RESEARCH ARTICLE OPEN ACCESS

AUTONOMOUS AGRICULTURAL BOT

Arati Nimbalkar, Anam Shaikh, Jayashree Hogale, Manisha Gite, Prof.R.S.Parte

Abstract:

With the advancement of science and recent technologies the attention of scientist is getting directed towards two field – Farming and Robotics System. But the combination of two technologies can serve efficiently for many problems by overcoming the limitation of previous technologies. Robotics technologies alone serve very well for the various problems in the field of engineering, medical, military, industry evolution and other various areas of development and requirements, but here we pile together the new advancement in agriculture with robotics to develop the agriculture system which can be used in more complex dynamic systems. This technology provides optimum and efficient solution for wide ranges of production with their merits and demerits. This robotic system is named as agricultural robot. We have to develop a robot capable of performing operations like automatic ploughing, seed dispensing and watering. It also provides manual control when required and keeps tabs on the humidity with the help of humidity sensors. The main component here is the AVR Atmega microcontroller that supervises the entire process. Initially the robot tills the entire field and proceeds to ploughing, simultaneously dispensing seeds side by side. After seeding it also levels the soil and waters the ground. For manual control the robot uses the Bluetooth pairing app as control device and helps in the navigation of the robot inside the field. The field is fitted with humidity sensors placed at various spots that continuously monitor the environment for humidity levels. It checks these levels with the set point for humidity and alerts the farmer. It also has temperature sensors and moisture sensor that sends data to the app. The water sprinklers, if on, bring down the humidity level thus providing an ideal growing environment to crop. Farmers today spend a lot of money on machines that help them decrease labour and increase yield of crops but the profit and efficiency are very less. Hence automation is the ideal solution to overcome all the shortcomings by creating machines that perform all operations and automating it to increase yield on a large scale.

KEYWORDS:

Movement, Agricultural robot,, Arduino, Robot Architecture, Agricultural Functions, Android, Sensors.

INTRODUCTION:

Farmers today spend a lot of money on machines that help them decrease labour work and increase yield of crops. There are various machines that are available for ploughing, harvesting, spraying pesticides etc., however these machines have to be manually operated to perform the required operations and moreover separate machines are used for every function. The yield and profit returns from employing this equipment are very less as compared to the investment. Another issue is the growing demands of the world's population. The World Health Organization estimates that Earth's population will touch 9 billion in 35 years which will lead to a staggering demand in increase of growth of food crops. Automation is the ideal solution to overcome all the above-mentioned shortcomings by creating machines that perform more than one operation and automating those operations to increase yield on a large scale. XUE Jinlin, XU Liming published a paper on "Autonomous Agricultural Robot and its row Guidance", at the International Conference on Measuring Technology. The objectives of this paper are: to enable the farmer to plough large areas of land in minimum amount of time, to perform automated ploughing and simultaneous

seeding process using Advanced Virtual RISC (AVR), to provide manual control with the help of Bluetooth, to measure and control humidity in the field using humidity sensors and water sprinkler. Agriculture is humankind's oldest and still important economic activity, providing the food, feeder, fibre and fuel necessary for our survival. The current trend in agricultural robot development is to build more smart efficient machines that reduce the expense of the farmer while still providing one more services and higher quality. Development of a robot that can perform automated ploughing and seeding operation can be manually navigated by the farmer and stabilizes the humidity in the environment. Robotics and automation can play a significant role in enhancing agricultural production needs. We can also implement with the advancement in sensors and control systems that allow for optimal resource and integrated disease and pest management. Alijanobi, A.A published a paper titled "A set up of mobile robotic unit for Fruit harvesting" at the 2010 19th International workshop. Yan Li, chunlei Xia, Jangmyung Lee published a paper titled "Vision based pest detection and automatic spray in green 2015 IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development (TIAR 2015) 18 house plant".Once the concept of Automation and agriculture is accepted the adoption rates will become high and the costs of technology will come down. Autonomous machines will be safer, more consistent with more efficient plant agronomy. The robot in the fig 1 shows how a robot is used in the agricultural fields. With the help of robots, autonomous agricultural operations such as spraying, mechanical weed control, fruit picking, watching the farm day and night, allowing farmers to reduce the environmental impact, increase precision in an effective manner. The Advantage of Automated techniques are Robots can work nonstop and in hazardous environment, Robots can detect presence of diseases, weed, insect infestations and other stress. Due to the light weight of the robots they do not compact the soil as large machinery does.

