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Automatic Seed Sowing and Moisture Control Using ARM Controller

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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 labour work. The qualitative approach is to develop a system which minimizes the work of farmer and also reduces the time for seed sowing operation, digging operation and water wastage. Moisture level indicator is important which helps for water saving. A soil sensor is used to measure the moisture level in the soil and is sent to the ARM controller. The robotic system developed is completely automatic, which reduces the farmers work.

KEYWORDS: ARM controller (LPC2148), YL-38, seed sowing, L293D, agriculture robot.

I. INTRODUCTION

Before independence production and productivity of crops were quite low. The production was not sufficient to feed the Indian population. The country used to import them in large quantities for fulfilling the needs of our people from many countries. The reason for low production and productivity were unavailability of machines in the cultivation field. In India most of the farming work is done manually when compared with other countries. There were no machines for sowing the seeds and it is done by man power only. The cost spent for man power was more and the speed of the operation was very less. In the present scenario, most of the cities in India do not have sufficient skilled man power in agricultural sector and that affects the progress of developing country. Therefore farmers have to use upgraded technology for cultivation activity. Seed sowing machine developed so far are operated manually or there is no smartness of work done by it except seed sowing. Manual method includes broadcasting the seeds by hand. A pair of bullocks is used to carry the heavy equipment of levelling and seed dropping. The energy needed for robotic machine is less as compared with other machines like tractors or any agriculture tools. The main application area of robots in agriculture is at the harvesting stage and seed sowing stage. Sowing and growing periods of crops are different [1]. It also performs digging operation. Seed sowing has to be done in a proper path in the field [2]. Driverless robots are designed to replace human labour. The cost of the robot is less. Water is the main source in the agriculture field. The required amount of water has to be used due to this water wastage can be reduced. When the moisture level is less, it is sensed by soil moisture and signal is sent to the controller. It is easy to maintain, time required for seed sowing is also less. There are different types of sensors can be used for the measurement of soil humidity. Hygrometer is also used as the soil moisture sensor [3]. The hygrometer has both digital and analog outputs. But it cannot change with the rapid variations in the temperature. Stevens HydraProbe II is the soil moisture sensor, but the disadvantage of this is in stony area it does not work properly [4]. Hence to avoid this agriculture robot is developed. The agriculture robot developed in this project performs seed sowing and sensing the moisture content in the field and digging operation.

This paper is organized as follows. Introduction and literature survey is explained in section I. Section II gives the theory related to the seed sowing. Section III delivers the system design and hardware components and section VI gives the working principle of agriculture robot. Section V deals with experimental result obtained. Section VI delivers the conclusion.

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II. THEORY of SEED SOWING

Many seed sowing methods are used in the agriculture field. They require man power and are cost effective. Using agriculture robot cost is reduced and human requirement is also less. In many states seed sowing is done manually. Opening the furrows by plough and sowing the seeds in that furrows. Seed dropping is done by hand or using the bamboo/meta funnel attached to the plough to sow in the smaller area. Hence traditional seed sowing method has limitations like seeds are not uniformly distributed in the field. So the human requirement is more. During kharif season placement of seeds at uneven depth may result in poor emergence of seed. After seed sowing water has provided on the field. If excess water is poured seeds may go along with the water. So there is wastage of water. Hence soil moisture sensor has to be inserted in the field. The main purpose of developing agriculture robot is to perform seed sowing operation and maintaining moisture level in the field.

III. SYSTEM DESIGN and HARDWARE

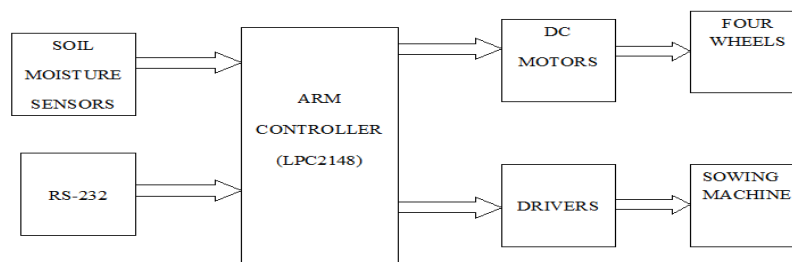


Figure.1 Block diagram of the agriculture robot.

The block diagram of agriculture robot shown in figure 1, consists of soil moisture sensors, RS-232, DC motors, chases, wheels, ARM controller (LPC2148), funnel are used. All the hardware components are placed on 16cm Length, 12cm width chassis. Features of all the hardware components are explained below.

