

# A Ground-based Multipurpose AG-RO

<sup>1</sup>Kashif Ahmed, <sup>2</sup>Shubham, <sup>2</sup>Shuvam Deb, <sup>2</sup>Abhishek N, <sup>3</sup>Deepak Kumar

<sup>1</sup> Assistant Professor, <sup>2</sup> Eighth Semester, <sup>3</sup>IAM  
<sup>1</sup>Department of Electrical and Electronics Engineering,  
<sup>1</sup>CMR Institute of Technology, Bangalore, India

**Abstract:** Since the early dawn of civilization, agriculture has been an intrinsic part of human life. When we look at the modern farming arena, we observe that this is rapidly changing. With the increased demand and rising production costs, farmers are looking for modern farming equipment's that could help them in cutting the cost and even reduce the labor hours. One such modern agricultural tool which is rising on horizon of agricultural advancements is an RF based Agricultural Robot (AG-RO). These Autonomous robots are creating abundant curiosity and driving some of the great enthusiasts for its development from different dimensions of engineering.

In this paper, we are implanting autonomous robotic machines to carry out agricultural tasks. This robot will be used to perform agricultural operations such as ploughing, seed sowing and water sprinkling. The objectives of the proposed system are to dig the soil, to plough the seeds and to provide irrigation system by spraying water with a pump automatically.

The robot constitutes of ARM controller along with a geared dc motor and an RF decoder for driving the motor, a remote which consists of an assembly of switch array to send signals for designated movement, a microcontroller, an RF encoder, a pump and water sprinkler arrangement. The RF modules used here are STT-433 MHz Transmitter, STR-433 MHz Receiver, HT12E RF Encoder and HT12D RF Decoder. The control switches are interfaced to the RF transmitter through RF encoder. The encoder continuously reads the status of the switches, passes the data to the RF transmitter which then transmits the data to the AG-RO.

**IndexTerms - AG-RO, STR-433, RF Modules, ARM, Sprinkler.**

## I. INTRODUCTION

The main motive for developing Agricultural Automation Technology is decreasing labor force, a phenomenon common in the developed countries. The reasons are the need for improved food quality, high yield, better efficiency at an effectively lesser cost and man hour. Robotics offer solutions with precision in agriculture to processes seeding, harvesting, weed control, grove supervision, chemical applications, etc. to improve productivity and efficiency [1]. The applications of instrumental robotics are spreading every day to cover further domains, as the opportunity of replacing human operators provides effective solutions with return on investment. When more conservative issues are granted by robotics, heavy chemicals or drugs dispensers, manure or fertilizers spreaders, etc. are activities more and more concerned by the deployment of unmanned options [2]. All kinds of agricultural robots have been researched and developed to implement several agricultural equipment's in many countries.

AG-RO can perform basic elementary functions like shoveling, seeding, sprinkling of pesticides or water. The application of agricultural machinery in agricultural activities has experienced an increase in investment and research due to the use of robotics applications in the machinery design and task executions [3]. 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. The multipurpose agricultural robots are designed to perform the basic functions required to be carried out in farms.

## II. LITERATURE SURVEY

The robotics fields are gradually increasing its productivity in agriculture field. Some of the major problems in the Indian agricultural are rising of input costs, accessibility to skilled labors, lack of water resources and crop monitoring. To overcome these problems, the automation technologies with robots can be used in agriculture. The automation in the agriculture could help farmers to reduce their efforts. The robot is controlled using remote using RF frequency module [1]. The advantage of using RF frequency is that it can penetrate most solids and pass through walls, long range and not sensitive to any environmental change and weather condition [5].

Robot is controlled using ARM controller. It has square body which can move in any direction as per required. It can shovel the soil plant seed in it cover with soil and necessary pre-emergence fertilizers or water can be sprinkled. 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 to increase the yield [4]. The AG-RO's navigation is performed by remote guided by user. It uses ARM controller and RF module along with geared motors. It is controlled using wireless module that can be control by its remote [3]. To drop the seed a geared motor along with hollow cylindrical container with pores is used and to shovel metal or wooden spikes are used which can be moved in vertical directions to determine the depth of shoveling depending on the requirement of seeds. Motivation for the research is to decrease harvesting cost and increase the productivity. Conventional harvesting method is highly labor intensive and inefficient in terms of both economy and time. Machine harvesting systems by robot are a partial solution to overcome these issues [1]. Thus, reduce the harvesting cost to about 35-45% of total production cost.

