A REVIEW: AUTONOMOUS AGRIBOT FOR SMART FARMING

[1]ASHISH LALWANI, [2]MRUNMAI BHIDE, [3]S. K. SHAH

[1,2]PG Student, [3]HOD PG Department,
Skncoe, Vadgoan, Maharashtra, India

Abstract— Increasing population requires the food production to be increased which requires better cultivation in the form of proper utilization of seeds and fertilizers with minimum labor work. The main objective of autonomous agribot is efficient utilization of resources and to reduce labor work. It can perform various tasks like soil testing, sowing of seeds, spraying of fertilizers and harvesting of fruits. It can measure the NPK content of soil using colour testing of chemical solution using fiber optic and dispense the required amount of fertilizers which is necessary or less in soil. It can dig a hole in soil by drilling mechanisms and plants seed and cover hole by soil again. It can spray the pesticides using spraying mechanisms. All above operations are performed by using ARDUINO controller which is master and others are lilypad which are slaves performs specific operation. By using image processing and robotic arm the agribot will detect fruits on tree and cut the fruit and dump it on basket, all this harvesting work can be done by using Raspberry pi.

Keywords— Agribot, ARDUINO controller, Raspberry pi, NPK testing, sowing of seeds, pesticides spraying, Harvesting.

I. INTRODUCTION

The main motive for developing Agricultural Automation Technology is the decreasing labour force, a phenomenon common in the developed world. The reasons are the need for improved food quality. Robotics and artificial intelligence achievements offer solutions in precision agriculture to processes related to seeding, harvesting, weed control, grove supervision, chemical applications, etc. to improve productivity and efficiency. In the current generation most of the countries do not have sufficient skilled man power in agricultural sector and it affects the growth of developing countries. So it's necessary to automate the sector to overcome this problem. In India there are 70% people dependent on agriculture. Robotics is the branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing. The design of a rover will often incorporate agricultural efforts, though it may not look much like a human being or function in a human like manner. These types of intelligent systems having robust and feasible model with a number of integrated functionalities is the demand of future in every field of technology, for the betterment of the society.

The application of agricultural machinery in precision agriculture has experienced an increase in investment and research due to the use of robotics applications in the machinery design and task executions. Precision autonomous farming is the operation, guidance, and control of autonomous machines to carry out agricultural tasks. It motivates agricultural robotics. It is expected that, in the near future, autonomous vehicles will be at the heart of all precision agriculture applications. The goal of agricultural robotics is more than just the application of robotics technologies to agriculture. Currently, most of the automatic agricultural vehicles used for weed detection, agrochemical dispersal, terrain levelling, irriga-

tion, etc. are manned. An autonomous performance of such vehicles will allow for the continuous supervision of the field, since information regarding the environment can be autonomously acquired, and the vehicle can then performs its task accordingly.

Agriculture was the key development in the rise of human civilization. A remarkable change in agricultural practices has occurred over the past century in response to new technologies, and the development of world agricultural markets. This also has led to technological improvements in agricultural techniques. Robotics is the branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback. The design of a rover will often incorporate agricultural efforts, though it may not look much like a human being or function in a human like manner [1].

Agribot is a robot designed for agricultural purposes. In the 21st century the trends of development on automation and intelligence of agricultural machinery is increasing. All kinds of agricultural robots have been researched and developed to implement a number of agricultural products in many countries. This Bot can performs basic elementary functions like harvesting, planting and spray the pesticides. The application of agricultural machinery in precision agriculture has experienced an increase in investment and research due to the use of robotics applications in the machinery design and task executions. Precision autonomous farming is the operation, guidance, and control of autonomous machines to carry out agricultural tasks. It motivates agricultural robotics. The goal of agricultural robotics is more than just the application of robotics technologies to agriculture. Currently, most of the automatic agricultural vehicles used for weed detection, agrochemical dispersal, terrain levelling, irrigation, etc.

