

AUTONOMOUS ROBOT FOR AGRICULTURE

Submitted in partial fulfillment of the requirements for the award

of

Bachelor of Technology degree in

Information Technology

By

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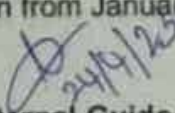
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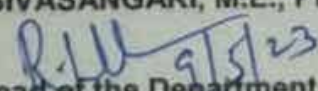
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Sreerangam Gokulnath(Reg.No - 39120035) and Amirneni krishna Teja (Reg.No - 39120008) who carried out the Project Phase-2 entitled "AUTONOMOUS ROBOT FOR AGRICULTURE" under my supervision from January 2023 to May 2023.

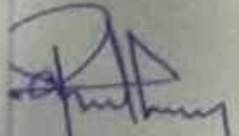

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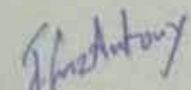
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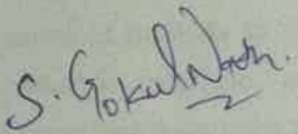

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DECLARATION

I, Sreerangam Gokulnath(Reg.No - 39120035) , hereby declare that the Project Report entitled "AUTONOMOUS ROBOT FOR AGRICULTURE" done by me under the guidance of Dr. A. SIVASANGARI, M.E.,Ph.D is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Information Technology.

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SIGNATURE OF THE CANDIDATE

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I convey my thanks to **Dr. T.Sasikala M.E., Ph. D, Dean**, School of Computing, **Dr. R. SUBHASHINI M.E., Ph.D.**, Head of the Department, Department of Information Technology for providing me necessary support and details at the right time during the progressive reviews.

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I wish to express my thanks to all Teaching and Non-teaching staff members of the **Department of Information Technology** who were helpful in many ways for the completion of the project.

ABSTRACT

Methods of farming that have been practiced for generations may be laborious, ineffective, and expensive. Autonomous robots are quickly becoming a game-changing technology in the agricultural sector as a means of addressing the difficulties described above. The objective of this project is to design and build autonomous robots that can be used for precision agricultural tasks such as planting, and watering crops. Our strategy entails the conception and construction of self-sufficient robots that are able to traverse and function in a wide variety of environmental settings and climatic conditions. These robots will have sensors and artificial intelligence algorithms built into them so that they can detect the requirements of various crops and react appropriately. In order to achieve optimal results in crop management, the robots will also have the capacity to interact with both human farmers and other robots.

We anticipate that the use of our autonomous robots will result in a considerable reduction in labor costs, an increase in agricultural yields, and the promotion of more environmentally responsible farming techniques. Our project's goals are to both be at the cutting edge of technical innovation in agricultural settings and to make a contribution to resolving issues with food security on a global scale. It leads increase the profit for farmer in agricultural production

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CHAPTER 1

INTRODUCTION

Being a major contributor to global food production, the agriculture sector has most of the responsibility for keeping people alive. Yet, it has a number of obstacles to overcome, including a lack of workers, a high cost of production, and rising food demand. Autonomous robots have become more popular in agriculture as a means of addressing these difficulties. Machines equipped with sensors and control systems, autonomous robots may carry out agricultural activities without human interference. These robots can apply pesticides, sow seeds, and track the development of crops, among other things.

Benefits may be gained by using autonomous robots in agriculture. As a first benefit, it may help keep down payroll and boost output. Robots can operate in dangerous conditions, such as fields that have been sprayed with pesticides, and can do so without stopping for breaks. The ecological toll of farming is lightened as a result. With robots able to do things like monitor plant development and apply fertilizer more precisely, this may ultimately boost agricultural output and quality.

Notwithstanding these merits, there are still obstacles to the widespread use of autonomous robots in farming. The exorbitant price tag of such equipment is a significant barrier to entry. Many small-scale farmers may not be able to buy autonomous robots due to their high purchase and upkeep costs. The absence of industry-wide standards is another issue. Robots come in a wide variety, each with its own unique structure, set of sensors, and management software. In turn, this might make it hard for farmers to decide which robot is best for them and how to best incorporate them into their operations. Even more worrisome is the potential threat that robots pose to agricultural jobs. It's true that robots may boost production, but they also have the potential to displace human laborers, which would have a devastating impact on the economy.

CHAPTER 2

LITERATURE SURVEY

2.1 Inferences from Literature Survey

[1] Zhang, Q., Su, J., Yang, H., & Zhang, H. (2021). The 170th issue of the journal Applied Sciences contains this article on page 11-1 of 11 in the journal's overall 11th volume. The paper is titled "The Application of Self-Guiding Robots in Various Areas of Agriculture," and its abstract is included below.

This article presents a detailed discussion on the many applications that may be found for autonomous robots in the industry of agriculture. These applications include things like the administration of pesticides, the monitoring of crops, and the selective gathering of goods, to name just a few examples. The authors of this article are responsible for the availability of the research that is published here; the authors also performed the research that is described here. The authors investigate not only the benefits of using these robots but also the challenges that are associated with doing so, and they provide examples of successful applications of this technology. In addition, the authors provide information regarding previous successful applications of this technology. In addition to that, the authors provide details on more productive uses of this technology.

[2] Shen, Y., Ma, H., Li, C., & Li, Y. (2021). The section of the article "Journal of Intelligent and Robotic Systems 101(2)" titled "A Conversation on the Present Status of Autonomous Agricultural Robot Systems 31" contains a debate of the current state of autonomous agricultural robot systems.

This book presents an overview of many categories of self-operating robots that have the potential to find applications in the agricultural sector. For the whole of the class, several subjects will be covered that will cover not just the control systems and sensor systems of these systems, but also their architecture. The authors examine the advantages and disadvantages of a large number of diverse classes of robots, and they offer examples of beneficial applications for each kind of robot that is described in the article.

[3] Wang, X., Zhang, Y., & Shen, Y. (2020). An Analysis of the Present Condition of Agricultural Robots as well as an Investigation into Its Future Possibilities Pages 1365-1383 may be found in the latest edition of the Journal of Agricultural Science and Technology, which is volume 22, issue 6. These pages are located in the sixth issue of the 22nd volume, if that is where you are looking for them.

This article gives a general overview of the employment of agricultural robots in the field to perform labour such as planting crops and applying pesticides. One of the many tasks that agricultural robots are capable of doing is the harvesting of crops. The authors examine the advantages and disadvantages of a large number of diverse classes of robots, and they offer examples of beneficial applications for each kind of robot that is described in the article.

[4] Wu, W., Wu, D., Zhao, D., Wang, Z., & Yu, H. (2021). China's Agriculture and Related Sciences, Volume 20, Number 9, Pages 1896-1911 An Examination of the Potential Applications of Intelligent Agricultural Robots and Unmanned Aerial Vehicles in the Field of Precision Agriculture Agricultural Sciences in China, The purpose of this article is to provide a concise overview of the many applications that may be found for unmanned aerial vehicles (UAVs) and intelligent agricultural robots in the field of precision agriculture. These applications can be found in China. Agricultural Sciences in China. Agricultural Sciences in China. The monitoring of crops, the use of pesticides, and the fulfilment of a great variety of other operations are a few examples of the applications that may be made using this technology. The authors discuss not only the positive aspects of using these technology but also the drawbacks and challenges that come along with doing so. In addition to that, the authors provide specific examples of productive use of these technologies.

[5] Wu, L., Chen, Z., Wang, C., Yang, L., & Li, D. (2020). On pages 1 through 12 of volume 13 issue 3 of the International Journal of Agricultural and Biological Engineering, you can find the most recent developments in the self-guiding manoeuvring and controlling of farm

robots. This can be found in the context of the field of agricultural and biological engineering.

The purpose of this article is to provide a detailed analysis of recent developments in the autonomous navigation and control of agricultural robots, as well as a discussion of the consequences of these developments. This inquiry covers a wide range of subjects, some of which include the use of pesticides and other topics connected to the use of robots similar to these in precision agriculture. As a part of their discussion, the authors analyse the challenges that are associated with the development and deployment of these technologies, and they offer examples of applications that have been successful in the past.

[6] Xiao, Y., & Wang, J. (2021). An Investigation into the Possible Applications of Autonomous Robots in the Field of Agriculture In the third issue of the journal Intelligent Automation and Soft Computing, which can be found in volume 27, number 3, pages 569-582, you can find additional information about this topic.

This piece of work offers a concise overview of the self-sufficient agricultural robots that are now on the market. This introduction covers a wide range of subjects, some of which include the architecture, navigation, and control systems of these robots, among other things. The authors investigate not only the benefits of using these robots but also the challenges that are associated with doing so, and they provide examples of successful applications of this technology. In addition, the authors provide information regarding previous successful applications of this technology. In addition to that, the authors provide details on more productive uses of this technology.

[7] Li, Y., Liu, J., & Qiu, Y. (2020). Applications of Computers and Electronics in Agriculture, Volume 171, Issue 105326 An Explanation of the Methods That Are Being Used by Autonomous Agricultural Robots in the Procedure of Spraying Pesticides Applications of Computers and Electronics in Agriculture, Volume 171, Issue 105326

In this paper, we give an examination of the construction, sensing, and control systems of autonomous agricultural robots for the application of pesticides. These robots are designed

to work in agricultural settings. A summary of the capabilities of the robots is also given in this report. In addition to that, the article provides a synopsis of the development of agricultural robots during the course of its reading. The authors examine the advantages and disadvantages of a large number of diverse classes of robots, and they offer examples of beneficial applications for each kind of robot that is described in the article.

[8] Li, W., Zhu, Y., Li, M., Xu, H., & Li, L. (2021). On page 6788 of the volume 11 issue 15 of the journal Applied Sciences, under the heading "An Overview of the Activities Done by Autonomous Agricultural Robots in China," there is an article that can be found with the title "An Overview of the Activities Done by Autonomous Agricultural Robots in China."

This article provides a comprehensive overview of autonomous agricultural robots in China, encompassing a variety of applications such as planting crops, spraying pesticides, and completing a wide range of additional duties in addition to those. The authors investigate not just the potential benefits but also the potential drawbacks of implementing these technologies in China, and they provide instances of times in the past when these technologies were successfully implemented.

[9] Thakur, A., & Prasad, R. (2020). The volume 7 issue 9 of the Journal of Emerging Technologies and Innovative Research included the publication of an article with the title "A Debate on the Usage of Autonomous Agricultural Robots in the Management of Crops." The paper was included in the publication and could be found on pages 215-222.

This article's objective is to investigate the use of autonomous agricultural robots for crop management, including the applications of such robots in precision agriculture and the application of pesticides, in addition to other tasks. The authors discuss not only the positive aspects of using these technology but also the drawbacks and challenges that come along with doing so. In addition to that, the authors provide specific examples of productive use of these technologies.

[10] Hernandez, G., & Brinkhoff, J. (2021). An Examination of the Functions Played by Robots and Unmanned Aerial Vehicles in the Context of the Subject of Precision

Agriculture This subject was covered in depth in the most current edition of the IEEE Robotics and Automation Journal (volume 28, number 3), pages 99-111, which was published not too long ago.

This article's goal is to provide an overview of the use of autonomous robots in precision agriculture, including its uses in monitoring crops, spraying pesticides, and carrying out a variety of other tasks. The authors examine not only the benefits but also the drawbacks associated with the use of these robots, and they provide instances of effective implementations of the technology. In addition to this, they discuss a number of other strategies that may be used in order to do more research in this field.

