Autonomous Mobility Agricultural Robot

SS Karthik[1], Velkur Harsath Kumar[2], Shreeraj Halemane[3], Ruthvik Yadav[4]

[*1,2,3,4]*Formerly, Dept. of Mechanical Engineering, RNS Institute Of Technology, VTU, Bangalore, Karnataka, India*

Abstract - *India is an agriculture-based country in where, up to 70% of people depend on farming as their main source of income. Also economically, farmers are very poor due to which they cannot purchase tractors and other costly equipment hence they use the traditional method of farming such as bullocks, horses and he-buffalo for operations. This will not satisfy the need for energy requirements of agriculture as compared to other countries in the world. So, our thought process is that human and animal efforts can be minimized to a large extent by some advanced mobility solution which will be suitable for small scale farmers from both an economic and labour-efficiency perspective. Hence, we put forward this robot which will satisfy all such needs and solve the difficulties. In this project, we used a 12V motor for digging/ploughing operation, the next two operations are the manual base which is sowing (using a barrel with help of a motor and patterned openings) and levelling (a simple earth flattener where height can be adjusted). Overall, these functions are controlled by an Arduino Uno Controller with our indigenous programming, one can program it based on their needs and requirements. This machine performs three farming operations (digging, sowing & levelling) which are used in small scale farming. By using the above implements, one may perform various farming operations efficiently and economically. Also in the in the future the same technology can be implemented with a Solar Panel so it can recharge utilize the Solar Power and save traditionally produced electricity.*

Key Words: Autonomous Field Robots, Robotics, Embedded C Programming, Arduino Uno, H-Bridge Motor Control, Geared DC Motors, Agricultural Technology, Off-highway technology, Ploughing.

1.INTRODUCTION

In India generally, the conventional methods of seed sowing include use of an animal-drawn funnel and pipes driller/drilling with the help of a tractor a tractor. The first methods required lot of man power and a very time and energy-consuming. However, operators of tractor-based drilling equipment are subjected to significant noise and vibrations, which can negatively impact their health and productivity. At present, the primary focus in the development of autonomous field robots is on enhancing speed, improving energy efficiency, refining guidance sensors and their accuracy, and integrating advanced technologies such as wireless communication and GPS.

In the earlier decades agricultural technology was not developed well. Hence, they were seeded by hand. Since the technology is quite developed it's not required to do seeding in sunlight. By using robotic technology, one can sit in their comfort zone and perform seeding operation just by tracking the robot's motion.

The main reason behind the automation of farming processes is to save the time and energy required for performing repetitive farming tasks and increase the productivity of yield by treating every crop individually using the precision farming concept. Designing such robots is modelled based particular approach and certain considerations agricultural environment in which it is going to work. These considerations and different approaches are discussed in this paper. Ploughing the land and sowing the seeds are the primary operations in the plantation in Agriculture. The work replaces human power with robotic means. The idea behind this work is to make agriculture cost-effective by reducing the human intervention and fossil fuel. With this view, a multipurpose ploughing machine is designed and developed. This Robot will be very useful for agricultural purposes and very simple to construct.

1.1 OBJECTIVES

- •To create a prototype model first that can club ploughing, seeding and levelling.
- •To be used for peanuts, Toor dal, Ragi, Jowar, corn and other grain crops.
- •Minimize the engine emission near the fields and environment.
- •Implement autonomous technology for reducing as much human intervention as possible.
- •To create a vehicle that can alternate the purpose of a tractor comparatively at a lower cost.
- •Effective utilization of time and energy required for performing repetitive farming tasks and increase the productivity of the fields.