A. ARM Controller(LPC2148)

The LPC2148 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 KB to 512 KB. ARM has 8KB to 40KB of on chip RAM, 32KB to 512KB of on chip flash memory 128bit wide interface/accelerator enables high speed 60MHz operation. Two 10 bit ADC provides 14 analog inputs, with conversion time as low as 2.44micro seconds per channel. Single 10 bit DAC provides variable analog output. Multiple serial interfaces including two UARTs (16C550), two fast I2C bus (400 Kbit/s).Upto 45 of 5V tolerant fast general purpose I/O pins. Upto 21 external interrupt pins available. Power saving modes includes idle and power down.CPU operating voltage range of 3.0V to 3.6V with 5V tolerant I/O pads [5].

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Vol. 6, Issue 6, June 2017

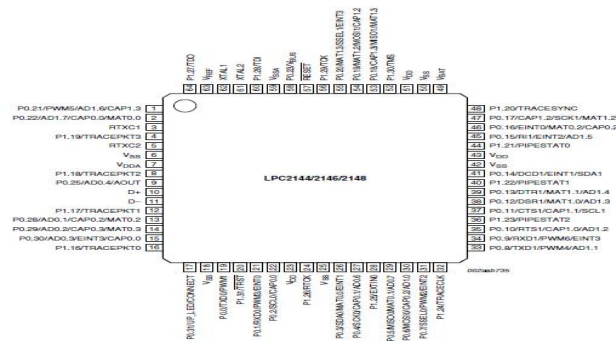


Figure.2 Pin configuration of ARM controller

B. DC MOTORS and MOTOR DRIVER

DC motors of 12V, 7.5A and 60 rpm is used in the project. The L293 and L293D are quadruple high-current half-H drivers. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. L293Dis designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high current/high-voltage loads in positive-supply applications [6]. L293D is used to drive the DC motor.

Table I
DIRECTION OF DC MOTOR

Direction	Input A	Input B
Forward	High	High
Clockwise	Low	High
Anticlockwise	High	Low
Reverse	High	High
Stop	Low	Low

Table I delivers the behaviour of the DC motor for various input conditions. The DC motors are attached to the two wheels, when the input commands are given the robot moves forward, reverse, clockwise (right), and anticlockwise (left).

C. Soil Moisture Sensors

YL-38 Soil Moisture Sensor is used to measure the moisture level in soil. It is widely used for performing experiments in courses like soil science, environmental science and botany. The YL-38 ranges from 0 to 45% volumetric water content in soil. It operates on 3mA at 5V DC. Its operating temperature is from -40⁰ to +60⁰ C [7].

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 6, Issue 6, June 2017

D. Servomotor



Figure.3. Connection of servomotor

A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analog or digital) representing the position commanded for the output shaft. The motor is paired with some type of encoder to provide position and speed feedback [8]. Servomotor pin connection to ARM board is shown in figure 3.

E. Seed Sowing Mechanism

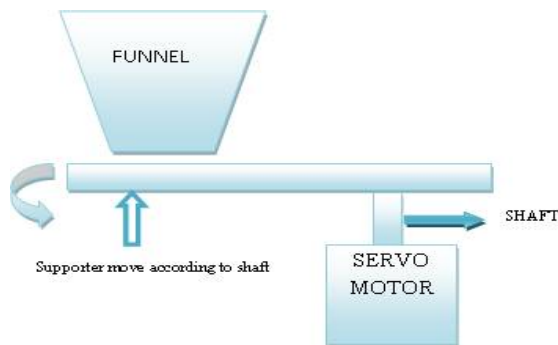


Figure.4. Servomotor mechanism

Figure 4 shows the seed sowing mechanism. For seed sowing application servomotor is used in this proposed system. Servomotor is a simple electrical motor. When the shaft of the servomotor turned by required degree which is attached to the funnel containing seeds, seeds fall when shaft opens.

F. Voltage Used by Different Modules

TABLE II
POWER SUPPLY REQUIRED FOR DIFFERENT MODULES OF THE SYSTEM

Different modules of the system	Voltage(V)
ARM board	12
ARM CONTROLLER (IC)	5
To run Dc motors	12
Enable driver circuit	5
Servomotor	3.3

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Vol. 6, Issue 6, June 2017

Table II delivers the power supply required for different modules of the system.

IV. WORKING PRINCIPLE

The two wheels of robot are connected to the DC motors and other two wheels connected at the front without DC motors. These all are connected to the chases. For the proper growth of the plants moisture has to be maintained. This is done by using the soil moisture sensor (YL-38).