LITERATURE SURVEY:

Some of the real issues in the Indian agricultural are mounting of input costs, approachability of skilful labours, absence of water resources and crop checking. To beat these issues, the mechanization advancements with robots were utilized as a part of agribusiness. The robotics helps the farmers in agriculture to reduce their efforts. The robot which performs functions like automatic seeding system, automatic pest control unit, automatic compost spraying etc is designed to ease the work of the farmers and increase the outcome. This beats the adversity of farmers in farming their land irrespective of the weather conditions. The Arduino is used for the software implementation of the robot and the motor direction is controlled using the driver L293D. The robot is advanced with hardware parts such as seed drum alongside channels and delving system containing cutting edges in the mechanical get together of the vehicle. The sensors utilizing the Bluetooth module were effective and demonstrated the capacity of the equipment stage made out of sensors, and microcontroller. The results with the Bluetooth module constrained the information transmission which are fundamentally the restricted range. The integrated system of agribot uses Wi-Fi to communicate between 2 robots which performs activities like seeding, spraying of fertilizers and insecticides. It uses ultrasonic proximity sensor to avert the obstacles in the path. Single seed is picked up from bulk of seeds and lead to vacuum pump and in order to suck a seed inside the funnel linear actuator is used. 100 2018 International Conference on Design Innovations for 3Cs Compute Communicate Control 978-1-5386-7523-6/18/$31.00 ©2018 IEEE DOI 10.1109/ICDI3C.2018.00030 Bluetooth module and GSM directly speak with Arduino utilizing I/O ports. Seed sowing are finished using servomotor then the pole of servomotor can be turned by the required degree which is associated with the holder containing seeds that point fall in the dirt. A level bar furnished with various jagged teeth is fixed on it to loosen the soil bed and ploughing the soil. Seed dispenser is done using servo mechanism. Parameters such

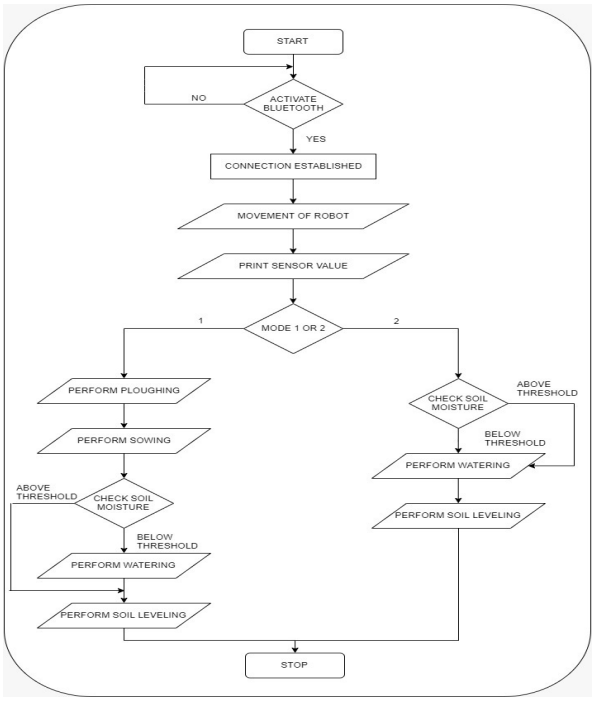
as soil condition, area covered by the robot and weight of the material for levelling are examined for different motors. The advantages of these robots are reducing human intervention, ensuring proper irrigation and efficient utilization of resources. These robots are fundamentally helpful in automated weed control; usage of fertilizers based on soil condition, soil sensors for drip irrigation in rain feed areas. The proposed design is mainly used for crop establishment, plant care and selective harvesting.

AIMS AND OBJECTIVES:

- Automating ploughing
- Automating sowing
- Automating watering
- Automating soil leveling
- Reducing work of farmers
- Increasing yield by proper maintenance using sensors such as soil moisture, temperature, humidity, water.

