understandable for an observer. It helps the farmers to monitor their crops by testing moisture content in the soil. The relative humidity is the ratio of moisture to the highest amount of moisture at a particular temperature. If there is a lot of humidity in the air, less water is evaporated in the plant which increases photosynthesis. 50-60% optimum humidity is required for vegetative growth and flowering plants.

Fig.4- Humidity Sensor

3.1.4 Cultivator

Cultivating in agriculture is done to prepare a seedbed in which the crop will be planted and to bury the crop residue in the soil which helps to warm the soil before planting. This tool is used to remove weeds and aerate the soil by turning the soil.

3.1.5 Water pump

The water pump helps the farmers to utilize, monitor and control water in a judicious manner. The wastage of water is reduced and farming is carried out efficiently.

3.1.6 Seed sowing

There are many disadvantages in the traditional method of seed sowing and hence Agribot has another feature in which the seeds are sowed without human intervention. The main advantage of the seed driller is all the seeds are sowed at an appropriate depth and have an equal distance between them. The competition for food, water, sunlight is eliminated by using seed driller. Using this tool minimum number of seeds are wasted and seeds are not eaten by birds because seeds are covered by soil. Labour cost and time are saved using this method.

3.1.7 Solar Panel

The light energy absorbed from the sun is converted into electrical energy and stored in DC battery to perform the required functions.

3.1.8 Relay

Relay is a switch that is used to turn on and off the electric path to the devices through Arduino UNO. Agribot implemented is safe and has reliable power control due to relay.

3.1.9 DC Battery

DC Battery is a device which stores electrical energy generated by solar panel and acts as a power supply to perform all the functions of the system. Battery is a source of energy for all the components in the system.

3.1.10 ESP8266

ESP8266 is a small module that is highly integrated and has low power. The module comes with high durability, compactness and power-saving architecture. It is a SOC that is integrated with TCP/IP protocol stack. The pins present in this Wi-Fi module are RX, VCC, GPIO O, RESET, CH_PO, GPIO 2, TX, and GND. RX and TX are the pins that are used for communication. Powering pins are VCC and GND.

3.1.11 Raindrop Sensor

Raindrop sensor consists of nickel coating in the form of lines. It works on the principle of resistance. This module has an electronic board and a printed circuit board that collects raindrops. The sensor is connected to Arduino UNO and it is used to sense rain. It is farmer-friendly because it helps them to water the plants only when it is required. The resistive dipole of the sensor shows high resistance when wet and low resistance when dry. The voltage is increased when there is no raindrop on the sensor.

3.1.12 L293 Motor Driver

The motor is driven using a L293 motor driver. 600mA is the maximum current per channel and 36V is the maximum voltage of the motor supply. It is one of the most useful sensors which reduces water wastage. If the moisture content in the soil is below threshold value then the sensor switches motor ON and turns OFF the motor if the moisture content of the soil is normal. It is a motor driver IC which consists of 16 pins to control 2 DC motors in any direction.

3.1.13 CO_2 Sensor

Research work has shown that CO2 has both positive and negative impact on agriculture. This sensor is used to measure CO2 gas.400-500 ppm is the ambient level of CO2. Plant growth will be higher if the CO2 level is increased to 1000-1500 ppm. C02 burn occurs if the level is 2000 ppm or higher. C02 sensor is used to monitor the above conditions and alert the farmers when required.

3.1.14 Cutter

The cutter is interfaced in this system to remove unwanted plants and weeds. This module is connected by using driver circuit.

3.2 Software Section

3.2.1 Arduino UNO

Arduino UNO is a microcontroller board that is used to handle software and hardware in an easier way. Crystal oscillator and power jack are interfaced in this module. It is an easy to use programmable device. Arduino technology is flexible and we can load the programs without the need of hardware programmer to burn the program. The operating voltage of the Arduino UNO is 5V. Arduino UNO has 14 input/output pins and 6 analog input pins.

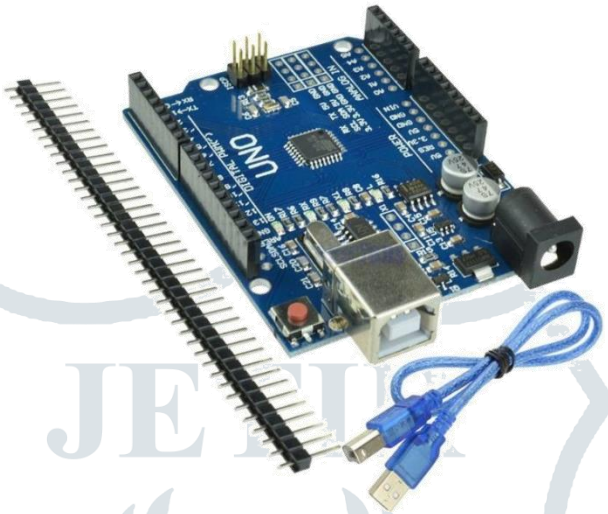

Fig.5- Arduino UNO

3.2.2 Embedded C

Embedded C is the main reason behind the working of every embedded system we come across in our daily life. It is frequently used to control hardware architecture. It has high scalability, reliability, and portability. Embedded C programming which is traditional C language extension is the most powerful language in the software field. Embedded C is cross development in nature and hardware dependent.

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