A. *Comparison between Present sowing techniques and sowing with Agribot System*

Table 1: Comparison of sowing techniques.

SR. NO.	Parameters	Manual	Tractor	Digging and sowing using Agribot
1.	Man Power	More	Moderate	Less
2.	Time Required	More	More	Less
3.	Digging and sowing technique	Manually	Manually	Automatically
4.	Adjustable seed distance	No	No	Yes
5.	Seed Wastage	Moderate	More	Less
6.	Energy needed	High	Very High	Less
7.	Pollution	No	More	No
8.	Alarm and display	No	No	Yes

Table1. Shows that the manual sowing method requires more man power and time than the sowing with tractor but still it is more than sowing with agribot. Also using agribot we can change the distance between the two plants and the wastage of seed is also less.

B. *Limitations of Manual Farming*

If farming is done manually then a lot of human efforts are required and then also the required quality work is not possible. Also there is wastage of seeds and fertilizers due to improper use of it. Also the harvesting part is very difficult manually because it may happen that the fruits are cut before their maturity level of it because grading of fruit is done manually. Manual harvesting method is slow and also very costly.

C. *Agribot design challenges*

Today agricultural robots can be classified into several groups: harvesting or picking, planting, weeding, pest control, or maintenance. The goal is of creating "robot farms" where all of the work will be done by machines. The main obstacle to this kind of robot farm is that farms are a part of nature and nature is not uniform. It is not like the robots that work in factories building cars. Factories are built around the job at hand, whereas, farms are not. Robots on farms have to operate in harmony with nature. Robots in factories don't have to deal with uneven terrain or changing conditions. So following are some challenges in designing agribot [3].

1. It is difficult to drop only one seed at a time, so control the flow of seed tank is difficult task to plant only one seed.
2. Difficult to design seeding mechanisms with plough in the farm and cover it with soil again.
3. Difficult to design spraying mechanisms, while spraying the pesticides it is necessary to control the flow of air and pesticides from the nozzle, otherwise only the air or pesticides will be out from the nozzle and proper spraying is not done.
4. While harvesting the fruit on tree, the fruit will be detected by using 2D camera we get only X-Y direction but it is difficult to get Z direction which is distance of fruit on tree from robot.

The review is organized as follows: the model of agribot system is presented; related problems, design challenges are discussed in Section I. Related work is presented in section II. In section III proposed methodology is presented. In section IV, conclusion and set of remarks presented at the end of the brief.

II. RELATED WORK

Different methods that are used to implement agribot is presented below.

The robot which performs operation like soil, moisture testing, seeding, spraying pesticides, removes compost from the field is presented in [1], which also performs obstacles avoidance operation and metal detection in the path. The robot is controlled using cell phone using DTMF technique. Because of using DTMF technique it overcomes the range or distance problem of using Bluetooth or RF module which having limited working range.

Agribot integrated system which uses Wi-Fi to communicate between two robots is presented in [2], which perform activities like seeding, weeding, spraying of fertilizers and insecticides. It is controlled using Arduino Atmega2560 controller and powerful Raspberry pi minicomputer to control and monitor working of robot. It has hexapod body which can move in any direction as per required. It has ultrasonic proximity sensor to avoid the obstacles in the path, and underbody sensor system to detect that seed is planted or not. It can dig a hole in soil plant seed in it n cover the hole again with soil and necessary pre emergence fertilizers applies on it, and move on along with communicating with other robot near to it using Wi-Fi.

Command based self-guided digging and seed sowing rover, a sensor guided rover for digging, precise seed positioning and sowing has been proposed to reduce the human effort and also to increase the yield is presented in [3]. The rover's navigation is performed by remote guiding devices fortified with the positioning system. It uses Arduino Atmega2560 controller and ultrasonic radar sensor for obstacle avoidance. It is controlled using wireless module that can be control by PC/ TAB/ Mobile. It gives acknowledgement massage of seed tank empty or full to the farmer.