2. PROJECT METHODOLOGY

2.1 FLOW CHART

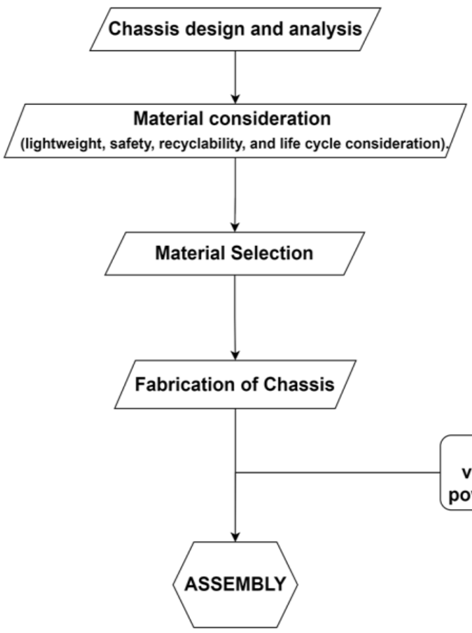

Fig -1: Flow-chart for Methodology

- The chassis design of the prototype model was made on Solid Works, AutoCAD and the electrical circuit layout design is done on diagrams.net.
- After considering our requirements and needs we have chosen mild steel due to the availability of the material in a thin sheet. The weld ability of rest of the parts to the frame is also a consideration that was taken into account.
- After planning and selecting the material, we move on to the fabrication stage of the chassis and the tools for the operations that are designed according to the requirements and constraints.
- By taking all the fabricated parts we assemble them as per the design.
- The electrical components are mounted on a cardboard according to the circuit layout. The connections to the components from the power source to the wheels are wired.
- Once the fabrication of the model and electrical connections is completed, then both of them are assembled and carried forward for testing of the prototype.

3. COMPONENTS

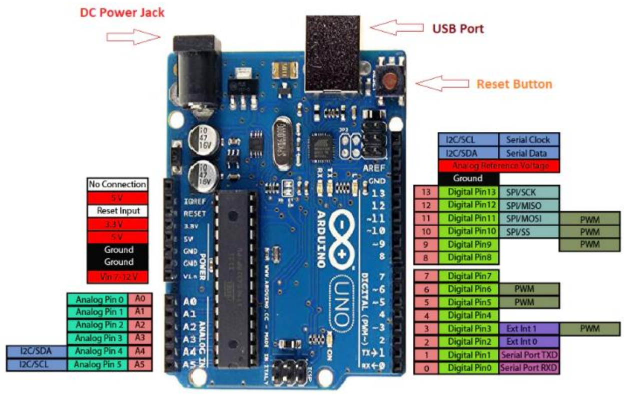

Fig -2: Arduino Uno Pin Allocations
Source: https://www.theengineeringprojects.com/

Component	Quantity	Spec-Sheet
Arduino Uno	1	5V-supply
H-Bridge	3	L298N IC
Power Supply (Battery)	1	12V DC, 7.5Ah
Ultrasonic Sensor	1	HC-SR04
Wi-Fi Module	1	ESP8266, 8 Pins
Geared DC motors	4	10RPM, 12V

a) **Arduino:** It is an open-source platform that provides both hardware and software for designing single-board microcontrollers and kits, enabling the creation of digital devices and interactive objects that can sense and control both physical and digital elements.

b) **H-Bridge**: With these control pins, we can manage the motor's direction, allowing it to move forward or backward. This is achieved by applying either a HIGH (5 Volts) or LOW (Ground) logic signal to the inputs, determining the motor's spinning direction.

c) **Power Supply**: The source of power we have selected here is a battery of 12 Volts and a capacity of 7.5 Ah.

d) **Ultrasonic Sensor**: It measures the distance of a target object by emitting ultrasonic sound waves, and then converts the reflected sound into an electrical signal which is understandable for the machine.

e) **Wi-Fi Module**: It includes a built-in TCP/IP protocol stack, allowing straightforward connection to a microcontroller for Wi-Fi network access. In our setup, this component facilitates communication between our remote (cellphone) and the Arduino controller

f) **Geared DC motors:** A geared DC motor consists of a motor and gearbox combined. The gearbox allows the motor to augment its torque output while decreasing its overall speed. Essential characteristics of a geared DC motor include its speed (in RPM) and voltage. In this instance, the DC motor possesses a 10 RPM speed and runs on 12V. Gear can be chosen based on need, matching the load to pull and usage it can be decided.

