Marathwada Shikshan Prasarak Mandal’s

**Deogiri Institute of Engineering and Management Studies,**

**Aurangabad**

**Seminar Report**

**On**

**Farming robot**

Submitted By

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**Deogiri Institute of Engineering and Management Studies,**

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(2019- 2020)

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In partial fulfillment of

Bachelor of Technology

(Computer Science & Engineering)

Guided By

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**Aurangabad**

(2019- 2020)

**CERTIFICATE**

This is to certify that, the Seminar entitled “**Farming robot** ” submitted by

**Vaibhav Tate and Hrugved Chavan** is a bonafide work completed under my supervision and guidance in partial fulfillment for award of Bachelor of Technology (Computer Science and Engineering) Degree of Dr. Babasaheb Ambedkar Technological University, Lonere.

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**Abstract**

Now a days agricultural field is suffering from many problems . In this era of technology this problems can be solved effectively with the means of self-learning robots which reduce the human efforts and do farming in effective , healthy way.

The robot will perform many basic agricultural activities like seed sowing , watering , spraying fertilizers etc. The robot will be controlled through a mobile app which will have a navigation panel and various buttons for various activities.This robot is designed to reduce the efforts of farmers and to develop their economical condition by effective farming practices. Digital farming is the practice of modern technologies such as sensors, robotics, and data analysis for shifting from tedious operations to continuously automated processes. This paper reviews some of the latest achievements in agricultural robotics, specifically those that are used for autonomous weed control, field scouting, and harvesting. Object identification, task planning algorithms, digitalization and optimization of sensors are highlighted as some of the facing challenges in the context of digital farming.

The concepts of multi-robots, human-robot collaboration, and environment reconstruction from aerial images and ground-based sensors for the creation of virtual farms were highlighted as some of the gateways of digital farming. It was shown that one of the trends and research focuses in agricultural field robotics is towards building a swarm of small scale robots and drones that collaborate together to optimize farming inputs and reveal denied or concealed information. For the case of robotic harvesting, an autonomous framework with several simple axis manipulators can be faster and more efficient than the currently adapted professional expensive manipulators.

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**Introduction**

Implementation of digital farming and site-specific precision management are some of the possible responses to this expectation, which depends not only on the sensor technology but the continuous collection of field data that is only feasible through proper utilization of agricultural robots. Agricultural scientists, farmers, and growers are also facing the challenge of producing more food from less land in a sustainable way to meet the demands of the predicted 9.8 billion populations in 2050. That is equivalent of feeding a newly added city of 200 000 people every day. Integration of digital tools, sensors, and control technologies has accelerated design and developments of agricultural robotics, demonstrating significant potentials and benefits in modern farming. These evolutions range from digitizing plants and fields by collecting accurate and detailed temporal and spatial information in a timely manner, to accomplishing complicated nonlinear control tasks for robot navigation. Autonomous guided tractors and farm machinery equipped with local and global sensors for operating in row-crops and orchards have already become mature. Examples include the John Deere iTEC Pro (Deere & Company, Moline, Illinois) which uses Global Navigation Satellite System for steering control, and the Claas autonomous navigation (Harsewinkel, Ostwestfalen- Lippe, Germany) which offers Cam Pilot steering and 3D computer vision in addition to the GPS-based control to follow features on the ground. Agricultural field robots and manipulators have become an important part in different aspects of digital farming.

Automation of agricultural operations is demand of the time to improve the productivity with the help of tools and technology. In recent years, the development of autonomous vehicles in agriculture has experienced increased interest. Many researchers started developing more rational and adaptable vehicles for agricultural operations. In the field of agricultural autonomous vehicles, a concept was adopted to use multiple small efficient autonomous machines in place of traditional large tractors [9]. Moreover,such asystem may have a less environmental impact as it can reduce over-application of chemicals and high usages of energy and inputs by the control that is better matched to stochastic requirements.

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conventional machines. Most of the researcher are working for autonomous vehicle design for

precision agricultural mobile robots. The design works on implementing three different verticals namely 1. Mobile robot navigation 2. Implements (Framework & Applications) 3.sensor modules. Different countries like the USA, European Unions, Denmark, Australia, Finland, India etc are designing mobile robots under these verticals which are mainly to procure agriculture farming over commercial industries. Research groups have developed differentspecialized navigation techniques like an odometer, vision based,sensor based, inertial, active beacon, GPS, map-based, landmark navigation techniques to operate robots under unified controlspace for farming. This technique is used for application likeseed-bed preparation,seed mapping,seed placement, reseeding, cropscouting, weed mapping, robotic weeding control, micro-spraying, robotics gantry, robotic irrigation, etc.