The agribot which perform only two operation is presented in [4], in that it performs operation like digging hole in field that is ploughing in the field and then planting a seed at a regular interval and cover the plough area with soil. To drop the seed stepper motor is used and to dig a hole spike wheel is used. The Psoc

controller from cypress is used to control all the operation.

The robot performing soil moisture test, Ph measurements, seeding and fertilizing using Arduino328 is presented in [5], live streaming to see the operation of robot the camera is mounted on robot, by live streaming it is possible to control the direction of it instead of making it path follower or line follower. The robot is controlled by remote which is connected through internet using Raspberry pi.

Up to this point only seeding and fertilizing techniques are discussed now we see about harvesting techniques. Motivation for the research is to decrease harvesting cost and increase the value of their product to the consumer. Conventional harvesting method is highly labor intensive and inefficient in terms of both economy and time. Machine harvesting systems are a partial solution to overcome these issues by removing fruits from the trees efficiently thus to reduce the harvesting cost to about 35-45% of total production cost.

An agribot which is unmanned aerial vehicle (UAV's), high speed image processing algorithms and machine vision techniques is presented in [7]. The techniques that have used in this paper reinforce the possibility of transforming agricultural scenario to modernity within given resources. It is basically a quadcopter empowered with vision for detecting mangoes on tree and cutting ancillaries. It could hover around the trees, detect the ripe mangoes, cut and collect them.

The approach has been applied for targeting fruits for robotic fruit harvesting. Efficient locating the fruit on tree is one of the major requirements for any harvesting system is presented in [9]. The fruit detection using improved multiple features based algorithm. Improved multiple features refers to an image processing algorithm that trained for efficient feature extraction.

III. PROPOSED METHODOLOGY

Proposed system requires IR sensors, Image processing, robotic arm and controller as main blocks for the design. Selection of Controller will be done on the basis of number required memory size, number of analog and digital input/output pins. Hence for system design controllers like ATMEL 8051, PIC and Arduino will be considered.

Depending upon number of peripheral used and memory size required for system design, system will be design using Arduino microcontroller as main control unit due to following design issues.

1. In ATMEL 8051 there is no provision of inbuilt ADC and if system demands ADC interface for any problem, there is a need to interface ADC externally. Due to which extra cost will increase.
2. In case of ARM processor, there is a provision for on chip ADC interface. As system demands limited number of resources, there will be the possibility of wasting number of unused resources.

3. Arduino has 54 digital input/output pins, 16 analog input pins.
4. It is possible to connect lily pads which are atmega328 controller to the arduino.
5. Cost is also an important aspect to consider for design.

Hence due to above mentioned points system will have to be implemented by using Arduino controller.

A. Proposed Block Diagram

Farming using agribot is major task to achieve. Proposed system will be totally based on it. Agribot deals more strongly with proper execution of task like human being. It also proper utilizes the resources available like seeds, fertilizers, there should be less wastage of things and complete the task in as minimum time as possible.
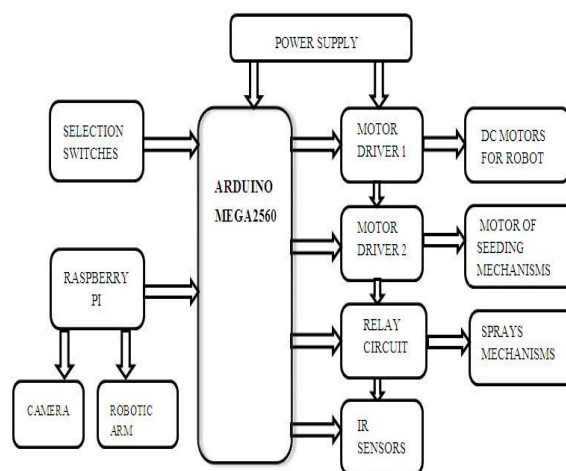

Fig. 1. Proposed system block diagram.