PROPOSED SOLUTION:

This project is an Autonomous Agriculture Robot which is controlled over Bluetooth protocol using an Android App. The Android App consists of 5 buttons for movement of robot. The actions that would be performed by the robot are Forward, Backward, Right, Left and Stop. It also consists of list picker for selecting Bluetooth device connected to the robot. Once the Android application establishes a secure connection with the robot then the app is ready for controlling the actions of robot. The robot is capable of Digging, Sowing, Watering and Soil Levelling. Digging is done using Motor Drill. Sowing action will be performed using Servo Motor for lock mechanism. Watering will be done by Pump Motor. Levelling is done using Flat leveller. The Android App has a button for Starting all these processes. The robot also has sensors like the DHT11 sensor, water sensor and Soil Moisture sensor. The sensor values are automatically sent to Android App. The DHT11 sensor is used for measuring the temperature and humidity in the surrounding of the robot. The water sensor is used for detecting the water level of the container used for watering. The soil moisture sensor is used to sense the moisture content of the soil. The robot works in two modes. In the first mode the robot performs actions such as ploughing, sowing, watering and soil levelling along with movement of robot. In the second mode the robot performs only watering action by sensing the soil moisture content. First mode of operation is used in the initial stages while the second mode of operation is used after the initial stage when the robot only needs to water the field. The sensor data can also be manually updated by the in-app Refresh button.



Inputs: in1, in2, in3, in4, temp, hum, smoist, wlvl.

Outputs: out1, out2, out3, out4, atemp, ahum, asmoist, awlvl

Notations:

in1 = Input 1 to motor driver

in2 = Input 2 to motor driver

in3 = Input 3 to motor driver

in4 = Input 4 to motor driver

temp = Value of Temperature sensor

hum = Value of Humidity sensor

smoist = Value of Soil Moisture sensor

wlvl = Value of Water Level sensor

out1 = Output 1 from Motor Driver

out2 = Output 2 from Motor Driver

out3 = Output 3 from Motor Driver

out4 = Output 4 from Motor Driver

atemp = Alert from Temperature sensor

ahum = Alert from Humidity sensor

asmoist = Alert from Soil Moisture sensor

awlvl = Alert from Water Level sensor

Mathematics:

if (in1 == high) then generate high on out1.

else if (in1 == low) then generate low on out1.

if (in2 == high) then generate high on out2.

else if (in2 == low) then generate low on out2.

if (in3 == high) then generate high on out3.

else if (in3 == low) then generate low on out3.

if (in4 == high) then generate high on out4.

else if (in4 == low) then generate low on out4.

if (temp > 27 C) then generate alert atemp.

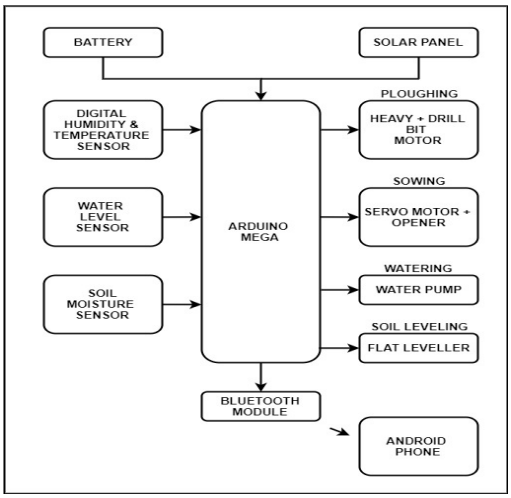
if (hum < 45%) then generate alert ahum.

if (smoist < 40%) then generate alert asmoist and switch on water pump.

if (wlvl <= 1L) then generate alert wlvl.

display temp, hum, smoist and wlvl to android app.

SYSTEM ARCHITECTURE:

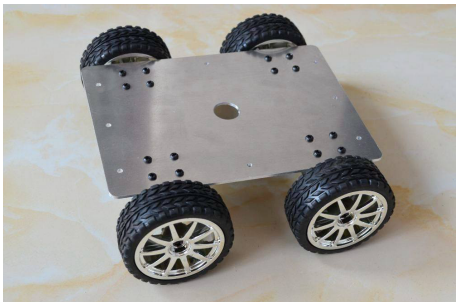


HARDWARE USED

1. Wheels

Used for movement of robot.