### III. PROPOSED SYSTEM

The proposed system focused on the design, development and the fabrication of the multipurpose agricultural robot with irrigation system in addition to ploughing and seeding. The multipurpose agricultural Robot is used to control the three functions like digging the soil, seed sowing, and water spraying with least changes in accessories through RF module without affecting cost. The block diagram of the proposed model is shown in Fig.1 and Fig.2.

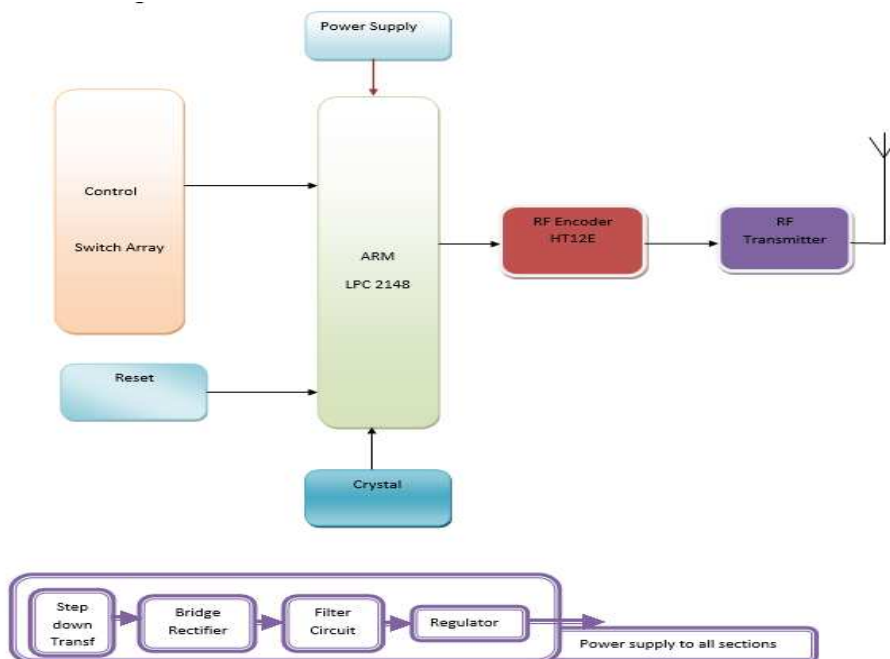


Fig.1. Block Diagram of Transmitter

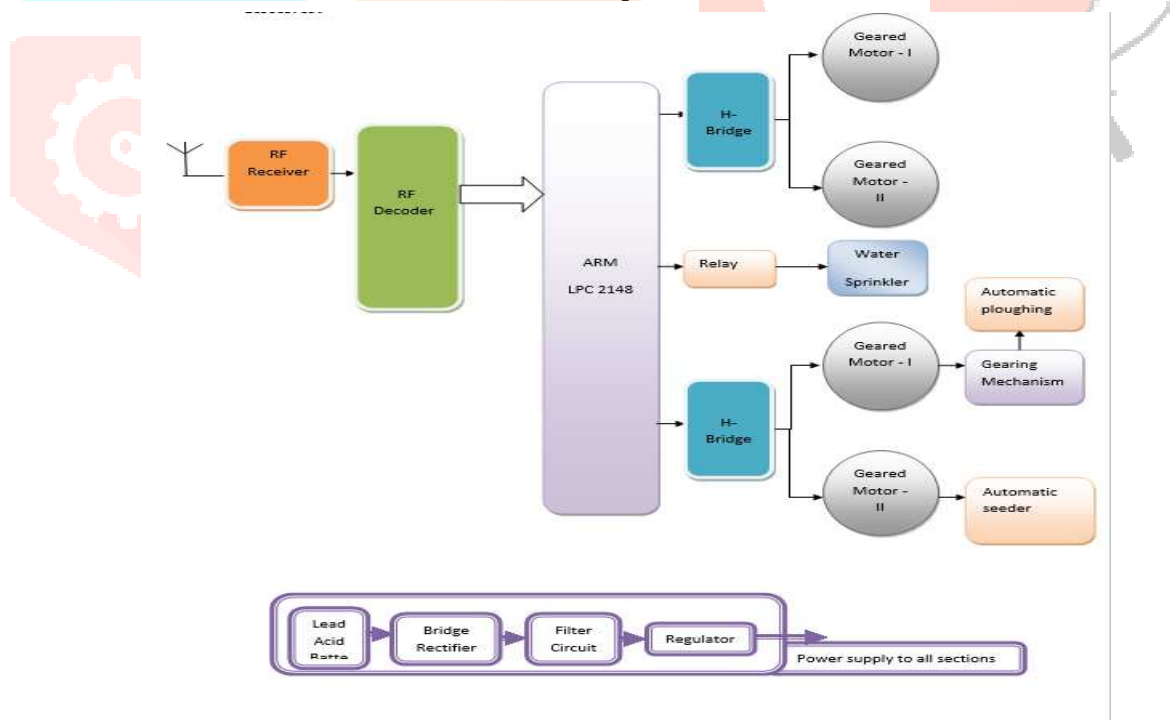


Fig.2. Block Diagram of Receiver

### IV. HARDWARE MODEL

The whole system of the robot works with the battery. The robot requires 12V battery to operate the system. The base frame consists of 4 wheels connected to four arms and the rear wheel is driven by DC motor. One end of the frame, cultivator is driven by dc motor which is made to dig the soil. The seeds are released from a rotating hollow cylindrical storage driven by DC motor. A leveler is made to close the seeds and water pump sprayer is used for sprinkling the water. A remote with RF module is used to control the entire operation of robot for ploughing, seeding and irrigation systems. The Heart of the proposed