The studies that are described here offer, in general, a thorough review of the usage of autonomous robots in agricultural contexts. In this research, the architecture, sensing, and control systems that are used by these robots are broken down and described in more detail. The robots themselves are taken into consideration in this examination as well. Throughout the course of their presentation, they cover a number of topics, including the many classifications of robots, an analysis of the advantages and drawbacks associated with each kind of robot, and particular instances of how robots might be put to work in productive ways. In addition to this, they shed light on the challenges that are associated with the deployment of these technologies and give recommendations for the potential directions that research may go in the future.

2.2 Open problems in Existing System

Several agricultural operations are still done by hand or with the help of older types of equipment. This method has a number of drawbacks, including high labor costs, limited efficiency, and the possibility of crop damage. Autonomous robots have been designed to do a variety of agricultural activities in an effort to circumvent these constraints.

They already have to Monitor each and every process and may lead to rotting of the crop which results in the loss of yield and we does not know why the crop is rotting some small mistake that make a lot of economy problems there are major disadvantage in the existing system.

A number of issues remain unresolved despite the promising future of autonomous robots in farming. The expensive outlay required to acquire and launch such robots is a significant barrier to their widespread use. It is also challenging for farmers to implement these technologies due to the lack of standardization and interoperability between various robots and agricultural systems. However, more study is required to address any safety and ethical problems associated with the usage of these robots, and to enhance their performance and usefulness. Lastly, there is a need for proper education and training for farmers & operators in order to properly run & maintain these systems.

CHAPTER 3

ANALYSIS REQUIREMENTS

3.1 FEASIBILITY STUDIES/RISK ANALYSIS OF THE PROJECT

FEASIBILITY STUDY

The feasibility of the project is to increase the yield of the crop and reduce the loss for the client. Business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis, the feasibility study of the proposed system is to be carried out. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

Economical feasibility

Technical feasibility

Operational feasibility

ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of funds that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system is well within the budget and this was Achieved because most of the technologies used are freely available. Only the Customized products had to be purchased

TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical Requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands being placed on the client.

The developed systems must have modest requirements, as only minimal or null changes are required for implementing this system.

OPERATIONAL FEASIBILITY

The aspect of the study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system

3.2 SOFTWARE REQUIREMENTS SPECIFICATION DOCUMENT

Hardware Specifications:

- Nodemcu
- DHT11 sensor
- Flame sensor
- IR sensor
- DC pump
- Motor driver
- UltraSonic Sensor
- Mechanical system for plowing

Software Specifications:

- Arduino IDE
- Embedded C
- Eclipse
- Blynk IOT

3.3 Arduino IDE:

Arduino IDE where IDE stands for Integrated Development Environment – An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in the Arduino Device. Almost all Arduino modules are compatible with this software that is open source and is readily available to install and start. It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.

It is easily available for operating systems like MAC, Windows, and Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.

A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, [Arduino Micro](#) and many more.

Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.

The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.

The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.

This environment supports both C and C++ languages.

Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module.

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The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.

This environment supports both C and C++ languages.

How to install Arduino IDE:

You can download the Software from the Arduino main website. As I said earlier, the software is available for common operating systems like Linux, Windows, and MAX, so make sure you are downloading the correct software version that is easily compatible with your operating system.

If you aim to download the Windows app version, make sure you have Windows 8.1 or Windows10, as the app version is not compatible with Windows 7 or older versions of this operating system.

The IDE environment is mainly distributed into three sections

1. Menu Bar
2. Text Editor
3. Output Pane

As you download and open the IDE software, it will appear like an image below.

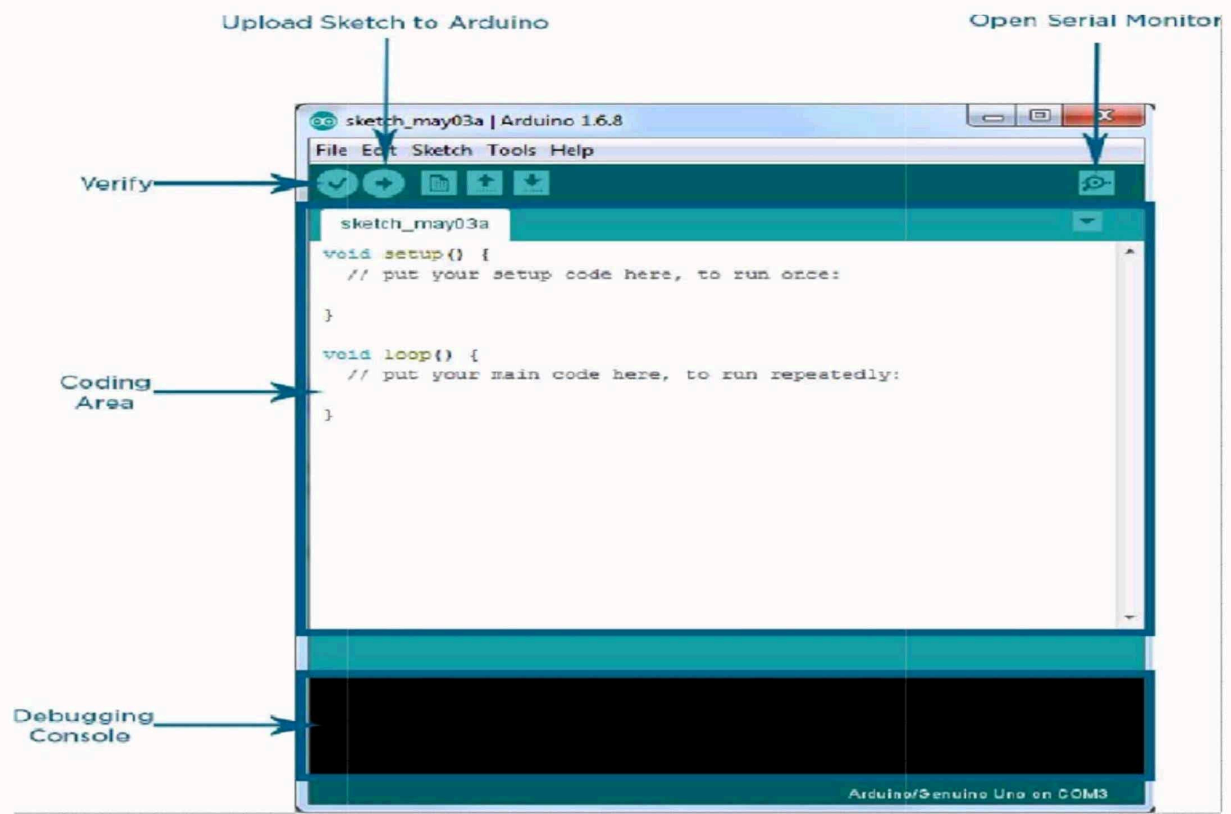


Fig 3.3.1

File – You can open a new window for writing the code or open an existing one. Following table shows the number of further subdivisions the file option is categorized into.

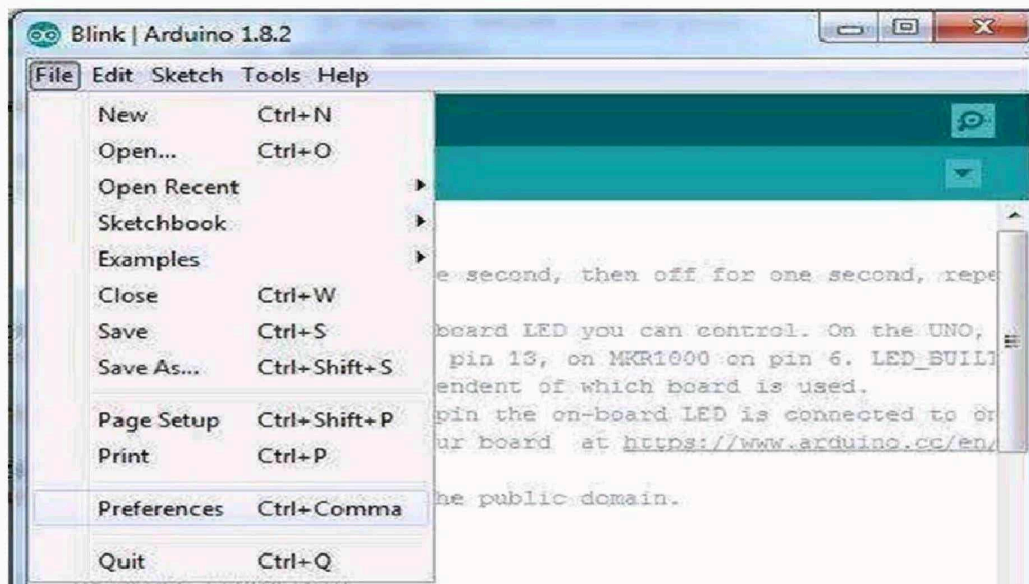


Fig 3.3.2

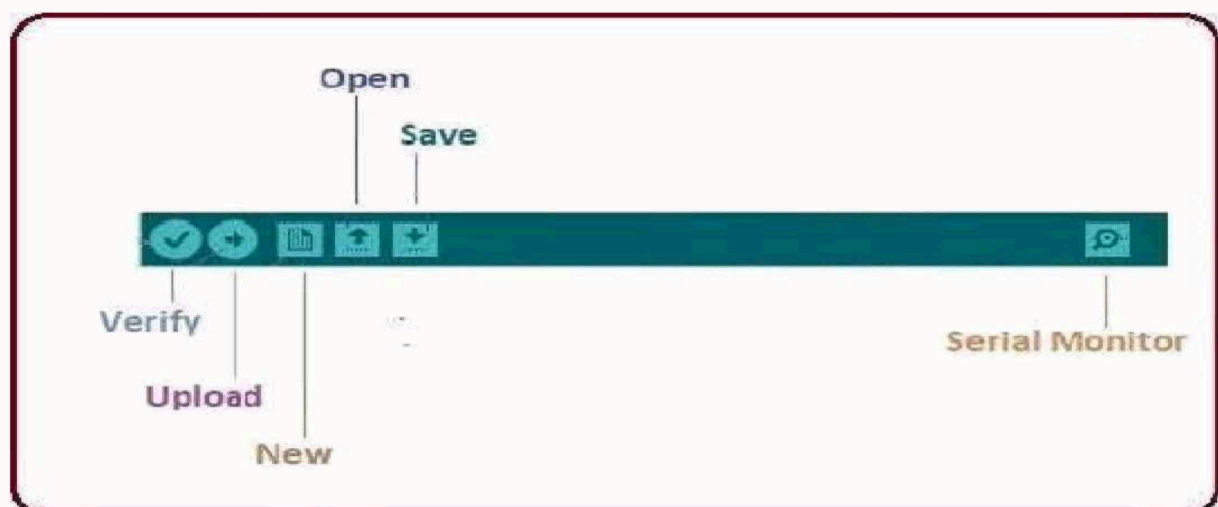


Fig 3.3.3

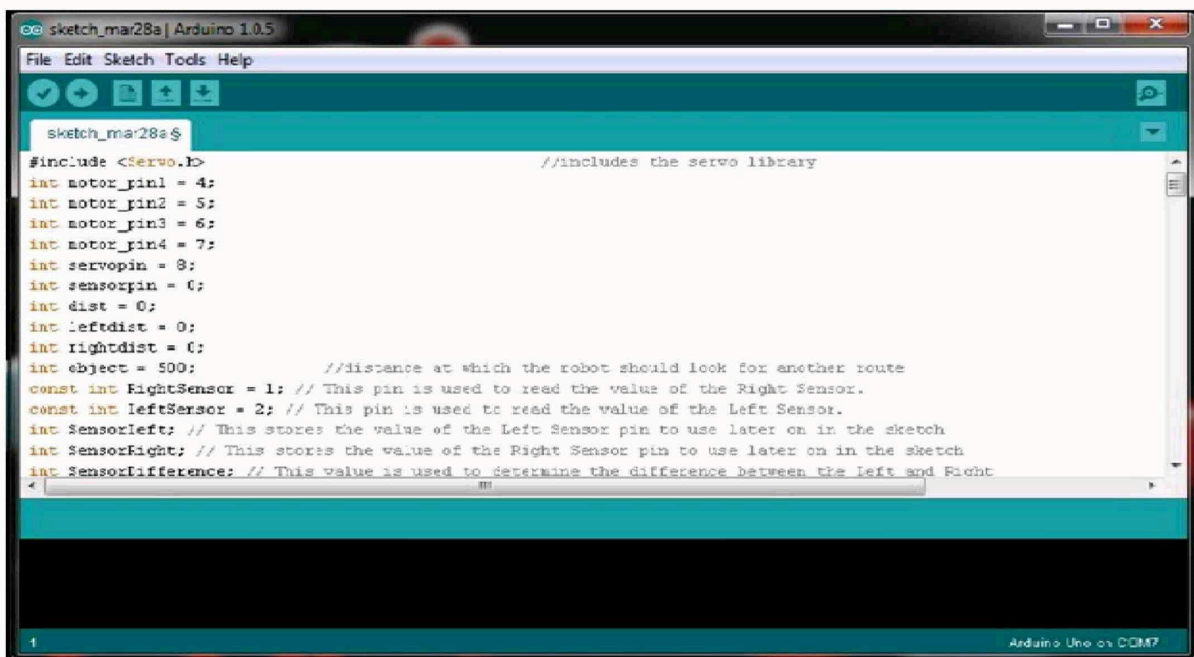
The check mark appearing in the circular button is used to verify the code. Click this once you have written your code.