2. Chassis



Powder coated Metal chassis for robots. Easy to mount the motors on place by using normal motor mount nut. It can either be used in skid steel configuration (4 motors). The body contains perforated holes for easy mounting of

various size circuit boards and other mechanical components.

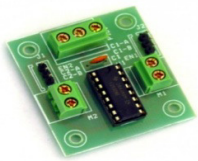
3. Dummy wheels

It is used for replacing motors connected to the chassis.

4. DC motor

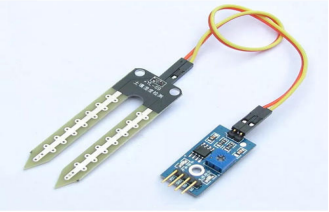
DC Motor – 100RPM – 12Volts geared motors are generally a simple DC motor with a gearbox attached to it. This can be used in all-terrain robots and variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly. 100 RPM 12V DC geared motors widely used for robotics applications. Very easy to use and available in standard size.

5. L293D Motor Driver



L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC.

6.Soil moisture sensor

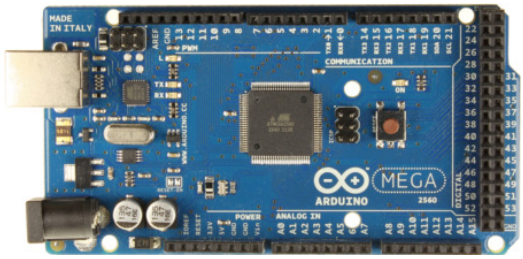


This Moisture Senor can be used for detecting the moisture of soil or judge if there is water around the sensor, let the plant in your garden able to reach out for human's help when they are thirsty. This sensor is very easy to use, you can just simply insert in into the soil and read the data.

7.Water sensor

A water detector is an electronic device that is designed to detect the presence of water for purposes such as to provide an alert in time to allow the prevention of water leakage. A common design is a small cable or device that lies flat on a floor and relies on the electrical conductivity of water to decrease the resistance across two contacts. The device then sounds an audible alarm together with providing onward signalling in the presence of enough water to bridge the contacts. These are useful in a normally occupied area near any infrastructure that has the potential to leak water, such as HVAC, water pipes, drain pipes, vending machines, dehumidifiers, or water tanks.

8.Arduino Mega



The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

The Mega 2560 is an update to the Arduino Mega, which it replaces.

Specification

Operating Voltage 5V
Input Voltage (recommended) 7-12V
Input Voltage (limits) 6-20V
Digital I/O Pins 54 (of which 14 provide PWM output)
Analog Input Pins 16
DC Current per I/O Pin 40 mA
DC Current for 3.3V Pin 50 mA
Flash Memory 256 KB of which 8 KB used by bootloader
SRAM 8 KB
EEPROM 4 KB
Clock Speed 16 MHz

9. Pump motor

It is a submersible motor which can be used to pump liquid from one place to another.

10.Micro servo motor (SG90)

It is tiny and lightweight with high output power. This servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos. It comes with a 3 horns (arms) and hardware.

11.Jumper

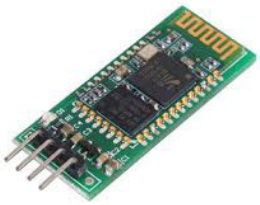
A jump wire (also known as jumper wire, or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a

breadboard, the header connector of a circuit board, or a piece of test equipment.

12.Solar panel

Photovoltaic solar panels absorb sunlight as a source of energy to generate direct current electricity. A photovoltaic (PV) module is a packaged, connected assembly of photovoltaic solar cells available in different voltages and wattages. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. The most common application of solar energy collection outside agriculture is solar water heating systems.

13.Bluetooth Module HC05

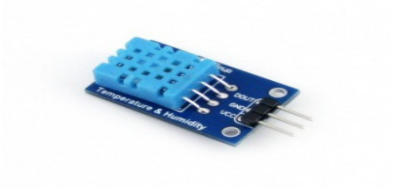


The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. You can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc.