An agricultural robot is subjected to an extremely dynamic environment, and yet expected to touch, sense, or manipulate the crop and the surroundings in a precise manner which makes it necessary to have the minimal amount of impact while increasing efficiency[20]. Although industrial robotic platform with precision accuracy and speed are available, their application in agriculture is limited due to what we refer to as unstructured environments and uncertain tasks which impose great challenges. For example, the demand for off-season cultivation of fruits and vegetables require different aspects of automation and robotics in closed-field plant production environments like greenhouses[21]. A field robot with spraying, de-leafing, and harvesting manipulator and end-effector for such tasks in a dynamic, complex, and uncertain environment should take into account the different arrangements of plant sizes and shapes, stems, branches, leaves, fruit color, texture, obstacles, and weather influences in order to operate efficiently in the real world condition. In the case of harvesting for example, the sensing mechanism has to identify the ripeness of fruits in the presence of various disturbances in an unpredicted heterogeneous environment, while the actuation mechanism should perform motion and path planning to navigate inside the plant system or tree canopy with minimum collisions for grasping and removing the soft fruit delicately. This is by far more challenging compared to an industrial robot in charge of picking and placing a solid bolt in an assembly line

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**Literature survey**

For the literature survey the most important that what research happen in Farming robot and what should we will do invention part in the farming robot.

Research works on agricultural robotics cover a wide range of applications, from automated harvesting using professional manipulators that are integrated with custom designed mobile platforms and innovative grippers such as the one shown in Figure 1, or autonomous targeted spraying for pest control in commercial greenhouses, to optimum manipulator design for autonomous de-leafing process of cucumber plants, and simultaneous localization and mapping techniques for plant trimming. Most of the published literatures in this context are focused on (i) vision-based control, advanced image processing techniques, and gripper design for automated harvesting of valuable fruits (see for example the published literatures on sweet pepper, oil palm, mango, cucumber, almond, apple,

strawberry, cherry fruit, citrus, vineyard, and tomato, or navigation algorithms and robust machine vision systems for development of field robots that can be used in yield estimation ,thinning, weeding and targeted spraying, seedling and transplanting, delicate handling of sensitive flowers, and multipurpose autonomous field navigation robots. In addition to these, several virtual experimentation frameworks have been developed for agricultural robots. An example includes the work of in which a generic high-level functionality was provided for easier and faster development of agricultural robots. In another attempt, a customized software platform called ForboMind was introduced to support field robots for precision agriculture task with the objective to promote reusability of robotic components. ForboMind is open-source, and support projects of varying size and complexity, facilitate collaboration for modularity, extensibility, and scalability. In order to experiment with vision sensors and agricultural robots[7], created a completely simulated environment in V-REP (Coppelia Robotics)[78], ROS[79], and MATLAB (Mathworks, Natick, MA, USA) for improvement of plant/fruit scanning and visual servoing task through an easy testing and debugging of control algorithms with zero damage risk to the real robot and to the actual equipment.

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Example solutions addressing robotic harvesting included eye-in-hand look-and-move configuration for visual servo control, optimal manipulator design and control, end-effector and gripper design, stability tests for robot performance analysis in the dense obstacle environments, motion planning algorithms, and orchard architecture design for optimal harvesting robot. Improvements in vision-based control system have enabled several applications of robotic manipulators for greenhouse and orchard tasks and have contributed to the decrease in workload and labor’s fatigue while improving the efficiency and safety of the operations. These achievements were considered a challenge in the earlier agricultural robotics works. One of the main aspects of agricultural robotics is concerned with the substitution of the human workforce by field robots or mechanized systems that can handle the tasks more accurately and uniformly at a lower cost and higher efficiency[6,99-103]. Weed control and precise spraying are perhaps the most demanded applications for agricultural field robots. In this regard, targeted spraying[104] with robots for weed control application has shown acceptable results and reduced herbicide use to as little as 5%-10% compared to blanket spraying[105]. While still not fully commercialized, various promising technologies for weed robots have been introduced and implemented over the past 10 years as the results of interdisciplinary collaborative projects between different international research groups and companies. Some of the well-known names that are actively involved in the research and development for various types of weed control robots are the Wageningen University and Research Center (The Netherlands), Queensland University of Technology, the University of Sydney, Blue River Technologies (Sunnyvale, CA, USA), Switzerland’s

ecoRobotix (Yverdon-les-Bains, Switzerland), and France’s Naio Technologies (Escalquens, France). For example a flexible multipurpose farming and weeding robot platform named BoniRob[18,106] (shown in Figure 2a) was developed as a joint project between the University of Osnabrueck, the DeepField Robotics start-up, Robert Bosch company, and the machine manufacturer Amazonen-Werker. The available time, labor, equipment, costs, and types of weeds and the areas infested need to be considered when planning a weed control program.