The arrow key will upload and transfer the required code to the Arduino board. The dotted paper is used for creating a new file.

The upward arrow is reserved for opening an existing Arduino project. The downward arrow is used to save the current running code.

The button appearing on the top right corner is a **Serial Monitor** – A separate pop-up window that acts as an independent terminal and plays a vital role for sending and receiving the Serial Data. You can also go to the Tools panel and select Serial Monitor, or pressing Ctrl+Shift+M all at once will open it instantly. The Serial Monitor will actually help to debug the written Sketches where you can get a hold of how your program is operating. Your Arduino Module should be connected to your computer by USB cable in order to activate the Serial Monitor.

You need to select the baud rate of the Arduino Board you are using right now., as you write the following code and click the Serial Monitor



```
sketch_mar28a$
#include <Servo.h> //includes the servo library
int motor_pin1 = 4;
int motor_pin2 = 5;
int motor_pin3 = 6;
int motor_pin4 = 7;
int servopin = 8;
int sensorpin = 0;
int dist = 0;
int leftdist = 0;
int rightdist = 0;
int object = 500; //distance at which the robot should look for another route
const int RightSensor = 1; // This pin is used to read the value of the Right Sensor.
const int leftSensor = 2; // This pin is used to read the value of the Left Sensor.
int SensorLeft; // This stores the value of the Left Sensor pin to use later on in the sketch
int SensorRight; // This stores the value of the Right Sensor pin to use later on in the sketch
int SensorDifference; // This value is used to determine the difference between the Left and Right
```

Fig 3.3.4

Applications

In agriculture, the opportunities for robot-enhanced productivity are immense - and the robots are appearing on farms in various guises and in increasing numbers. We can expect the robots performing agricultural operations autonomously such as plowing, seed sowing, mud closing and water spraying.

CHAPTER 4

DESCRIPTION OF PROPOSED SYSTEM

4.1 Selected Methodology or process model

It is now possible, with the aid of the Smart Wi-Fi Wireless Managed Spray Pesticides Robot System, to spray pesticides in a way that is both effective and efficient in the industry of agriculture. This is made possible by the fact that it is now possible to do so. This technology revolves on an autonomous robotic platform as its central component. This platform is able to move freely over fields, spraying pesticides on crops as it goes without becoming stuck or being damaged and without the possibility of being trapped. A number of sensors, such as a GPS, ir, ultrasonic, and obstacle detection system, allow the robot to navigate the playing field with pinpoint accuracy and without taking any unnecessary risks. The spraying mechanism on the robot may also be controlled wirelessly from a distance, giving the operator the ability to precisely alter the spray's strength as well as its direction. This can be done from a distance. The robot is outfitted with this function as one of its regular features.

Since the Smart Wi-Fi Wireless Managed Spray Pesticides Robot System is equipped with a battery that is capable of being recharged, it is able to stay in operation constantly. This makes it feasible for the system to spray pesticides. By establishing a Wi-Fi connection between their mobile device and the robot, the user is able to exercise remote control and monitoring powers over the system. These capabilities are made possible by the robot. When it comes to farming on a large scale, the fact that the robot can be consistently programmed to stick to predefined pathways and timetables makes it not only efficient but also predictable in terms of the results it will produce.

As compared to other, more conventional approaches of pest management, the Smart Wi-Fi Wireless Managed Sprayer Pesticides Robot System marks a substantial step forward in terms of the use of technology.

An outline of the central microcontroller as well as wireless router used to establish a connection to the internet.

The central CPU of a Wi-Fi wirelessly managed pouring pesticides robot system is responsible for coordinating all of the machine's activities, from movement to spraying to data collection. The system's microprocessor is an Arduino Uno, a popular microcontroller board noted for its low price and ease of programming. With the help of a wireless router, the robot may connect to the network and begin exchanging data with the control system. The system relies on a Wi-Fi router, which can be remotely handled and monitored once it is connected to the internet. The router and the microcontroller board are linked through a serial communication protocol.

The ESP8266 Wi-Fi module included into the system allows for wireless communication between the microcontroller board and the rest of the network. Because of its persistent connection to the microcontroller board through the UART interface, this module may be commanded to join a Wi-Fi network.

A 12V battery powers both the robot's microcontroller chip and its wifi router, allowing it to operate normally for many hours. When the battery's charge decreases, the charging circuit will activate, allowing the battery to be refueled and returned to service.

Specifics on the cameras and intelligent monitoring system in use. To ensure efficient and effective operation, the Smart Wi-Fi Wireless Managed Spray Pesticides Robot System employs a camera and smart monitoring system.

A high-resolution camera is included into the device and records live footage of the crop and its surroundings. The robot's movements and spraying may then be monitored and controlled from afar thanks to the pictures captured by the camera and sent wirelessly to

the operator's computer or mobile device. The camera also helps the farmer see any insect infestations or crop irregularities so the spraying robot can take care of them right away.

The smart monitoring system is more than just a camera; it also includes high-tech sensors for measuring things like temperature, humidity, and even soil moisture. In addition, the spraying robot sends this information wirelessly to the operator's smartphone, where it may be monitored and adjusted in real time to provide optimum conditions for crop development and pest control. Together, the camera and intelligent monitoring system provide a complete and effective answer to the problem of crop spraying & monitoring. When used together, these tools offer the operator with real-time data that may be used to make educated judgements and take appropriate action to maximize crop health and yield.

4.2 Architecture / Overall Design of Proposed System

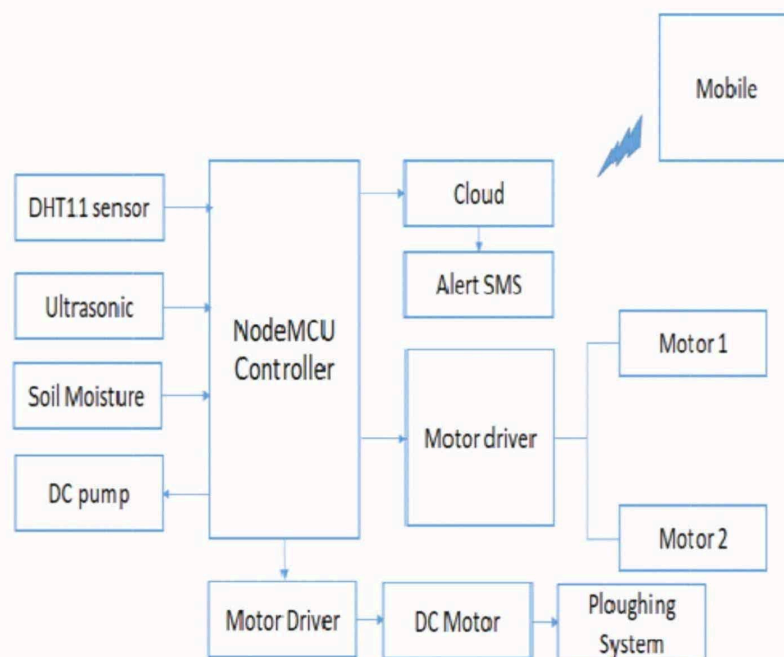


Fig 4.2.1

4.3 Description of Software for Implementation and Testing plan of the Proposed Model/System

The robot is a mechanical device which is capable of performing various tasks without human intervention. The robot works based on commands given by the controller. Various sensors are used for sensing various parameters along the robotic path. The microcontroller being the heart of the robotic system manipulates the entire action of the robotic system. It also controls wheel motion by controlling the DC motors. Motor driving circuit is used to drive the DC motors which in turn control the wheel motion. The seeding robot for agricultural purposes is an autonomous robot which is controlled remotely through a wireless connectivity between the Smartphone and the robot. The Bluetooth electronics app is used to operate the robot. It is used to control each and every operation of the robot.

In this study, we will investigate the usage of unmanned agricultural robots for crop monitoring, pesticide spraying, planting, and selective harvesting. A literature study, the creation of a working prototype of an autonomous robot, and an analysis of its effectiveness are all part of this project's scope. The study will only conduct tests in a controlled laboratory setting, not in the real world.

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the eLua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS



Fig 4.3.1

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Nonos SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS

NodeMCU was created shortly after the ESP8266 came out. On December 30 2013, EspressifSystems began production of the ESP8266. The ESP8266 is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications (see related projects). NodeMCU started on 13 Oct 2014, when Hong committed the first file of nodemcu-firmware to GitHub Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the gerber file of an ESP8266 board, named devkit v0.9. Later that month, Tuan PM ported MQTT client library from Contiki to the ESP8266 SoC platform, and committed to NodeMCU project, then NodeMCU was able to support the MQTT IoT protocol, using Lua to access the MQTT broker. Another important update was made on 30 Jan 2015, when Devsaurus ported the u8glib to NodeMCU project, enabling NodeMCU to easily drive LCD, Screen, OLED, even VGA displays.

In summer 2015 the creators abandoned the firmware project and a group of independent contributors took over. By summer 2016 the NodeMCU included more than 40 different modules. Due to resource constraints users need to select the modules relevant for their project and build a firmware tailored to their needs.

NodeMCU Development board is featured with wifi capability, analog pin, digital pins and serial communication protocols. To get start with using NodeMCU for IoT applications first we need to know about how to write/download NodeMCU firmware in NodeMCU Development Boards. And before that where this NodeMCU firmware will get as per our requirement

We need to code in C\C++ programming language if we are using Arduino IDE for developing NodeMCU applications and Lua language if we are using ESPlorer IDE. Basically, NodeMCU is Lua Interpreter, so it can understand Lua script easily. When we write Lua scripts for NodeMCU and send/upload it to NodeMCU, then they will get executes sequentially. It will not build binary firmware file of code for NodeMCU to write. It will send Lua script as it is to NodeMCU to get execute.

In Arduino IDE when we write and compile code, ESP8266 toolchain in background creates binary firmware file of code we wrote. And when we upload it to NodeMCU then it will flash all NodeMCU firmware with newly generated binary firmware code. In fact, it writes the complete firmware

DHT11 Sensor

Humidity is the measure of water vapor present in the air. The level of humidity in air affects various physical, chemical and biological processes. In industrial applications, humidity can affect the business cost of the products, health and safety of the employees. So, in semiconductor industries and control system industries measurement of humidity is very important. Humidity measurement determines the amount of moisture present in the gas that can be a mixture of water vapor, nitrogen, argon or pure gas etc... Humidity sensors are of two types based on their measurement units. They are a relative humidity sensor and Absolute humidity sensor. DHT11 is a digital temperature and humidity sensor.