system is ARM controller. RF module, DC motors, relays are interfaced to the ARM controller to provide various operations like Ploughing, seeding, water spraying. The entire mechanism of the system is controlled by remote controller with RF module. The wireless communication of RF module enables the robot to move in four directions as front, back, right and left. Various commands can be used to move robot into forward, reverse, stop, left, and right. The microcontroller in the proposed model enables various functions in the field according to the commands received from remote.

The front view and top view of prototype model is shown in Fig. 3. The functionality of the prototype model has been controlled with the help of relay switch to power up robot through 12V battery.

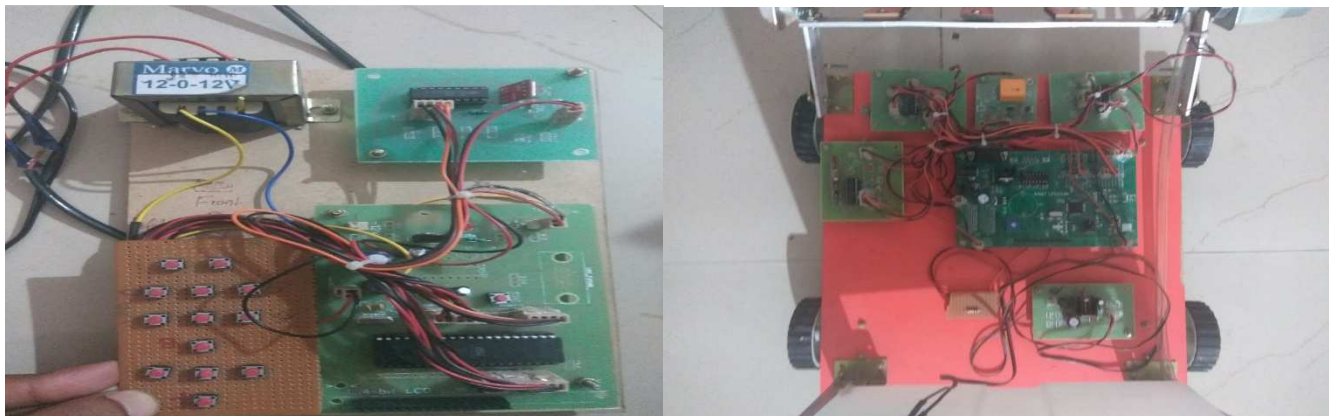


Fig. 3 Top and front view of the prototype model

#### 4.1 Ploughing

The primary purpose of ploughing is to turn over the upper layer of the soil, bringing fresh nutrients to the surface, while burying weeds and the remains of previous crops and allowing them to break down. In the prototype model shown above, a DC Motor coupled with the screw rod is used for ploughing the farm. As the screw rod rotates, the nut welded to the cultivator slides between the screws of the rod. Then the cultivator is lowered down and the soil is dug up to 1.5 inches. The direction of the cultivator can be controlled by the remote.