MF-Scamp robots are designed for scouting, weeding and harvesting . It is designed either four wheel or sixwheel drive weed seeking robot to perform weed removing or destroy the weed.

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Generally the crops are grown inrows and column which can remove weeds when running hoe tools between the crops row and column. Now this intelligent hoe tools uses vision sensor to locate and identify the crops in rows and column and steers itself accurately, to a larger extend reducing the usage of herbicides. It also uses colorsensor to identity weeds between the crops by producing weed maps identifying plans. This robot designed not only reduce the labor time but also the economic feasible withslight reductions in prices of navigation systems. This kind of design not only reduce the cost of spraying but also decrease the usage of tractor. The negative effects of the robot is the higher costs for small farmers and additional costs used for electronics devices like GPS-system. This prototype is designed to collect timely and accurate information in the crop carrying range of sensors to assess crop health and status. This high clearance platform carries instruments above the crop canopy and utilize GPS. The portal robot shown in Fig. 3 and 4 used to provide automated cropsurvey as well as to measure crop nutrient status and multispectral responses (stress), visible images (pan Chromatic), weedspecies and weed density. Using machine vision the position and density (biomass) of different weed species are recorded in the form of weed mapping. Two different methods are used to identity weeds round the crop, first is to record the increased leaf area around weedy area as crops are planted in rows and secondly using active shape recognition, developed to identify human faces, similarly can be used to identity weedspecies by the shape of their outline. Currently 19 species of weeds can be recognized using color segmentation. The final result is the weed map created with the help of the machine vision and the robot knowing the position of the weeds which can be removed, kill or retard from the unwanted area. Different physical interaction techniques are used to remove the weeds one example is to break the soil and root interface by tillage and promote wilting of weed plants.

BoniRob is a multi-purpose robotic platform for applications in agriculture. It has four independently steerable drive wheels that has the ability to adjust its track width and makes it highly maneuverable as shown in Fig. 5. The robot run purely on batteries or connected to a generator to extend its range and usage time. It can be retrofitted and upgraded with exchangeable application modules (tools). The robot can navigate autonomously along plant rows (e.g. dams) in the field, carrying the application module (plantation) as it goes.

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It has environmental sensors like Lidar, inertialsensors, wheel odometry,satellite and GPS for row detection and navigation. This robot is designed for application like chemically weed control or uses a rod device to crush the weeds, to combat volunteer potatoes from the previous year, to measure soil compaction and manage plant breeding. Testing of the robot in carrot fields have proved that it is over 90% effective in removing weeds and preserving crop plants.

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**PROJECT BUILDING**

There are various machine used for agricultural purposes out of which some are cost effective but required more man power. In multitasking agricultural robot, we are trying to reduce the cost as well as human dependency by making it fully automated. The main processing unit is Raspberry pi 3 and it easy-to-use hardware and software . It is used as an input and output device to get continues readings from sensors and based on these readings generate corresponding control signals to ensure the accurate working of the robot. All the modules like seed sowing, soil moisture sensors, directly communicate with raspberry pi using I/O ports. This paper consist of two fragments and using smart phone to control system. In the present system, every fragment is integration with different sensors and devices and they are interconnected to one central server via wireless communication modules. The server sends and receives information from farmer end using internet connectivity. This system allow the farmer to control multitasking robot appliances sensors and motors from mobile phone through an internet connections. Architecture of The System It consist of Raspberry Pi 3, the heart of the project. Small single computer like credit card size. It works on 5V supply. It has inbuild wireless LAN and Bluetooth connectivity.