As shown in the Figure 1, a manual switches are used to control the robot action like for NPK measurement of soil, seeding, fertilizer spray, harvesting of on tree fruit. When the power supply is turned on the robot will be in idle mode it performs nothing till any one manual switch is pressed. As soon as the switch is-press the robot will perform the dedicated task-provided in the program. After the robot start performing the task at same time it can detect obstacles in the path of the robot using IR sensors. If any obstacle comes in the path then the robot will try to avoid that obstacle by changing the path but at the same time it continuously monitors any other obstacles in the path. The robot will follow only the dedicated path if there is no obstacle in the path.

CONCLUSIONS

This robotics agricultural machine is designed to facilitate the farmers to ease their work and increase the productivity with its multitasking working features such as automatic seeding system, automatic pest control unit, automatic compost spraying etc.

By developing this robotic vehicle with its multi-tasking agricultural features, it overcomes the difficulty of farmers in farming their land in every season no matter what is the weather that day. Considering all the situations, the robot integrated with different sub modules can be used for redemption and agricultural purposes worldwide especially countries like India where agriculture provides the principal means of livelihood for the major Indian population.

ACKNOWLEDGMENT

REFERENCES

[1] Amritanshu Srivastava, Shubham Vijay, Alka Negi, Akash Singh, "DTMF Based Intelligent Farming   Robotic Vehicle," International Conference on   Embedded Systems (ICES 2014), 978-1-4799-5026-3, IEEE 2014.

[2] Gulam Amer, S.M.M. Mudassir, M.A. Malik,   "Design and operation of Wi-Fi Agribot Integrated system", International Conference on Industrial   Instrmentation And control (ICIC), 978-1-4799-7165-7/15, IEEE 2015.

[3] M. priyadarshini, Mrs. L. Sheela, "Command based self guided digging and seed sowing rover",International Conference on Engineering Trends and Science & Humanities, ISSN: 2348 – 8379, ICETSH-2015.

[4] Akhila Gollakota, M. B. shriniva, "Agribot - a   multi-purpose agricultural robot," India conference (INDICON) 2011 Annual IEEE 978-1-4577-1110- 7, 1-4, IEEE 2011.

[5] Shivaprasad B. S., Ravishankara M. N.,B. N. Shoba, "Design and implementation of seeding and fertilizing agriculture robot", International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 3, Issue 6, June 2014.

[6] Karan singh, K. Agrawal, A. K. Dubey, M. P. Chandra, "Development of the controller based seed cum fertilizer drill", Intelligent systems design (ISDA) 12th Internal conference 978-1-4673-5119-5/12 IEEE 2012.

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

[8] Qingchun Feng,Xiaonan Wang, Guohua Wang, Zhen Li, "Design and Test of Tomatoes Harvesting Robot," International Conference on Information and Automation Lijiang, China, pp 949-952, IEEE 2015

[9] Hetal Patel, Dr. R. K. Jain, Dr. M. V. Joshi, "Fruit Detection using Improved Multiple Features based Algorithm," International Journal of Computer Application, Volume 13-No.2, IEEE 2011.

[10] Stefania Matteoli, Marco Diani, Rossano Massai, Giovanni Corsini, Damiano Remorini, "A Spectroscopy-Based Approach for Automated Nondestructive Maturity Grading of Peach Fruits", IEEE Sensors Journal, Vol.15, No. 10, October 2015.

[11] Audrey Guillet, Roland Lenain, Benoit Thuilot, Philippe Martinet, "Adaptable Robot Formation control", IEEE Robotics &Automation Magazine, March 2014.

[12] Narzu Tarannum, Md. Khalilur Rhaman, Sabbir Ahmed Khan, Shifur Rahman Shakil, "A Brief Overview and Systematic Approch for Using   Agricultural Robot in Developing Countries", Journal of Modern Science and Technology Vol. 3. No.1. March 2015. Issue. Pp. 88-101.

★★★