Features:

- Protocol: Bluetooth Specification v2.0+EDR
- Frequency: 2.4GHz ISM band
- Modulation: GFSK
- Emission power: ≤4dBm, Class 2
- Sensitivity: ≤-84dBm at 0.1% BER
- Speed: Asynchronous: 2.1Mbps(Max) / 160 kbps, Synchronous: 1Mbps/1Mbps
- Security: Authentication and encryption
- Profiles: Bluetooth serial port
- Power supply: +3.3VDC 50mA
- Working temperature: -20 ~ +75 Centigrade

14.Temperature Humidity Sensor (DHT 11)



A humidity sensor senses, measures and regularly reports the relative humidity in the air. It measures both moisture and air temperature. Relative humidity, expressed as a percent, is the ratio of actual moisture in the air to the highest amount of moisture air at that temperature can hold. The warmer the air is, the more moisture it can hold, so relative humidity changes with fluctuations in temperature.

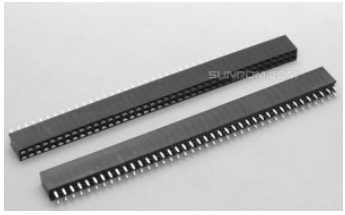
15.Arduino USB Cable

USB stands for Universal Serial Bus. It is used as a data cable for programming Arduino Mega board. It is also used to power Arduino Mega board. It supplies 5V to the board.

16. 12V DC Power Supply

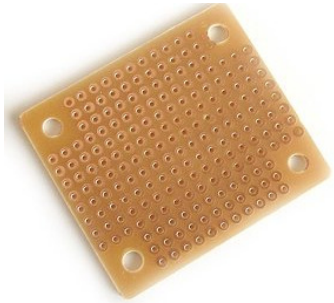
12V power supplies (or 12VDC power supplies) are one of the most common power supplies in use today. In general, a 12VDC output is obtained from a 120VAC or 240VAC input using a combination of transformers, diodes and transistors. 12V power supplies can be of two types: 12V regulated power supplies, and 12V unregulated power supplies.12V regulated power supplies come in three styles: Switching regulated AC to DC, Linear regulated AC to DC, and Switching regulated DC to DC.

17. Header



A pin header (often abbreviated as PH, or simply header) is a form of electrical connector. It consists of one or more rows of male pins typically spaced 2.54 millimetres (0.1 in) apart, but common sizes also include 5.08 millimetres (0.2 in), 5.00 millimetres (0.197 in), 3.96 millimetres (0.156 in), 2.00 millimetres (0.079 in), 1.27 millimetres (0.05 in) and 1.00 millimetre (0.04 in). The distance between pins is commonly referred as pitch in the electronic community.

18. Perf Board



Perfboard is a material for prototyping electronic circuits (also called DOT PCB). It is a thin, rigid sheet with holes pre-drilled at standard intervals across a grid, usually a square grid of 0.1 inches (2.54 mm) spacing. These holes are ringed by round or square copper pads, though bare boards are also available. Inexpensive perfboard may have pads on only one side of the board, while better quality perfboard can have pads on both sides (plate-through holes). Since each pad is electrically isolated, the builder makes all connections with either wire wrap or miniature point to point wiring techniques. Discrete components are soldered to the prototype board such as resistors, capacitors, and integrated circuits. The substrate is typically made of paper laminated with phenolic resin (such as FR-2) or a fiberglass-reinforced epoxy laminate (FR-4).

19. Battery Snap

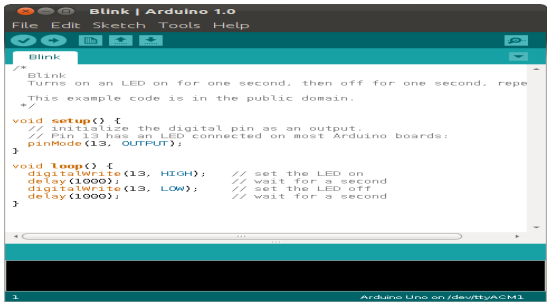
It is used to connect 9V battery to the pins to provide power supply.