#### 4.2 Seed Sowing

Seeding is putting seeds in the soil. In the prototype model shown above, a cylindrical container is used for Seed storage and is arranged to sow the seed based upon command given by the user with the help of DC motor. The rotational movement of the container forces seeds to fall from the container on to the field.

#### 4.3 Irrigation

Irrigation is the method in which a controlled amount of water is supplied to plants at regular intervals for agriculture. In the prototype model shown above, motor coupled with relay switch is used for water pump to spray the water in the field.

ARM controller is used to control various operations of proposed system. Port1 and port0 of ARM controller are used to control ploughing, seeding, leveling and water spraying through motor drivers of robot.

The hardware design resulted in interfacing RF module, DC motors, ploughing system, irrigation system and seeding to ARM controller through motor drivers. The software part includes developing and testing with the support of Flash-magic for movement of wheels, ploughing, seeding, leveling and water spraying functions. Embedded C program is developed for ARM

controller to control the above operations. RF modules of Transmitter STT433 and Receiver STR433 with the pin diagram of ARM controller are shown in the Fig. 4 and Fig. 5. The technical specifications are given in Table 1.

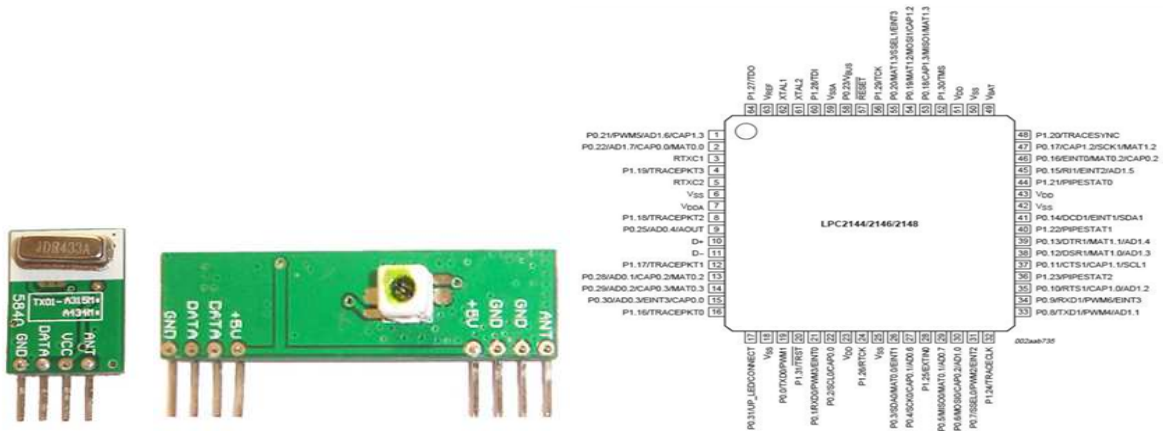


Fig. 4 Transmitter STT433 and Receiver STR433 Fig. 5 Pin Diagram of ARM LPC2148

Table 1: Technical Specifications

Domain	Embedded
Software	C, Keil, Proload
Power Supply	+5V, 500mA Regulated Power Supply
Communication Device	RF Module
Transmitter	STT – 433MHz
Receiver	STR – 433MHz
H Bridge	L293D
ARM	LPC2148
DC Motor	Geared 60 RPM

**V. RESULTS**

In this project we have studied and implemented a RF based farmer friendly AGriculturalRObot (AG-RO) with motorized shovel control system including automatic seed dispensing. The AG-RO has been successfully tested for various functions like ploughing, seeding and water spraying. It was developed by integrating agricultural robot with embedded C programming. Various parameters like soil condition, area covered by the robot and weight of the material for leveling are analyzed for different motors. The advantages of multipurpose agricultural robots are reducing human intervention, ensuring proper irrigation and efficient utilization of resources. In future, it can be extended by coupling AI to test the condition of soil and type of seed. It can also be coupled with real time information of weather forecast and machine learning. It can further asses the crop type according to soil assessment and send the same information to the agricultural development authority to increase the productivity.

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