4. OPERATIONS INVOLVED

Note: Below mentioned operations are in the same sequence as in actual working. Also respective implements can be designed based on convenience and crop/field design.

1. **Ploughing Operation**: The upper arm of the ploughing tool is welded to the frame of the Robot. As the Robot moves forward ploughing takes place.

2. **Seed Sowing Operation**: The tool is used for dropping seeds into the soil. The seeds poured from the funnel that is connected to one side of the barrel, the other end is connected to the motor which rotates the barrel

3. **Levelling Operation:** The levelling tool is connected to back of the frame, which is used to level out the soil once digging is done following seed sowing.

Fig -3: Final robot

4. SUSPENSION IDEA FOR UNEVEN TERRAIN

Fig -4: Name of the figure

This model that we've fabricated is supposed to simulate an actual field work which is never flat and clean. The unevenness, ups and downs in a rough terrain of a farm needs a machine that has a proper Robot dynamic designed. So, to make our model to work on an uneven surface we have utilized the independent suspensions system

Working: The rod in the middle of damper (shown in fig 4.1) acts as displacing agent for the respective wheel/motor it is mounted to which is intended to help stabilize the robot when encountered with an obstacle in an agricultural field.

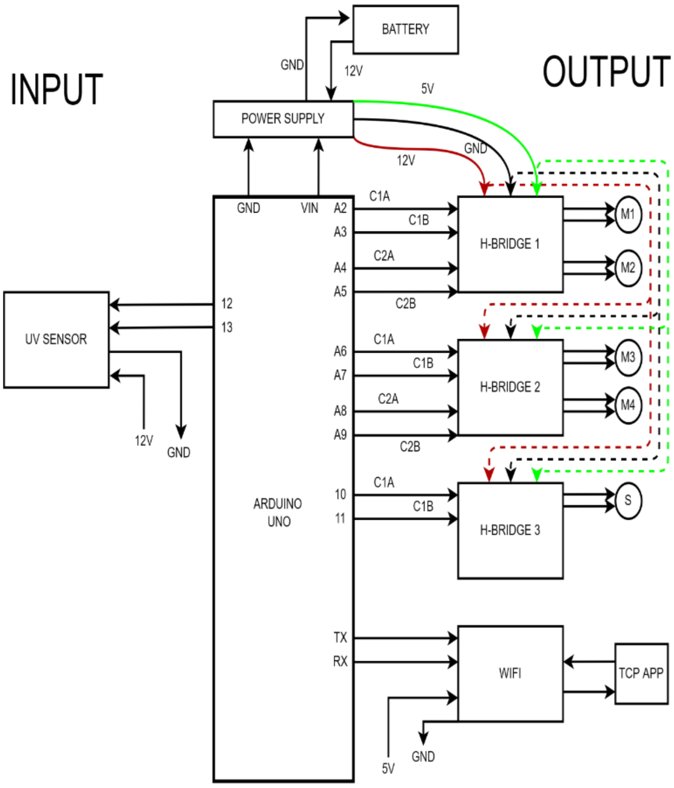

Fig -5: Terminal connection diagram

6. CONCLUSION

"Autonomous Mobility Agricultural Robot" was successfully completed along with trials in three agricultural operations that are ploughing, seeding and then leveling. We were able to bring it to life with the help of Embedded C programming on Arduino Uno. The robot will perform all the three operations autonomously on it's own with just a click of a button through an app on cellphone.

In the future, fully automated farms will allow robots to handle tasks such as mowing, fertilizing, pest and disease monitoring, harvesting, and tilling. This level of automation makes sure the farmer just supervises the operation rather than part taking in it. This robot can be slightly tweaked, i.e the base code/programming can be modified based on one's requirement for using it on different kinds of crop. Hence, it is a very practical robot which would definitely aid the farmers in this current generation.