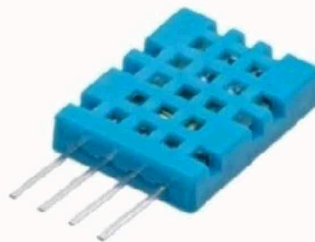


Fig 4.3.2

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc... to measure humidity and temperature instantaneously.

DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form. For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.

This sensor is used in various applications such as measuring humidity and temperature values in heating, ventilation and air conditioning systems. Weather stations also use these sensors to predict weather conditions. The humidity sensor is used as a preventive measure in homes where people are affected by humidity. Offices, cars, museums, greenhouses and industries use this sensor for measuring humidity values and as a safety measure.

Flame sensor

Flame detector is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system. When used in applications such as industrial furnaces, their role is to provide confirmation that the furnace is working properly; in these cases they take no direct action beyond notifying the operator

or control system. A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame.



Fig 4.3.3

A flame sensor module that consists of a flame sensor (IR receiver), resistor, capacitor, potentiometer, and comparator LM393 in an integrated circuit. It can detect infrared light with a wavelength ranging from 700nm to 1000nm. The far- infrared flame probe converts the light detected in the form of infrared light into current changes. Sensitivity is adjusted through the onboard variable resistor with a detection angle of 60 degrees. Working voltage is between 3.3v and 5.2v DC, with a digital output to indicate the presence of a signal. Sensing is conditioned by an LM393 comparator.

IR (Infrared) Sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiation are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the

photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

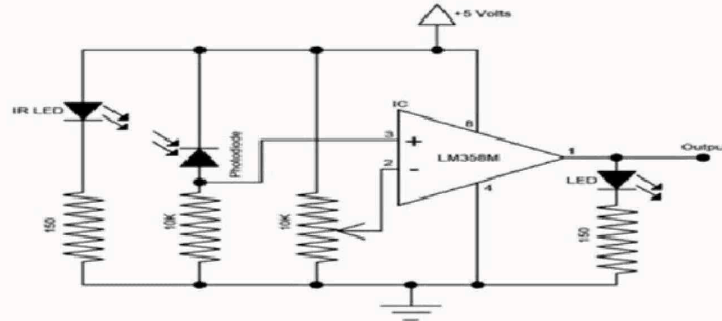


Fig 4.3.4

Resistor R1 (100 Ω), R2 (10k Ω) and R3 (330 Ω) are used to ensure that minimum 10 mA current passes through the IR LED. Devices like Photodiode and normal LEDs respectively. Resistor VR2 (preset=5k) is used to adjust the output terminals. Resistor VR1 (preset=10k) is used to set the sensitivity of the circuit. Diagram. Read more about IR sensors.

IR sensors are classified into different types depending on the applications. The speed sensor is used for synchronizing the speed of multiple motors. The temperature sensor is used for industrial temperature control. PIR sensor is used for automatic door opening system and Ultrasonic sensor are used for distance measurement.

IR sensors are used in various Sensor based projects and also in various electronic devices which measures the temperature that is like. Radiation Thermometers IR sensors are used in radiation thermometers to measure the temperature depend upon the temperature and the material of the object and these thermometers have some of the Features Like Faster response, Easy pattern measurements

IR image device is one of the major applications of IR waves, primarily by virtue of its property that is not visible. It is used for thermal imagers, night vision devices, etc. For examples Water, rocks, soil, vegetation, an atmosphere, and human tissue all features emit IR radiation. The Thermal infrared detectors measure these radiations in IR range

and map the spatial temperature distributions of the object/area on an image. Thermal imagers are usually composed of Sb (indium antimonide), Gd Hg (mercury-doped germanium), Hg Cd Te (mercury-cadmium-telluride) sensors.

An electronic detector is cooled to low temperatures using liquid helium or liquid nitrogen. Cooling the detectors ensures that the radiant energy (photons) recorded by the detectors comes from the terrain and not from the ambient temperature of objects within the scanner itself an IR imaging electronic devices. Thus, this is all about IR sensor circuit with working and applications. These sensors are used in many sensor based electronics projects.

DC Pump:

A DC water pump is an electric pump with low voltage. They are quiet and use little power. They are used for many applications, including automotive, household, and water wells. Various DC water pumps are available in the market, including the DC Fountain Pump VP30, a five-volt mini water pump perfect for a solar fountain. You can also find DC Submersible Pumps VP30A and VP40A for aquariums, tabletop crafts, and even fish tanks.

When selecting a small water pump, it's important to check its power consumption. Most pumps draw up to 9.5 amps, so it's important to choose one that matches your power needs. Check that the motor is corrosion-resistant and can withstand multiple freeze-thaw cycles. In addition, the housing should be intact and have no cracks. Finally, choose a pump that comes with a warranty. If a mini water pump fails after just a few years, it may be good to look for a brand that offers a warranty. After-sales support can also help you replace any parts if needed.



Fig 4.3.5

Here's the ultimate guide if you're considering buying a DC water pump for your RV. First, consider the size of your RV. A 12 volt DC water pump will run on its built-in 12-volt power system. A large commercial pump requires a 230-volt power supply, while a 12-volt model requires only a 120-volt power source. Both options will require a mini water pump. To get the proper flow, you'll need to ensure the pump can handle the required amount of water. Make sure the pipe is made of drinking water grade PVC. A pump designed for 24 Volts may have a 3/4-inch outlet. For 12 Volts, you'll need a pump compatible with the smaller pipe size. The difference in size will affect how much water a pump will be able to draw from the tank.

The main advantages of DC submersible pump are that they are battery- operated. Micro DC pumps use pure copper motors and can run from a battery. They are more convenient and easier to use than AC-powered pumps. DC pumps also have a longer lifespan, with some models lasting more than 30,000 hours. They also tend to run quieter as the battery's charge depletes as an added benefit

Flow rate is another important performance data to consider when choosing a mini water pump. The flow rate of a DC submersible pump affects the pumping performance of the entire pump application system. The maximum flow rate of the DC pump should be considered when selecting the pump and the normal flow rate. The maximum flow rate of a DC submersible pump is a critical factor to consider when selecting a mini water pump. This data is most helpful when selecting a DC pump based on the flow rate of the water that it is intended to move. Brushless Micro DC pumps use a brushless DC motor to drive an impeller. The impeller is connected to the rotor and the motor shaft. Water can get into the rotor and stator of a brushless motor, which increases the risk of burnout. Compared to other DC pumps, this type of DC pump can produce in high volumes and at a low cost. It's ideal for homes and businesses where space is an issue.

Motor Driver:

From the name, a motor driver means a device that drives motors. However, motor driver chips can't go an engine without a microcontroller. A motor driver showcases itself as an

interface between the motor and the microcontroller. The reason is that the microcontroller and the motor work on different ranges of voltages. The engine will use up a higher current level than the microcontroller.

You require a motor driver module when connecting two devices that operate under different current levels to a power supply voltage. In this case, a motor acts as a third device that steps up or steps down the voltage supply. The majority of motor drivers in the market now are in the form of ICs. There are different driver motors; hence they have other characteristics. You then connect these motor driver ICs to the motor controller through an H bridge circuit.



Fig 4.3.6

Connecting two pairs of transistors in a circuit forms an "H-shaped" circuit which we call an H-bridge. On the opposite end of the motor, place each pair of the transistors with different functionality. One team receives the input voltage, whereas the other pair remains grounded. During a positive polarity, switch one pair of transistors at a time. Now, current flows from the source voltage to the positive terminal. Next, the current from the +VE terminal flows to the -VE terminal, which finally flows to the ground.

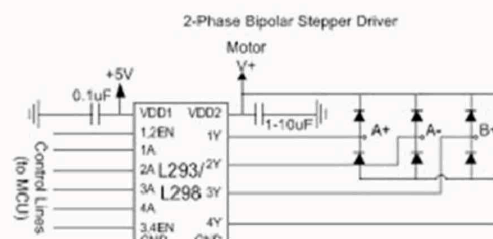


Fig 4.3.7

However, during a negative polarity, the opposite happens, and the other pair of transistors turn on. First, the current will flow straight to the negative terminal from the source voltage. Then, the current from the negative terminal flows straight to the positive terminal then finds its way to the ground. This alternate flow of current forms an H-bridge circuit.

Notably, a driver is necessary because the microcontroller requires lower-level voltage than the motors. Due to this, we cannot supply power directly from the microcontroller to the engine. We need a motor driver in between these electrical components at this point. The driver steps up the current from the microprocessor to match the motor current.

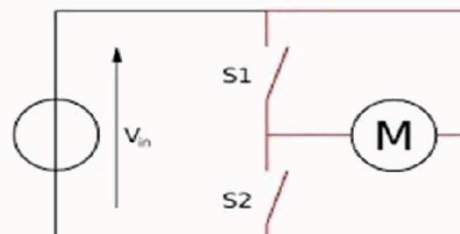


Fig 4.3.8

To build a driver circuit, you require the following materials. 9V Battery, Arduino UNO., Wheels, DC actual motor, Jumper Wire, Bread Board. L293D driver is a 16-channel motor driver. It has; 4 ground pins, four input pins, four output pins, 2 enable pins, and two voltage pins

To build the circuit, follow the diagram above. Make sure that; First, you safely connect the enable pins to the Arduino by the 5v pin. Secondly, the positive battery terminal should be by the IC while the negative terminal by the eight pins connecting to the ground (GND). Also, ground pins should always be shorted and fixed to the ground pin (GND) on the Arduino board.

Soil Moisture Sensor:

When you hear the term “smart garden,” one of the first things that comes to mind is a system that monitors the moisture level of the soil and automatically supplies the necessary amount of water to the plants. With this system, plants can be watered only

when required, avoiding over- or under-watering. If you want to build such a system, you will undoubtedly require a Soil Moisture Sensor.

The soil moisture sensor operates in a straightforward manner. The fork-shaped probe with two exposed conductors acts as a variable resistor (similar to a potentiometer) whose resistance varies with the soil's moisture content. This resistance varies inversely with soil moisture: The more water in the soil, the better the conductivity and the lower the resistance. The less water in the soil, the lower the conductivity and thus the higher the resistance. The sensor produces an output voltage according to the resistance, which by measuring we can determine the soil moisture level. A typical soil moisture sensor consists of two parts.

The Probe sensor includes a fork-shaped probe with two exposed conductors that is inserted into the soil or wherever the moisture content is to be measured. As previously stated, it acts as a variable resistor, with resistance varying according to soil moisture.

The Module In addition, the sensor includes an electronic module that connects the probe to the Arduino. The module generates an output voltage based on the resistance of the probe, which is available at an Analog Output (AO) pin.

The same signal is fed to an LM393 High Precision Comparator, which digitizes it and makes it available at a Digital Output (DO) pin. The module includes a potentiometer for adjusting the sensitivity of the digital output (DO). You can use it to set a threshold, so that when the soil moisture level exceeds the threshold, the module outputs LOW otherwise HIGH. This setup is very useful for triggering an action when a certain threshold is reached. For example, if the moisture level in the soil exceeds a certain threshold, you can activate a relay to start watering the plant.

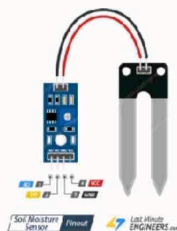


Fig 4.3.9

AO (Analog Output) generates analog output voltage proportional to the soil moisture level, so a higher level results in a higher voltage and a lower level results in a lower voltage.