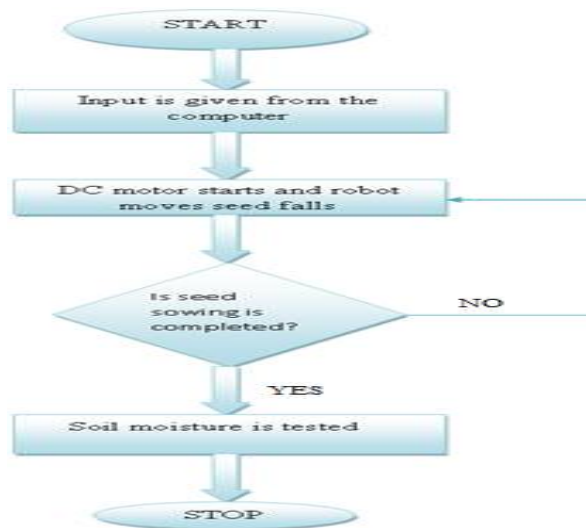


Figure.5. Flowchart of the agriculture robot working.

Agriculture robot is started with giving the supply and input is given from the computer. Input given to the robot are L (left), R (right), F (forward), B (reverse). According to these commands robot moves in left, right, forward or reverse direction. When it is moving in the forward direction it moves for three seconds then servomotor activates and the seed falls on the ground. Thus the seed sowing is done. UART is used for sending the data. After completion of seed sowing soil moisture sensor is used as shown in figure 5.

V. RESULTS

The proposed system gives low power, low cost and compact system with efficient output.

Table III

RESULTS OF SEED PLACEMENT

Placement of seeds by agriculture robot (Distance between two seeds)	Farm land	Grassy Land	Hard surface
Jowar seed	10cm	12cm	11.5cm
Soybean seed	5.5cm	5.3cm	5cm
Wheat seed	10cm	9cm	9.7cm

International Journal of Innovative Research in Science, Engineering and Technology

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Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

Table III shows the placement of seeds in three different contours effectively. The robot moves according to the input given. Baudrate is set to 9600. Simulation result shown in figure 6,7,8,9 explains the movement of robot in four direction.

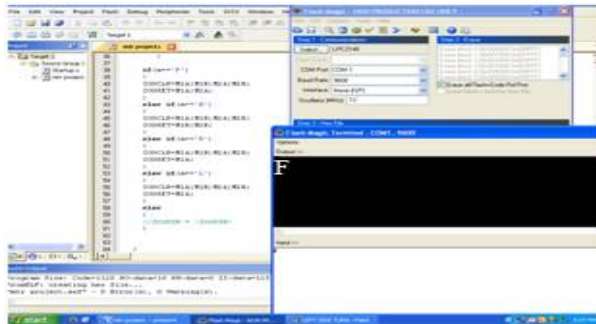


Figure.6. Robot moves in forward direction

Figure 6 explain that robot moves in the forward direction for three seconds and stops, at that time servomotor works, when the input command 'F' is given to the robot and process continuous. Digging is done along with this operation only.

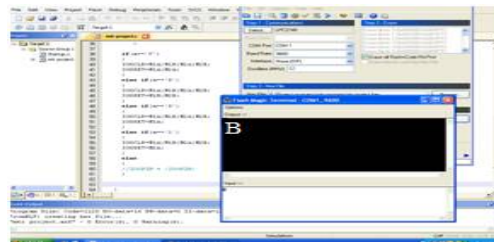


Figure.7 Robot moves in reverse direction

Whenever robot has to move in reverse direction, input command 'B' is to be given and robot moves in reverse direction till the distance required by the user as shown in figure 7. Here seed sowing and digging operation is not done.

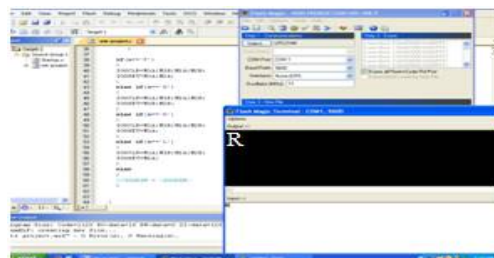


Figure.8. Robot moves in right direction

From figure 8, to move the robot in right direction 'R' command has to be given to the robot. Here seed sowing and digging operation is performed

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Vol. 6, Issue 6, June 2017

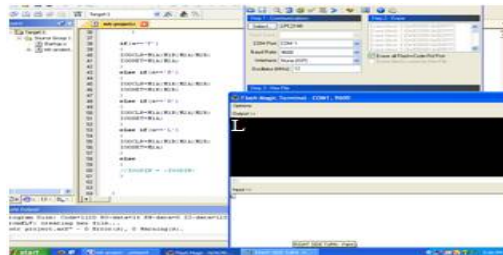


Figure.9. Robot moves in left direction

To move the robot in left direction 'L' command is given as shown in figure 9. Required distance it can be rotated by the user. While moving seed sowing and digging operation is not performed. Hence it can be controlled in all four directions.