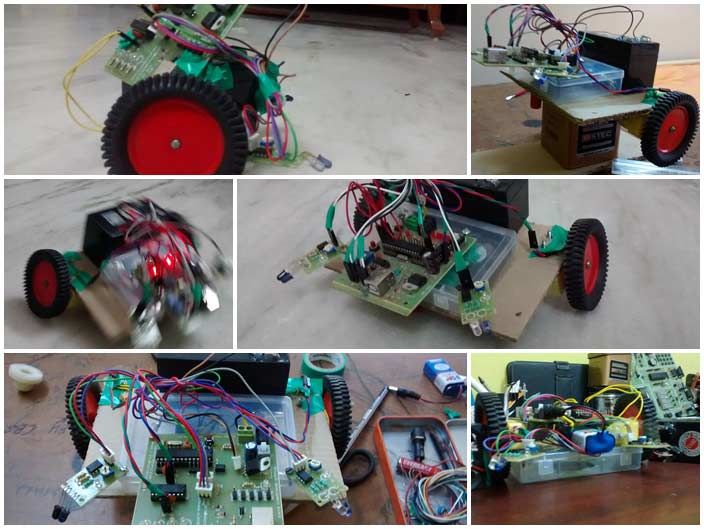
The multitasking robot is capable of performing multiple operations like seed sowing and smart irrigation. The mechanism of the robot is guided by the signals being sent out from the Raspberry Pi controller. The robot is composed of 6 motors out of which two is a servo motor and the remaining are RPM motors. The one servo mechanism is used for seed dispensing and another servo is used for smart irrigation. A 12V battery supply is feeded for the operation of wheels and other process. Four RPM motors are attached to the wheels on either side such that each side is driven by two motors each. From the mobile wireless connection farmer can operate the robot by switching onto the desired modes through dashboard.

3.2 Seed Dispensing For the process of seed dispensing, farmers from the mobile wireless connection they can operate the robot by switching the move bot mode and dispenser seed modes through dashboard. These mode signals are send to the raspberry pi 3. That the R-Pi controller wheel motors and devices. The move bot mode are assistance to travel the robot in forward direction. After the dispenser seed mode are doing the seed sowing process.

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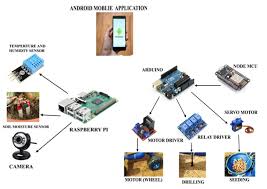
The seed dispensing process is to provide a light and compact robot adapted to be pushed over the ground to be seeded and capable of distributing seeds evenly in uniform quantities. A seed distribution system constructed in an upright main hopper for containing a mass of seeds. Then the seeds which are allowed to pass through a valve to the seed dispenser. From where the seeds are led to fall into the soil through the dispenser whose movement is aided by a servo motor. This nothing but a simple electrical motor, controlled with help of servo mechanism. The way a servo motor reads the information it’s being sent is by using an electrical signal called PWM. It sending ON electrical signals for a certain amount of time, followed by an OFF period, repeated hundreds of time a second. The amount of time the signal is on sets the angle the servo motor will rotate. So for 90 degrees, divided by 18, which is 5,



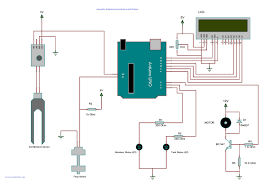
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Soil moisture is basically the content of water present in the soil. This can be measured using a soil moisture sensor which consists of two conducting probes that act as a probe. It can measure the moisture content in the soil based on the change in resistance between the two conducting plates. The resistance between the two conducting plates varies in an inverse manner with the amount of moisture present in the soil. This paper uses Python scripts run on a raspberry pi microcontroller to send GPIO PWN output to a servo motor to set its angle. GPIO stands for General Purpose Input/Output which mean these pins can either send electrical signals to drive hardware or receive them and read sensor data. We’re using them as output, to send signals to a servo motor. That the servo motor act the soil moisture sensor. A typical soil moisture sensor consist of two components. A two legged lead, that goes into soil or anywhere else where water content has to be measured. This has two header pins which connect to an amplifier/ A-D circuit which is in turn connected to the arduino nano. The amplifier has a Vin, Gnd, Analog and Digital data pins. This mean that we can get the values in both analog and digital forms. The soil moisture sensor gives a resistance variation at the output. It sends analog data which can be converted with an integrated analog to digital converted in the arduino nano. The arduino nano are connected to the raspberry pi with USB cables. It sends the current soil moisture sensor data in digital form to arduino nano. That digital signal is given to the raspberry pi 3 board. Then relay is switched ON/OFF to turn the water motor. If the soil moisture value is high then the water motor will be on, otherwise if the moisture level is low the motor will be off through the relay. Every moisture action indicated by the LCD display.