20. Drill Motors

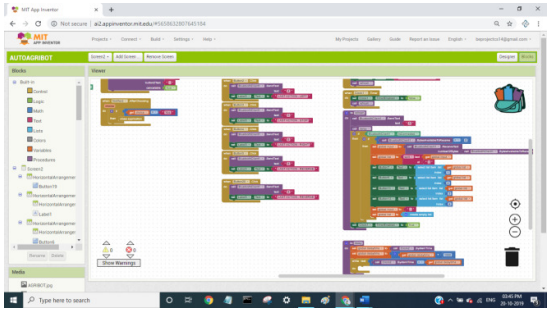
An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and winding currents to generate force in the form of rotation. The drill motor is a heavy torque motor with a drill bit connected to it.

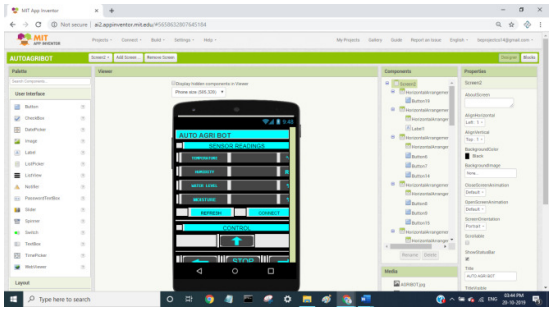
Software Requirements:

1.Arduino IDE

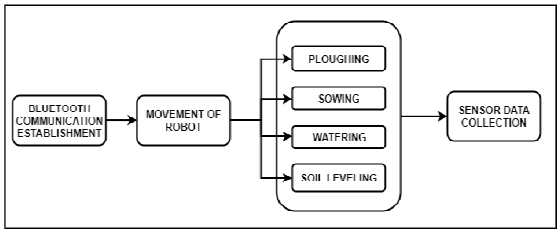


2.MIT app inventor2:

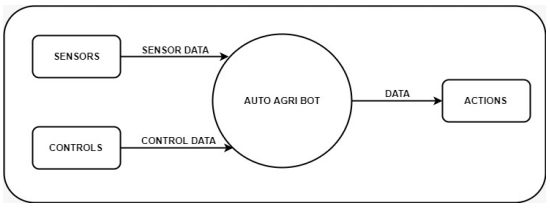


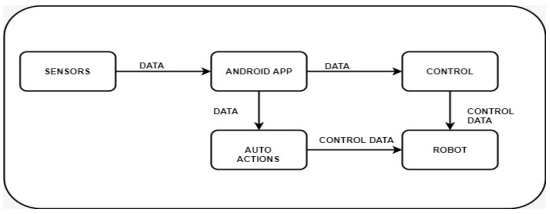


HIGH LEVEL DESIGN:



DATA FLOW DIAGRAM:





CONCLUSION: An initial outcome of this study indicates that most of these systems that which work autonomously are more flexible than traditional systems. The benefits of reduction in labour costs and restrictions on the number of daily working hours significantly improved. Thus, it has made possible to automate the most significant working routines. Multipurpose autonomous agricultural robot has successfully implemented and tested for various functions like ploughing, seeding, levelling and water spraying. It was developed by integrating agricultural robot with C programming.

REFERENCES:

1. Xue Jinlin, XU Liming, “Autonomous Agriculture Robot and its row guidance”, IEEE, International Conference on Measuring Technology, 2010, published

2. Aljanobi.A,”A set up of mobile robotic unit for fruit harvesting”, IEEE International workshop, 2010, references.

3. Yan Li, chunlei Xia, Jangmyung Lee, “Vision based pest detection and automatic spray in green house plant”, page no 920-925, International Symposium, references.

4. Ashish Lalwani, mrunmai Bhide, S. K. Shah, A Review: Autonomous Agribot For Smart Farming, 46th IRF International Conference, 2015

5. Akhila Gollakota, M.B.Srinivas, Agribot-A multipurpose agricultural robot, India Conference (INDICON), IEEE, 2011.

6. Sandeep Konam, "Agricultural Aid for Mango cutting (AAM)," Electronics & Communication Engineering, RGUKT, R.K. Valley Kadapa, India, 978-1-4799-3080-7 IEEE 2014.

7. Rasin, Z., H. Hamzah and M.S.M. Aras, 2009. Application and evaluation of high power Zigbee based wireless sensor network in water irrigation control monitoring system. Proceedings of the IEEE Symposium on Industrial Electronics and Applications, Volume, 2, October 4-6, 2009, Kuala Lumpur, Malaysia, pp: 548-551.