This technology required less man power, lesser time and cheaper infrastructure/investment when compared to conventional methods, so if we produce them in a big scale the cost will decease very significantly and we aim that this project will help bring at least a small impact in the agricultural society.

Based on the overall performance of the machine we can definitely say that the project will satisfy the need of small-scale farmer.

7. REFERENCES

[1] K. Lakshmisudha, S. Hegde, N. Kale, S. Iyer, "Smart Precision Based Agriculture Using Sensors", International Journal of Computer Applications (0975- 8887), Volume 146, No.11, pp.36-38,2011.

[2] M. Ramu, CH. R. Prasad, "Cost effective atomization of Indian agricultural system using 8051 microcontroller", International Journal of Advanced Research in Computer and Communication Engineering, vol. 2, no. 7, pp. 2563-2566, 2013.

[3] Naga RohitGunturi, "Micro Controller Based Automatic Plant Irrigation System", International Journal of Advancements in Research & Technology, Volume 2, pp.1436- 1439, Issue4, 2013.

[4] S. R. Nandurkar, V. R. Thool, R. C. Thool, "Design and Development of Precisib on Agriculture System Using Wireless Sensor Network", IEEE International Conference on Automation, Control, Energy and Systems (ACES), 2014.

[5] M.K.Gayatri, J.Jayasakthi, G.S.Anandhamala, "Providing Smart Agriculture Solutions to Farmers for Better Yielding Using IoT", IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development,2015.

[6] M. Dwarkani, R. Ram, S. Jagannathan, R. Priyatharshini, "Smart Farming System Using Sensors for Agricultural Task Automation", IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development, 2015.

[7] D. Chaware, A. Raut, M. Panse, A. Koparkar, "Sensor Based Automated Irrigation System", International Journal of Engineering Research & Technology (IJERT), vol. 4, no. 05, pp. 33-37, 2015.

[8] R. Jain, S. Kulkarni, A. Shaikh, A. Sood, "Automatic Irrigation System for Agriculture Field Using Wireless Sensor Network (WSN)", International Research Journal of Engineering and Technology (IRJET), vol.3, no. 04, pp. 1602-1605, 2016.

[9] N. Gondchawar, R.S.Kawitkar, "IoT Based Smart Agriculture", International Journal of Advanced

Research in Computer and Communication Engineering, Vol.5, Issue 6, pp.838- 842, June 2016. [10] https://www.robotshop.com/media/files/pdf/arduinomega2560 datasheet.pdf

[10] M. Priyadarshini, L. Sheela, "Command Based Self-Guided Digging and Seed Sowing Rover", International Conference on Engineering Trends and Science & Humanities (ICETSH- 2015).

[11] Ankit Singh, Abhishek Gupta, AkashBhosale, SumeetPoddar, "Agribot: An Agriculture Robot", International Journal of Advanced Research in Computer and Communication Engineering Vol. 4, Issue 1, January 2015.

[12] N. Firthous Begum, P. Vignesh, "Design, and Implementation of Pick and Place Robot with Wireless Charging Application", International Journal of Science and Research (IJSR-2013).

[13] Buniyamin N., Wan Ngah W.A.J., Sariff N., Mohamad Z, "A Simple Local Path Planning Algorithm for Autonomous Mobile Robots", International Journal of Systems Applications, Engineering & Development Issue 2, Volume 5, 2011.

[14] Ms. Trupti A.Shinde , Dr. Jayashree. S. Awati, "Design and Development of Automatic Seed Sowing Machine", Journal for Scientific Research & Development.

[15] Suraj V Upadhyaya, VijayaVittalaGowda G, Poojith M B, Vikranth, "A Review of Agricultural Seed Sowing", International Journal of Innovative Research in Science, Engineering and Technology.