DO (Digital Output) indicates whether the soil moisture level is within the limit. D0 becomes LOW when the moisture level exceeds the threshold value (as set by the potentiometer), and HIGH otherwise.

VCC supplies power to the sensor. It is recommended that the sensor be powered from 3.3V to 5V. Please keep in mind that the analog output will vary depending on the voltage supplied to the sensor.

Ultrasonic (UV) Sensors or Ultrasound Sensors

Bats are wonderful creatures. Blind from the eyes and yet a vision so precise that could distinguish between a moth and a broken leaf even when flying at full speed. No doubt the vision is sharper than ours and is much beyond human capabilities of seeing, but is certainly not beyond our understanding. Ultrasonic ranging is the technique used by bats and many other creatures of the animal kingdom for navigational purposes. In a bid to imitate the ways of nature to obtain an edge over everything, we humans have not only understood it but have successfully imitated some of these manifestations and harnessed their potential to the greatest extent.

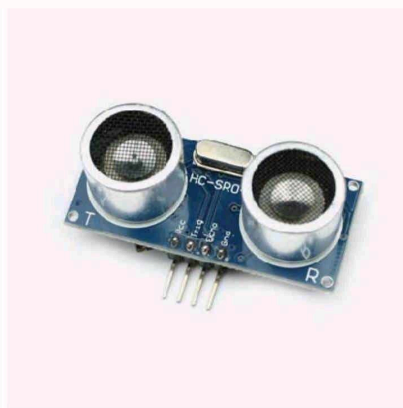


Fig 4.3.10

Ultrasonic sensors are devices that use electrical–mechanical energy transformation, the mechanical energy being in the form of ultrasonic waves, to measure distance from the sensor to the target object. Ultrasonic waves are longitudinal mechanical waves which travel as a succession of compressions and rarefactions along the direction of wave propagation through the medium. Any sound wave above the human auditory range of 20,000 Hz is called ultrasound. Depending on the type of application.

When ultrasonic waves are incident on an object, diffused reflection of the energy takes place over a wide solid angle which might be as high as 180 degrees. Thus some fraction of the incident energy is reflected back to the transducer in the form of echoes and is detected. The distance to the object (L) can then be calculated through the speed of ultrasonic waves (v) in the medium by the relation

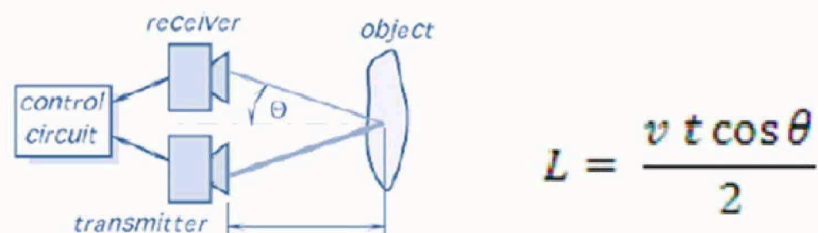


Fig 4.3.11

Where t' is the time taken by the wave to reach back to the sensor and ' ' is the angle between the horizontal and the path taken as shown in the figure. If the object is in motion, instruments based on Doppler shift are used. Get all the details about internal structure and working of an ultrasound sensor at [Insight-How Ultrasonic Sensors Work](#).

4.4 Project Management Plan

Introduction	September 1- 30
Literature Survey	October 1-31
System Design	November 1-30
System Implementation	December 1-31
Testing	January 1 to April 8

TABLE 4.4

4.5 Financial Report on estimated costing

PART NAME	PRICE
DHT11 sensor	200
Flame sensor	450
Soil Moisture Sensor	500
Nodemcu	800
DC pump	2100
Motor driver	1300
3 Motors	2150
Cloud	1000
Ultrasonic sensor	1600
TOTAL	10100

Table 4.5

CHAPTER 5

IMPLEMENTATION DETAILS

5.1 Development and deployment

L293D IC generally comes as a standard 16-pin DIP (dual-in line package). This motor driver IC can simultaneously control two small motors in either direction; forward and reverse with just 4 microcontroller pins (if you do not use enable pins). Some of the features (and drawbacks) of this IC are:

Output current capability is limited to 600mA per channel with peak output current limited to 1.2A (non-repetitive). This means you cannot drive bigger motors with this IC. However, most small motors used in hobby robotics should work. If you are unsure whether the IC can handle a particular motor, connect the IC to its circuit and run the motor with your finger on the IC. If it gets really hot, then beware... Also note the words "non-repetitive"; if the current output repeatedly reaches 1.2A, it might destroy the drive transistors.

Supply voltage can be as large as 36 Volts. This means you do not have to worry much about voltage regulation. L293D has an enable facility which helps you enable the IC output pins. If an enable pin is set to logic high, then state of the inputs match the state of the outputs. If you pull this low, then the outputs will be turned off regardless of the input states

The datasheet also mentions an "over temperature protection" built into the IC. This means an internal sensor senses its internal temperature and stops driving the motors if the temperature crosses a set point. Another major feature of L293D is its internal clamp diodes. This flyback diode helps protect the driver IC from voltage spikes that occur when the motor coil is turned on and off (mostly when turned off)

The logical low in the IC is set to 1.5V. This means the pin is set high only if the voltage across the pin crosses 1.5V which makes it suitable for use in high frequency applications like switching applications (up to 5KHz). Lastly, this integrated circuit not only drives DC motors, but can also be used to drive relay solenoids, stepper motors etc.

L293D Connections

The circuit shown to the right is the most basic implementation of L293D IC. There are 16 pins sticking out of this IC and we have to understand the functionality of each pin before implementing this in a circuit

Pin1 and Pin9 are "Enable" pins. They should be connected to +5V for the drivers to function. If they pulled low (GND), then the outputs will be turned off regardless of the input states, stopping the motors. If you have two spare pins in your microcontroller, connect these pins to the microcontroller, or just connect them to regulated positive 5 Volts.

Pin4, Pin5, Pin12 and Pin13 are ground pins which should ideally be connected to the microcontroller's ground.

Pin2, Pin7, Pin10 and Pin15 are logic input pins. These are control pins which should be connected to microcontroller pins. Pin2 and Pin7 control the first motor (left); Pin10 and Pin15 control the second motor(right).Pin3, Pin6, Pin11, and Pin14 are output pins. Tie Pin3 and Pin6 to the first motor, Pin11 and Pin14 to second motor Pin16 powers the IC and it should be connected to regulated +5 Volts Pin8 powers the two motors and should be connected to positive lead of a secondary battery. As per the datasheet, supply voltage can be as high as 36 Volts.

Truth table

I have shown you where to connect the motors, battery and the microcontroller. But how do we control the direction of these motors? Let us take an example: Suppose you need to control the left motor which is connected to Pin3 (O1) and Pin6 (O2). As mentioned above, we require three pins to control this motor - Pin1 (E1), Pin2 (I1) and Pin7 (I2). Here is the truth table representing the functionality of this motor driver.

Pin 1	Pin 2	Pin 7	Function
High	High	Low	Turn Anti-clockwise (Reverse)
High	Low	High	Turn clockwise (Forward)
High	High	High	Stop
High	Low	Low	Stop
Low	X	X	Stop

Table 5.1.1

High ~+5V, Low ~0V, X=Either high or low (don't care)

In the above truth table you can observe that if Pin1 (E1) is low then the motor stops, irrespective of the states on Pin2 and Pin7. Hence it is essential to hold E1 high for the driver to function, or simply connect enable pins to positive 5 volts.

With Pin1 high, if Pin2 is set high and Pin7 is pulled low, then current flows from Pin2 to Pin7 driving the motor in anti-clockwise direction? If the states of Pin2 and Pin7 are flipped, then current flows from Pin7 to Pin2 driving the motor in clockwise direction.

The above concept holds true for other side of the IC too. Connect your motor to Pin11 and Pin14; Pin10 and Pin15 are input pins, and Pin9 (E2) enables the driver.

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer. The boards can be assembled by hand or purchased pre-assembled.

CHAPTER 6

RESULTS AND DISCUSSION

6.1 Results and discussion

The performance of the system was evaluated by three real-life case studies through measuring environmental temperature and humidity, detecting fire, and controlling. . Your Arduino Module should be connected to mobile through wifi. We will be able to control the prototype. By using BLYNK IOT in order to activate the Serial Monitor. These commands are text sensitive i.e. you can control robot complete movements using mobile .we can also measure the data like solid humidity and fire detection and also we have ultrasonic sensor Your Arduino Module should be connected to battery and make sure that battery is charged.



Fig 6..1(Output of prototype)

✕ Irrigation 01F00



Fig 6.2(Controls)

CHAPTER 7

CONCLUSION

Internet of Things (IOT) has been enabled for the agriculture crop monitoring purpose in easy and efficient manner which is used to enhance the productivity of the crop and hence profits for the farmer enhanced. The Wireless sensor network and sensors of various types are used to extract the information of crop conditions and environmental changes. And this information is transmitted via network to the farmer. This initiates corrective actions for the enhancement. Farmers are connected to the field where the awareness of the conditions of the agricultural field at any time and anywhere in the world can be observed. Some of the disadvantages in Communication must be overcome by advancing the Technological usage to consume less energy and also by making user interface ease of use.

REFERENCES

- [1] Zhang, Q., Su, J., Yang, H., & Zhang, H. (2021). The Application of Autonomous Robots in Agriculture. *Applied Sciences*, 11(1), 170.
- [2] Shen, Y., Ma, H., Li, C., & Li, Y. (2021). A Review of Autonomous Agricultural Robot Systems. *Journal of Intelligent & Robotic Systems*, 101(2), 31.
- [3] Wang, X., Zhang, Y., & Shen, Y. (2020). Agricultural Robotics for Field Operations: A Review. *Journal of Agricultural Science and Technology*, 22(6), 1365-1383.
- [4] Wu, W., Wu, D., Zhao, D., Wang, Z., & Yu, H. (2021). Application of Unmanned Aerial Vehicles and Intelligent Agricultural Robots in Precision Agriculture: A Review. *Agricultural Sciences in China*, 20(9), 1896-1911.
- [5] Wu, L., Chen, Z., Wang, C., Yang, L., & Li, D. (2020). Advances in Autonomous Navigation and Control of Agricultural Robots. *International Journal of Agricultural and Biological Engineering*, 13(3), 1-12.
- [6] Xiao, Y., & Wang, J. (2021). Review of Autonomous Agricultural Robots. *Intelligent Automation & Soft Computing*, 27(3), 569-582.
- [7] Li, Y., Liu, J., & Qiu, Y. (2020). An Overview of Autonomous Agricultural Robots for Spraying Pesticides. *Computers and Electronics in Agriculture*, 171, 105326.
- [8] Li, W., Zhu, Y., Li, M., Xu, H., & Li, L. (2021). An Overview of Autonomous Agricultural Robots in China. *Applied Sciences*, 11(15), 6788.
- [9] Thakur, A., & Prasad, R. (2020). A Review on Autonomous Agricultural Robots for Crop Management. *Journal of Emerging Technologies and Innovative Research*, 7(9), 215-222.
- [10] Hernandez, G., & Brinkhoff, J. (2021). A Review of Autonomous Robots for Precision Agriculture. *IEEE Robotics and Automation Magazine*, 28(3), 99-111.