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In this paper agriculture robot controlled by Raspberry Pi 3. As hardware, the robot body is build mechanically and electronic components. The robotic control is made wireless that is; it controlled by the WI-FI. The smart phone and Raspberry Pi 3 board is connected through WI-FI. The desired mode are generated from smart phone are sent to the raspberry pi and raspberry pi receives these signals according to a program written in the python programming language. At this point, it is possible to talk about one and only communication channel. From the farmer mobile they would able to see the dashboard to run the robot. Fig.9. Disperse seed mode used for seed sowing operation. Move bot mode using for robot running. Plant servo mode used for soil moisture sensing. The agriculture robot are



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**Application**

Robots have many fields of application in agriculture. Some examples and prototypes of robots include the Merlin Robot Milker, Rosphere, [Harvest Automation](https://en.wikipedia.org/wiki/Harvest_Automation), Orange Harvester, lettuce bot,[[17]](https://en.wikipedia.org/wiki/Agricultural_robot#cite_note-17) and weeder. One case of a large scale use of robots in farming is the milk bot. It is widespread among British dairy farms because of its efficiency and nonrequirement to move. According to David Gardner (chief executive of the Royal Agricultural Society of England), a robot can complete a complicated task if its repetitive and the robot is allowed to sit in a single place. Furthermore, robots that work on repetitive tasks (e.g. milking) fulfill their role to a consistent and particular standard.[[18]](https://en.wikipedia.org/wiki/Agricultural_robot#cite_note-18)

Another field of application is [horticulture](https://en.wikipedia.org/wiki/Horticulture). One horticultural application is the development of RV100 by [Harvest Automation Inc.](https://en.wikipedia.org/wiki/Harvest_Automation) RV 100 is designed to transport potted plants in a [greenhouse](https://en.wikipedia.org/wiki/Greenhouse) or outdoor setting. The functions of RV100 in handling and organizing potted plants include spacing capabilities, collection, and consolidation. The benefits of using RV100 for this task include high placement accuracy, [autonomous](https://en.wikipedia.org/wiki/Autonomous) outdoor and indoor function, and reduced [production costs](https://en.wikipedia.org/wiki/Cost-of-production_theory_of_value).

Agricultural robots automate slow, repetitive and dull tasks for farmers, allowing them to focus more on improving overall production yields. Some of the most common robots in agriculture are used for:

* Harvesting and picking
* Weed control
* Autonomous mowing, pruning, seeding, spraying and thinning
* Phenotyping
* Sorting and packing
* Utility platforms

Harvesting and picking is one of the most popular robotic applications in agriculture due to the

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accuracy and speed that robots can achieve to improve the size of yields and reduce waste from crops being left in the field.12

These applications can be difficult to automate, however. For example, a robotic system designed to pick sweet peppers encounters many obstacles. Vision systems have to determine the location and ripeness of the pepper in harsh conditions, including the presence of dust, varying light intensity, temperature swings and movement created by the wind.

But it still takes more than advanced vision systems to pick a pepper. A robotic arm has to navigate environments with just as many obstacles to delicately grasp and place a pepper. This process is very different from picking and placing a metal part on an assembly line. The agricultural robotic arm must be flexible in a dynamic environment and accurate enough not to damage the peppers as they’re being picked.

Harvesting and picking robots are becoming very popular among farmers, but there are dozens of other innovative ways the agricultural industry is deploying robotic automation to improve their production yields.

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**Conclusion**

In this paper, we have introduced a systematic vision of IoT technologies for the advancement of agriculture. It increase the agriculture field, make tranquil work to the farmers and save the water and energy conservation. The raspberry pi 3 is an incredible little machine with endless automatic process. This smart irrigation system proves to be a useful system as it automates and regulates the watering without any manual intervention. Another system has been developed for the sowing of seeds in an automatic way. Here with the help of a robot the seeds are been dispensed in the soil in a proper sequence hereby reducing the wastage of seeds.

Research efforts for development of agricultural robots that can effectively perform tedious field tasks have grown significantly in the past decade. With the exception of milking robots that were invented in the Netherlands, robotics has not reached a commercial scale for agricultural applications. With the decrease of the workforce and the increase of production cost, research areas on robotic weeding and harvesting have received more and more attention in the recent years, however the fastest available prototype robots for weeding and harvesting are not even close to being able to compete with the human operator. For the case of picking valuable fruits using robots, the technology is now becoming closer to a commercial product with the emerging of the SWEEPER. For other fruits such as citrus and apples that can be mass harvested for juice industry, modifications of the existing mechanical harvesting systems with some robot functionalities may be more promising than using single robot system. Increasing the speed and accuracy of robots for farming applications are the main issues to be addressed for generalization of robotics systems, however, compared to the industrial and military cases, the lack of abundant research funding and budgets in agriculture hasdecelerated this process.

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**Signature of Student**

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