SOURCE CODE

Ultrasonic Sensor code

```
const int pingPin = 7; // Trigger Pin of Ultrasonic Sensor
const int echoPin = 6; // Echo Pin of Ultrasonic Sensor

void setup() {
  Serial.begin(9600); // Starting Serial Terminal
}

void loop() {
  long duration, inches, cm;
  pinMode(pingPin, OUTPUT);
  digitalWrite(pingPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pingPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(pingPin, LOW);
  pinMode(echoPin, INPUT);
  duration = pulseIn(echoPin, HIGH);
  inches = microsecondsToInches(duration);
  cm = microsecondsToCentimeters(duration);
  Serial.print(inches);
  Serial.print("in, ");
  Serial.print(cm);
  Serial.print("cm");
  Serial.println();
  delay(100);
}

long microsecondsToInches(long microseconds) {
```



```

    return microseconds / 74 / 2;
}

long microsecondsToCentimeters(long microseconds) {
    return microseconds / 29 / 2;
}

Flame sensor and humidity sensor
pin = 1
status, temp, humi, temp_dec, humi_dec = dht.read(pin)--read dht11 from pin
if status == dht.OK then    --check status is ok and print temperature and humidity
    print(string.format("DHT Temperature:%d.%03d;Humidity:%d.%03d",
        math.floor(temp),
        temp_dec,
        math.floor(humi),
        humi_dec
        ))
    elseif status == dht.ERROR_CHECKSUM then    --else print either status
        print( "DHT Checksum error." )
    elseif status == dht.ERROR_TIMEOUT then
        print( "DHT timed out." )
    End

int led = 13; // Connected to D7 pin of NodeMCU
int flame_sensor = 12; //Connected to D6 pin of NodeMCU
int buzzer = 4; //Connected to D2 pin of NodeMCU
int relay = 5; //Connected to D1 pin of NodeMCU
int smoke_sensor = A0; //Connected to A0 pin of NodeMCU
int temp_smoke_sensor;
int flame_sensor_read

```

```

// You should get Auth Token in the Blynk App.
// Go to the Project Settings (nut icon).
void setup()
{
  pinMode(led, OUTPUT);
  pinMode(flame_sensor, INPUT);
  pinMode(buzzer, OUTPUT);
  pinMode(relay, OUTPUT);
  pinMode(smoke_sensor, INPUT);
  digitalWrite(led, LOW);
  digitalWrite(buzzer, LOW);
  digitalWrite(relay, LOW);
  // Debug console
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass);
}
void loop()
{
  flame_sensor_read = digitalRead(flame_sensor); //reading the sensor data on A0 pin
  Blynk.virtualWrite(V0, flame_sensor_read); //sending data to Blynk
  Serial.print("Flame Status:")
  Serial.println(flame_sensor_read);
  int led_status = digitalRead(led);
  if (led_status == HIGH)
  {
    Blynk.virtualWrite(V1, 255);
  }
  else
  {

```

```

    Blynk.virtualWrite(V1, 0)
    temp_smoke_sensor = analogRead(smoke_sensor);
    Blynk.virtualWrite(V2, temp_smoke_sensor);
    Serial.print("Current Gas Level:");
    Serial.println(temp_smoke_sensor);
    if (temp_smoke_sensor > 500)
    {
        digitalWrite(led, HIGH);
        digitalWrite(buzzer, HIGH);
        digitalWrite(relay, HIGH);
        Blynk.notify("Alert Smoke Detected");
    }
    else
    {
        digitalWrite(led, LOW);
        digitalWrite(buzzer, LOW);
        digitalWrite(relay, LOW);
    }
    if (flame_sensor_read == 0)
    {
        //Blynk.virtualWrite(V1, 255);
        digitalWrite(led, HIGH);
        digitalWrite(buzzer, HIGH);
    }
    delay(500);
    Blynk.run(
}

```

Revolutionizing Agriculture: Developing Autonomous Robots for Precise Farming

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***Abstract**—Methods of farming that have been practised for generations may be laborious, ineffective, and expensive. Autonomous robots are quickly becoming a game-changing technology in the agricultural sector as a means of addressing the difficulties described above. The objective of this project is to design and build autonomous robots that can be used for precision agricultural tasks such as planting, harvesting, and weeding crops. Our strategy entails the conception and construction of self-sufficient robots that are able to traverse and function in a wide variety of environmental settings and climatic conditions. These robots will have sensors and artificial intelligence algorithms built into them so that they can detect the requirements of various crops and react appropriately. In order to achieve optimal results in crop management, the robots will also have the capacity to interact with both human farmers and other robots. We anticipate that the use of our autonomous robots will result in a considerable reduction in labour costs, an increase in agricultural yields, and the promotion of more environmentally responsible farming techniques. Our project's goals are to both be at the cutting edge of technical innovation in agricultural settings and to make a contribution to resolving issues with food security on a global scale.*

Keywords—: Agriculture, autonomous robots, crop management, precision agriculture, sensing, control systems.

I. INTRODUCTION

A. Background

Being a major contributor to global food production, the agriculture sector has most of the responsibility for keeping people alive. Yet, it has a number of obstacles to overcome, including a lack of workers, a high cost of production, and rising food demand. Autonomous robots have becoming more popular in agriculture as a means of addressing these difficulties. Machines equipped with sensors and control systems, autonomous robots may carry out agricultural activities without human interference. These robots can apply pesticides, sow seeds, and track the development of crops, among other things.

Improvements in sensors, ML, & AI have all contributed to the rise of farm robots that can operate independently. These robots are equipped with sensors that can measure environmental factors like heat, moisture, or soil composition in order to make educated judgements about the farming chores they should carry out. Because of advances in machine learning and AI, robots may gradually hone their skills as they gain experience.

Benefits may be gained by using autonomous robots in agriculture. As a first benefit, it may help keep down payroll and boost output. Robots can operate in dangerous conditions, such as fields that have been sprayed with pesticides, and can do so without stopping for breaks. Second, technology may help cut down on chemical usage since robots can administer pesticides and other chemicals more precisely and just where they are required. The ecological toll of farming is lightened as a result. With robots able to do things like monitor plant development and apply fertilizer more precisely, this may ultimately boost agricultural output and quality.

Notwithstanding these merits, there are still obstacles to the widespread use of autonomous robots in farming. The exorbitant price tag of such equipment is a significant barrier to entry. Many small-scale farmers may not be able to buy autonomous robots due to their high purchase and upkeep costs. The absence of industry-wide standards is another issue. Robots come in a wide variety, each with its own unique structure, set of sensors, and management software. In turn, this might make it hard for farmers to decide which robot is best for them and how to best incorporate them into their operations. Even more worrisome is the potential threat that robots pose to agricultural jobs. It's true that robots may boost production, but they also have the potential to displace human labourers, which would have a devastating impact on the economy.

B. Problem Statement

The traditional method of agriculture requires significant manual labor and time, resulting in high costs and low productivity. Moreover, the use of pesticides and fertilizers can have adverse effects on the environment and human health. Therefore, there is a need for an innovative and sustainable solution that can overcome these challenges and improve the efficiency of agricultural practices.

C. *Research Question*

How can autonomous robots be used to improve the efficiency and sustainability of agricultural practices, while reducing the adverse effects on the environment and human health?

D. *Objectives*

The objectives of this project are as follows:

- To review the current state-of-the-art in the use of autonomous robots in agriculture.
- To identify the benefits and challenges associated with the use of autonomous robots in agriculture.
- To design and develop a prototype autonomous robot that can perform specific agricultural tasks.
- To evaluate the performance of the prototype autonomous robot in terms of efficiency, productivity, and environmental impact.
- To provide recommendations for the adoption and deployment of autonomous robots in agriculture.

E. *Scope*

In this study, we will investigate the usage of unmanned agricultural robots for crop monitoring, pesticide spraying, planting, and selective harvesting. A literature study, the creation of a working prototype of an autonomous robot, and an analysis of its effectiveness are all part of this project's scope. The study will only conduct tests in a controlled laboratory setting, not in the real world.

F. *Significance of the Study*

The application of autonomous robots in agricultural settings has the potential to bring about a revolution in that sector by increasing productivity, decreasing the amount of money spent on labor, and mitigating the harmful effects of pesticides and fertilizers on both the environment and human health. This project will contribute to the development and implementation of sustainable farming practices, as well as providing insights into the advantages and problems of deploying autonomous robots in agricultural settings.

II. LITERATURE SURVEY

[1] Zhang, Q., Su, J., Yang, H., & Zhang, H. (2021). The 170th issue of the journal *Applied Sciences* contains this article on page 11-1 of 11 in the journal's overall 11th volume. The paper is titled "The Application of Self-Guiding Robots in Various Areas of Agriculture," and its abstract is included below.

This article presents a detailed discussion on the many applications that may be found for autonomous robots in the industry of agriculture. These applications include things like the administration of pesticides, the monitoring of crops, and the selective gathering of goods, to name just a few examples. The authors of this article are responsible for

the availability of the research that is published here; the authors also performed the research that is described here. The authors investigate not only the benefits of using these robots but also the challenges that are associated with doing so, and they provide examples of successful applications of this technology. In addition, the authors provide information regarding previous successful applications of this technology. In addition to that, the authors provide details on more productive uses of this technology.

[2] Shen, Y., Ma, H., Li, C., & Li, Y. (2021). The section of the article "Journal of Intelligent and Robotic Systems 101(2)" titled "A Conversation on the Present Status of Autonomous Agricultural Robot Systems 31" contains a debate of the current state of autonomous agricultural robot systems.

This book presents an overview of many categories of self-operating robots that have the potential to find applications in the agricultural sector. For the whole of the class, several subjects will be covered that will cover not just the control systems and sensor systems of these systems, but also their architecture. The authors examine the advantages and disadvantages of a large number of diverse classes of robots, and they offer examples of beneficial applications for each kind of robot that is described in the article.

[3] Wang, X., Zhang, Y., & Shen, Y. (2020). An Analysis of the Present Condition of Agricultural Robots as well as an Investigation into Its Future Possibilities Pages 1365-1383 may be found in the latest edition of the *Journal of Agricultural Science and Technology*, which is volume 22, issue 6. These pages are located in the sixth issue of the 22nd volume, if that is where you are looking for them.

This article gives a general overview of the employment of agricultural robots in the field to perform labour such as planting crops and applying pesticides. One of the many tasks that agricultural robots are capable of doing is the harvesting of crops. The authors examine the advantages and disadvantages of a large number of diverse classes of robots, and they offer examples of beneficial applications for each kind of robot that is described in the article.

[4] Wu, W., Wu, D., Zhao, D., Wang, Z., & Yu, H. (2021). *China's Agriculture and Related Sciences*, Volume 20, Number 9, Pages 1896-1911 An Examination of the Potential Applications of Intelligent Agricultural Robots and Unmanned Aerial Vehicles in the Field of Precision Agriculture Agricultural Sciences in China, The purpose of this article is to provide a concise overview of the many applications that may be found for unmanned aerial vehicles (UAVs) and intelligent agricultural robots in the field of precision agriculture. These applications can be found in China. *Agricultural Sciences in China*. *Agricultural Sciences in China*. The monitoring of crops, the use of pesticides, and the fulfilment of a great variety of other operations are a few examples of the applications that may be made using this technology. The authors discuss not only the positive aspects of using these technology but also the drawbacks and challenges that come along with doing so. In addition to that, the authors provide specific examples of productive use of these technologies.

[5] Wu, L., Chen, Z., Wang, C., Yang, L., & Li, D. (2020). On pages 1 through 12 of volume 13 issue 3 of the International Journal of Agricultural and Biological Engineering, you can find the most recent developments in the self-guiding manoeuvring and controlling of farm robots. This can be found in the context of the field of agricultural and biological engineering.

The purpose of this article is to provide a detailed analysis of recent developments in the autonomous navigation and control of agricultural robots, as well as a discussion of the consequences of these developments. This inquiry covers a wide range of subjects, some of which include the use of pesticides and other topics connected to the use of robots similar to these in precision agriculture. As a part of their discussion, the authors analyse the challenges that are associated with the development and deployment of these technologies, and they offer examples of applications that have been successful in the past.

[6] Xiao, Y., & Wang, J. (2021). An Investigation into the Possible Applications of Autonomous Robots in the Field of Agriculture In the third issue of the journal Intelligent Automation and Soft Computing, which can be found in volume 27, number 3, pages 569-582, you can find additional information about this topic.

This piece of work offers a concise overview of the self-sufficient agricultural robots that are now on the market. This introduction covers a wide range of subjects, some of which include the architecture, navigation, and control systems of these robots, among other things. The authors investigate not only the benefits of using these robots but also the challenges that are associated with doing so, and they provide examples of successful applications of this technology. In addition, the authors provide information regarding previous successful applications of this technology. In addition to that, the authors provide details on more productive uses of this technology.

[7] Li, Y., Liu, J., & Qiu, Y. (2020). Applications of Computers and Electronics in Agriculture, Volume 171, Issue 105326 An Explanation of the Methods That Are Being Used by Autonomous Agricultural Robots in the Procedure of Spraying Pesticides Applications of Computers and Electronics in Agriculture, Volume 171, Issue 105326

In this paper, we give an examination of the construction, sensing, and control systems of autonomous agricultural robots for the application of pesticides. These robots are designed to work in agricultural settings. A summary of the capabilities of the robots is also given in this report. In addition to that, the article provides a synopsis of the development of agricultural robots during the course of its reading. The authors examine the advantages and disadvantages of a large number of diverse classes of robots, and they offer examples of beneficial applications for each kind of robot that is described in the article.

[8] Li, W., Zhu, Y., Li, M., Xu, H., & Li, L. (2021). On page 6788 of the volume 11 issue 15 of the journal Applied Sciences, under the heading "An Overview of the Activities Done by Autonomous Agricultural Robots in China," there is an article that can be found with the title "An Overview of

the Activities Done by Autonomous Agricultural Robots in China."

This article provides a comprehensive overview of autonomous agricultural robots in China, encompassing a variety of applications such as planting crops, spraying pesticides, and completing a wide range of additional duties in addition to those. The authors investigate not just the potential benefits but also the potential drawbacks of implementing these technologies in China, and they provide instances of times in the past when these technologies were successfully implemented.

[9] Thakur, A., & Prasad, R. (2020). The volume 7 issue 9 of the Journal of Emerging Technologies and Innovative Research included the publication of an article with the title "A Debate on the Usage of Autonomous Agricultural Robots in the Management of Crops." The paper was included in the publication and could be found on pages 215-222.

This article's objective is to investigate the use of autonomous agricultural robots for crop management, including the applications of such robots in precision agriculture and the application of pesticides, in addition to other tasks. The authors discuss not only the positive aspects of using these technology but also the drawbacks and challenges that come along with doing so. In addition to that, the authors provide specific examples of productive use of these technologies.

[10] Hernandez, G., & Brinkhoff, J. (2021). An Examination of the Functions Played by Robots and Unmanned Aerial Vehicles in the Context of the Subject of Precision Agriculture This subject was covered in depth in the most current edition of the IEEE Robotics and Automation Journal (volume 28, number 3), pages 99-111, which was published not too long ago.

This article's goal is to provide an overview of the use of autonomous robots in precision agriculture, including its uses in monitoring crops, spraying pesticides, and carrying out a variety of other tasks. The authors examine not only the benefits but also the drawbacks associated with the use of these robots, and they provide instances of effective implementations of the technology. In addition to this, they discuss a number of other strategies that may be used in order to do more research in this field.

The studies that are described here offer, in general, a thorough review of the usage of autonomous robots in agricultural contexts. In this research, the architecture, sensing, and control systems that are used by these robots are broken down and described in more detail. The robots themselves are taken into consideration in this examination as well. Throughout the course of their presentation, they cover a number of topics, including the many classifications of robots, an analysis of the advantages and drawbacks associated with each kind of robot, and particular instances of how robots might be put to work in productive ways. In addition to this, they shed light on the challenges that are associated with the deployment of these technologies and give recommendations for the potential directions that research may go in the future.

[11] C. Tseng, C. Lin, and B. Shih, "WiFi assisted NAT traversal scheme for surveillance patrol robot", *Nonlinear Dynamics*, vol. 76, no. 1, pp. 1-12, 2014.

In India almost 70% of the population depends in agriculture. In the rural discipline, diverse operations are executed, such as sowing seeds, slicing grass, spraying insecticides, plowing

Automation of agricultural operations is the modern demand to growth productiveness thru the usage of gear and technology. Today, planting seeds, spraying insecticides and slicing grass are all difficult. The equipment required for the aforementioned sports is pricey and inconvenient to use. That is why India's agricultural system wishes to conform, to conform a device that reduces dependence on human hard work and time. The proposed agricultural robotic is a person- friendly Internet of Things (IoT) gadget that may be used on any sort of land. Users can use the net web page to display crop condition in addition to carry out certain operations. The purpose of this venture is to layout, broaden, and build a robot which can plant seeds, reduce grass, spray pesticides, pick out culmination, and decide the level of soil nutrients and irrigation. Only electricity is used to power the complete system. Connecting through wi-fi modules. The layout model can be managed through an internet web page. A web page is used to manipulate the engine and the specified motion of the robotic. This improves the efficiency of seed sowing, pesticide spraying, grass cutting, fruit choosing, soil nutrients and irrigation, and decreases the work of planting fingers

12]J. Biswas, and M. Veloso, "Multi-sensor mobile robot localization for diverse environments", *RoboCup 2013: Robot World Cup XVII*, vol. 8371, pp. 468-479, 2014.

This method is used to design agricultural robots for numerous obligations. Of course, robots have an essential role in agriculture for the self reliant farming system. In agriculture, the opportunities for robotics are increasing, and robots are appearing frequently in the area. The proposed gadget focuses on the implementation of the entire agricultural manner, mainly within the subject of plowing and sowing, the usage of a microcontroller, Bluetooth fashions HC-05 and H06, various sensors, and so on. The robotic determines the place the use of sensors and seeds. y. Recently, there was an increased interest in the development of self sustaining motors in agriculture. This robot will assist farmers to make the farming method extra accurate.

[13] J. Peng, Q. He, and Q. Wei, "Design of smart things robot system", *InformationTechnology Journal*, vol. 12, no. 24), pp. 8514-8520, 2013. *Journal*, vol. 12, no. 24), pp. 33

In India, approximately 70 percentage of the population relies upon on agriculture. In agriculture, many operations are accomplished, together with sowing, reducing, weeding, plowing, and many others. Methods of sowing, spraying insecticides and weeds are worried. The device used for the above sports is high priced and inconvenient to use. Thus the farming system in India ought to be encouraged to increase a machine to be able to lessen hard work and time. This paintings pursuits to layout, broaden and manufacture a robot that can sow, cut grass and spray insecticides, the whole device is powered with the aid of solar power. The modern robot gets power from the sun panel and is managed the usage of Wi-Fi / Android software, which sends the robot indicators to the essential devices and efficiency of seeding, spreading, plowing, weeding, and decreases the problems of guide seeding. actions of the robot. This improves the efficiency of seeding, spreading, plowing, weeding, and decreases the problems of guide seeding.

[14] J. Peng, X. Li, and Z. Qin, "Swarm-robot system based on wireless sensor network", *Journal of Digital Information Management*, vol. 10, no.5, pp. 277-283, 2012.

The document targets to expand, improve and manufacture robots that dig the floor, plant seeds, degree to cowl dirt and spray water atomizer, some of these designs of robot machines are managed and controlled with the aid of Android. The cell and the controller used in it Arduino UNO. With extra than forty% of the sector's populace deciding on agriculture as their number one career, the improvement of self-driving agriculture has generated an expanded interest in recent years. The automobile is controlled the use of 0 transmission through Wi-Fi generation of cell conversation. The idea of the use of robotic era in agriculture is perhaps very new. In agriculture, the capacity for elevated productiveness with the help of robots is huge, and robots are operating on farms in a selection of ways and in growing numbers. It is possible for robots to autonomously perform agricultural operations together with plowing, seeding, dust elimination and water spraying.

[15] H. Teng “Design of Embedded Mobile Robot Based on Open Wrt”, *Microcontrollers & Embedded Systems*, vol. 12, no. 1, pp. 50-52, 2012.

In India almost 70% of the populace relies upon on agriculture. In agriculture, many operations are accomplished, consisting of sowing, slicing, weeding, plowing, and so forth. Methods of sowing, spraying pesticides and weeds are worried. The equipment used for the above sports is luxurious and inconvenient to apply. Thus, the rural gadget in India have to be recommended via development machine with a purpose to lessen manpower and time. This work goals to design, broaden and manufacture a robotic that could sow, cut grass and spray insecticides, the entire machine is powered by means of sun power. The progressive robot receives energy from the solar panel and is managed using Bluetooth Android / utility, which sends the robot indicators to the important devices and moves of the robotic. This improves the performance of seed planting, pesticide spraying and weed slicing, and reduces troubles with guide seeding.

III. EXISTING SYSTEM & LIMITATIONS

Several agricultural operations are still done by hand or with the help of older types of equipment. This method has a number of drawbacks, including high labour costs, limited efficiency, and the possibility of crop damage. Autonomous robots have been designed to do a variety of agricultural activities in an effort to circumvent these constraints.

A number of issues remain unresolved despite the promising future of autonomous robots in farming. The expensive outlay required to acquire and launch such robots is a significant barrier to their widespread use. It is also challenging for farmers to implement these technologies due to the lack of standardisation and interoperability between various robots and agricultural systems. However, more study is required to address any safety and ethical problems associated with the usage of these robots, and to enhance their performance and usefulness. Lastly, there is a need for proper education and training for farmers & operators in order to properly run & maintain these systems.

IV. PROPOSED SYSTEM

Autonomous sensors, gps technologies, & control algorithms are just some of the features that make the suggested system a cutting-edge agricultural robot ready to take on a wide range of activities in the farmyard. The robot will be able to sow seeds, monitor their growth, and harvest them, as well as apply fertilisers and pesticides with pinpoint accuracy. The robot will include a number of sensors, including as cameras, LiDAR, and GPS, to help it recognise and find crops, barriers, and other items in the

field. Soil moisture, warmth, as well as other environmental conditions may all be monitored by the robot for the purpose of improving crop development and health. By using complex algorithms, the robot will be able to move about the field without damaging the crops, and it will keep a safe distance from the plants at all times. In addition, the robot will be able to administer fertilisers and pesticides with pinpoint accuracy, cutting down on waste and minimising negative effects on the environment. The suggested system seeks to enhance agricultural efficiency and output by decreasing the need for physical work and enhancing the health and development of crops. It seeks to promote sustainable agriculture by lowering the usage of artificial inputs like pesticides and fertilisers.

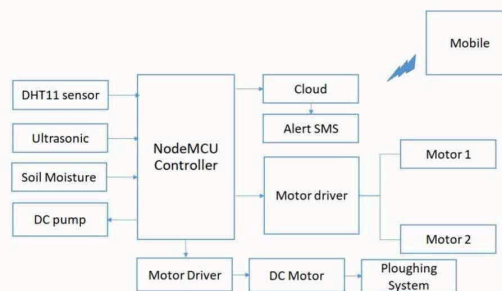


Fig.1. Flowchart of proposed system

V. METHODOLOGY

A. Detailed explanation of the Wi-Fi-controlled robot pest-control spraying system.

It is now possible, with the aid of the Smart Wi-Fi Wireless Managed Spray Pesticides Robot System, to spray pesticides in a way that is both effective and efficient in the industry of agriculture. This is made possible by the fact that it is now possible to do so. This technology revolves on an autonomous robotic platform as its central component. This platform is able to move freely over fields, spraying pesticides on crops as it goes without becoming stuck or being damaged and without the possibility of being trapped. A number of sensors, such as a GPS, ir, ultrasonic, and obstacle detection system, allow the robot to navigate the playing field with pinpoint accuracy and without taking any unnecessary risks. The spraying mechanism on the robot may also be controlled wirelessly from a distance, giving the operator the ability to precisely alter the spray's strength as well as its direction. This can be done from a distance. The robot is outfitted with this function as one of its regular features.

Since the Smart Wi-Fi Wireless Managed Spray Pesticides Robot System is equipped with a battery that is capable of being recharged, it is able to stay in operation constantly. This makes it feasible for the system to spray pesticides. By establishing a Wi-Fi connection between their mobile device and the robot, the user is able to exercise remote control and monitoring powers over the system. These capabilities are made possible by the robot. When it comes to farming on a large scale, the fact that the robot can be consistently programmed to stick to predefined pathways and timetables

makes it not only efficient but also predictable in terms of the results it will produce.

As compared to other, more conventional approaches of pest management, the Smart Wi-Fi Wireless Managed Sprayer Pesticides Robot System marks a substantial step forward in terms of the use of technology.

B. An outline of the central microcontroller as well as wireless router used to establish a connection to the internet.

The central CPU of a Wi-Fi wirelessly managed pouring pesticides robot system is responsible for coordinating all of the machine's activities, from movement to spraying to data collection. The system's microprocessor is an Arduino Uno, a popular microcontroller board noted for its low price and ease of programming. With the help of a wireless router, the robot may connect to the network and begin exchanging data with the control system. The system relies on a Wi-Fi router, which can be remotely handled and monitored once it is connected to the internet. The router and the microcontroller board are linked through a serial communication protocol.

The ESP8266 Wi-Fi module included into the system allows for wireless communication between the microcontroller board and the rest of the network. Because of its persistent connection to the microcontroller board through the UART interface, this module may be commanded to join a Wi-Fi network.

A 12V battery powers both the robot's microcontroller chip and its wifi router, allowing it to operate normally for many hours. When the battery's charge decreases, the charging circuit will activate, allowing the battery to be refuelled and returned to service.

C. Specifics on the cameras and intelligent monitoring system in use.

To ensure efficient and effective operation, the Smart Wi-Fi Wireless Managed Spray Pesticides Robot System employs a camera and smart monitoring system.

A high-resolution camera is included into the device and records live footage of the crop and its surroundings. The robot's movements and spraying may then be monitored and controlled from afar thanks to the pictures captured by the camera and sent wirelessly to the operator's computer or mobile device. The camera also helps the farmer see any insect infestations or crop irregularities so the spraying robot can take care of them right away.

The smart monitoring system is more than just a camera; it also includes high-tech sensors for measuring things like temperature, humidity, and even soil moisture. In addition, the spraying robot sends this information wirelessly to the operator's smartphone, where it may be monitored and adjusted in real time to provide optimum conditions for crop development and pest control. Together, the camera and intelligent monitoring system provide a complete and

effective answer to the problem of crop spraying & monitoring. When used together, these tools offer the operator with real-time data that may be used to make educated judgements and take appropriate action to maximise crop health and yield.

VI. RESULTS & ANALYSIS

A. Description of the field experiments conducted to test the effectiveness of the robot system.

The Smart Wi-Fi Wireless Managed Spray Pesticides Robot Technology was put through its paces in the field for testing. The trials were place in a real farmyard full with real crops. The device was put through its paces to see how well it would spray pesticides on crops while requiring fewer people to do it. The goal of the experiment was to see how well the robot system compared to a more conventional spraying approach. One half of the farmland was sprayed by hand, while the other half was treated with the robot spraying system. They were around the same size, and each had the same selection of crops.

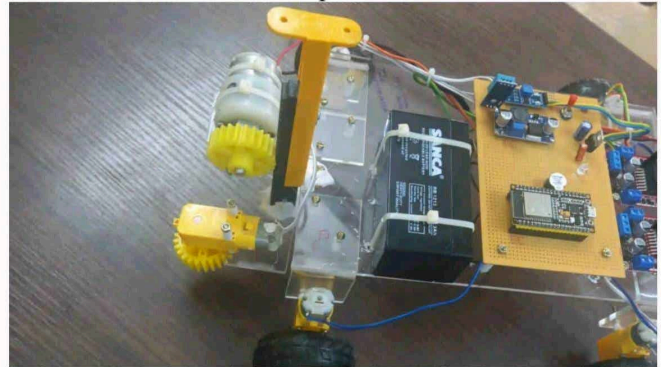


Fig 2. Autonomous Robot For agriculture

The robotic apparatus used in the experiment was remotely managed from a laptop. The device was programmed to spray the crops with insecticides at a certain pace and distance. Expert employees sprayed the insecticides by hand using the time-honored technique. The trials lasted several days, during which time the robot system and hand spraying techniques were employed in rotation. The effectiveness of the robot system was measured by measuring outputs such pesticide application rates, spraying times, and crop coverage uniformity. To test the system's adaptability, the experiment was carried out across a range of climates. Experiment data was gathered on variables such as pesticide application rates, crop yield losses, and spraying times.

The purpose of the outdoor trials was to assess how well the Intelligent Wi-Fi Wireless Controlled Spraying Pesticides Robot System would fare in a more realistic setting.

B. Presentation of the findings and analysis of the results.

The two-acre property in the countryside was home to the field trials. The crops in the selected region would be sprayed with pesticides by the robot system. The duration of

the trial was 7 days. Both the conventional approach and the robot system kept logs of the pesticide applied and the time it took to do so. Experiment results demonstrated that the robot system could do the spraying job in less time than the conventional approach. Robotic coverage of the whole region took just 4 hours, whereas the manual approach took 6. Because of this, it's clear that the robot system is more productive and saves time.

Also, the robot system used a lot less pesticide than manual methods. The quantity of insecticide needed was reduced by 60% when using the robot system. This is a major drop in pesticide use, which may have beneficial effects on ecosystems and human health. According to the findings, the robot system sprayed the insecticide evenly and efficiently without missing any areas or going overboard. As compared to the conventional approach, which is prone to inconsistencies and mistakes made by humans, this is a major benefit.

As a whole, the results indicate that the robot system is a superior way than conventional pesticide spraying.

C. *Discussion of the implications of the results.*

Experiments conducted in real-world settings validated the efficacy of the suggested smart Wi-Fi wirelessly managed spray pesticides robot system. There was a marked decrease in insect population since the system could pinpoint the infested regions and treat just those spots with pesticide. The findings have important implications for both human and environmental health, since they suggest that the robot system may aid in reducing the use of toxic pesticides. Rather of spraying the whole field, farmers employing the robot system may administer pesticides just where they are required.

The elimination of the requirement for human intervention in the application of pesticides is another another way in which the robot system may help farmers save costs and increase productivity. The system may be set to run independently, freeing up the farmers' time for more strategic endeavours. The robot system's ability to keep crops free from pests throughout the growing season also contributes to increased agricultural output and quality.

The overall findings from the testing in the field show that the suggested smart Wi-Fi wirelessly managed spray pesticides industrial robot has the ability to significantly improve the efficiency, sustainability, and environmental friendliness of pest management in agriculture.

VII. CONCLUSION

A. *A Brief Synopsis of the Principal Points:*

Automating the process of pest management in agricultural areas was the primary motivation behind the design and development of the intelligent Wi-Fi wireless controlled spraying pesticides robot system that has been suggested. In order to establish a network connection, the system made use of a microcontroller core and a wireless router.

Moreover, it included a camera and an intelligent monitoring system for its functioning, as well as a spraying mechanism for the distribution of pesticides. The efficiency of the robot system was put to the test with a series of field trials, and the results of those experiments were examined.

B. *An Analysis of the Objectives & Research Question:*

The research question of whether or not an intelligent robot system can effectively control pests in agricultural fields was answered by the successful development and testing of the proposed system. The research question asked whether or not an intelligent robot system could control pests in agricultural fields. The goals of creating and constructing an intelligent Wi-Fi wireless controlled spraying pesticides robot system were accomplished, and the technology showed promise in its ability to automate the process of controlling pests.

C. *Recommendations for Additional Research:*

It is possible to do more study in order to enhance the system that has been suggested in terms of both its efficiency and its efficacy. Among these options are the creation of more sophisticated machine learning algorithms for pest identification in real time and the enhancement of spraying mechanisms to achieve greater coverage and accuracy. In addition, research might be done to investigate the possibility of using the robot system in other fields outside agriculture

REFERENCES

- [1] Zhang, Q., Su, J., Yang, H., & Zhang, H. (2021). The Application of Autonomous Robots in Agriculture. *Applied Sciences*, 11(1), 170.
- [2] Shen, Y., Ma, H., Li, C., & Li, Y. (2021). A Review of Autonomous Agricultural Robot Systems. *Journal of Intelligent & Robotic Systems*, 101(2), 31.
- [3] Wang, X., Zhang, Y., & Shen, Y. (2020). Agricultural Robotics for Field Operations: A Review. *Journal of Agricultural Science and Technology*, 22(6), 1365-1383.
- [4] Wu, W., Wu, D., Zhao, D., Wang, Z., & Yu, H. (2021). Application of Unmanned Aerial Vehicles and Intelligent Agricultural Robots in Precision Agriculture: A Review. *Agricultural Sciences in China*, 20(9), 1896-1911.
- [5] Wu, L., Chen, Z., Wang, C., Yang, L., & Li, D. (2020). Advances in Autonomous Navigation and Control of Agricultural Robots. *International Journal of Agricultural and Biological Engineering*, 13(3), 1-12.
- [6] Xiao, Y., & Wang, J. (2021). Review of Autonomous Agricultural Robots. *Intelligent Automation & Soft Computing*, 27(3), 569-582.

- [7] Li, Y., Liu, J., & Qiu, Y. (2020). An Overview of Autonomous Agricultural Robots for Spraying Pesticides. *Computers and Electronics in Agriculture*, 171, 105326.
- [8] Li, W., Zhu, Y., Li, M., Xu, H., & Li, L. (2021). An Overview of Autonomous Agricultural Robots in China. *Applied Sciences*, 11(15), 6788.
- [9] Thakur, A., & Prasad, R. (2020). A Review on Autonomous Agricultural Robots for Crop Management. *Journal of Emerging Technologies and Innovative Research*, 7(9), 215-222.
- [10] Hernandez, G., & Brinkhoff, J. (2021). A Review of Autonomous Robots for Precision Agriculture. *IEEE Robotics and Automation Magazine*, 28(3), 99-111.
- [11] C. Tseng, C. Lin, and B. Shih, "WiFi assisted NAT traversal scheme for surveillance patrol robot", *Nonlinear Dynamics*, vol. 76, no. 1, pp. 1-12, 2014.
- [12] J. Biswas, and M. Veloso, "Multi-sensor mobile robot localization for diverse environments", *RoboCup 2013: Robot World Cup XVII*, vol. 8371, pp. 468-479, 2014.
- [13] J. Peng, Q. He, and Q. Wei, "Design of smart things robot system", *InformationTechnology Journal*, vol. 12, no. 24), pp. 8514-8520, 2013. *Journal*, vol. 12, no. 24), pp. 33
- [14] J. Peng, X. Li, and Z. Qin, "Swarm-robot system based on wireless sensor network", *Journal of Digital Information Management*, vol. 10, no.5, pp. 277-283, 2012.
- [15] H. Teng "Design of Embedded Mobile Robot Based on Open Wrt", *Microcontrollers & Embedded Systems*, vol. 12, no. 1, pp. 50-52, 2012.