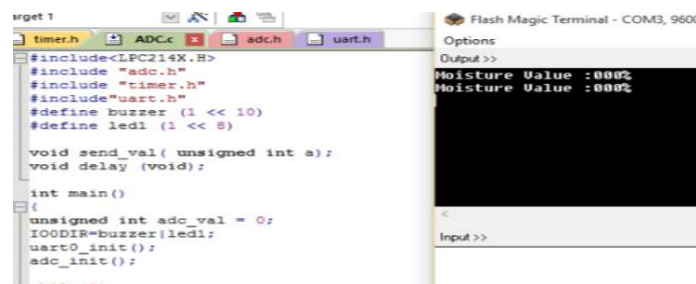


Figure.10 No moisture content in the soil

Figure 10 gives the percentage of water content in the field. It is observed during the working of sensor, there is no water content in the field, and it is dry. Hence the output is shown 0%. Then farmer has to supply the water to the field. This helps the proper growth of crops.

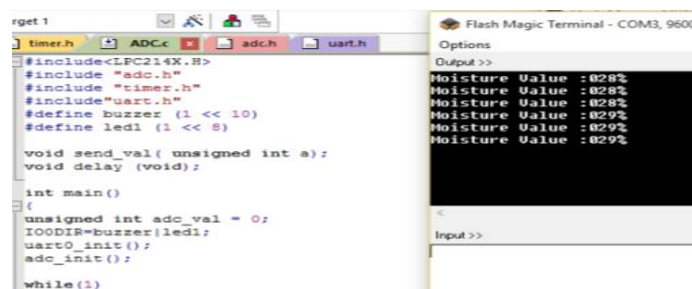


Figure.11. Moisture content present in the soil

Figure 11 shows that the presence of water in the field. The system is programmed in such a way that if water content is below 10% farmer has to supply the water to the field. When required amount of water is supplied to the field sensor senses and gives the indication to farmer.

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Table IV

Measurement of moisture content in the soil

Amount of water in the soil (ml)	Moisture content in the soil
5	15%
10	24%
15	33%
20	41%
25	48%

Table IV shows that amount of water used and moisture percentage. The system is validated for the moisture content in the soil, by taking 100gms of soil in a container and water is poured in the increment of 5ml. Thus the moisture percentage can be found.



Figure.12 Top view of a agriculture robot

Figure 12 shows the top view of the agriculture robot. ARM controller, servomotor, DC motor driver are placed on the chassis.

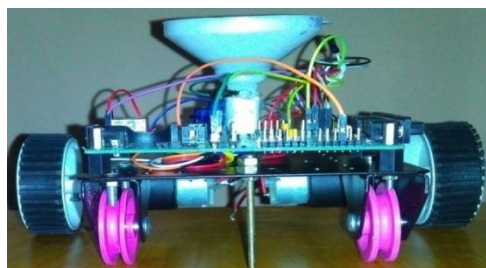


Figure.13. Front view of the agriculture robot

Front view of the agriculture robot is shown in figure 13. DC motors and wheels are attached to the chassis. For digging equipment is also attached at the front.

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(An ISO 3297: 2007 Certified Organization)

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Vol. 6, Issue 6, June 2017

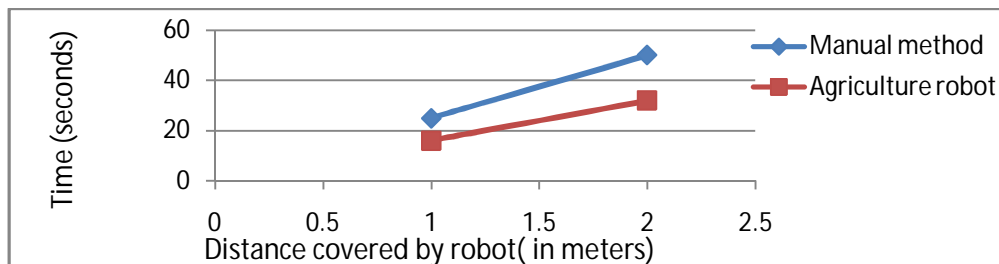


Figure.14. Graph of comparing seed sowing methods

Figure 14 shows the distance covered by the robot during seed sowing. It is observed that to cover one meter of distance it takes 16 seconds and manual method takes 25 seconds. By comparing the time taken by robot and manual method 21% of the time is saved for the farmer.

VI. CONCLUSION

For more production of food farmer has to work a lot in the field. To reduce the farmers work, agriculture robot has been developed. The system developed is compared with the manual method. It does the seed sowing, digging and measuring the moisture content in the soil. The robot is designed for movement in forward, reverse, right and left. So that entire field can be covered. The Cost for the robot is less. It is observed that 21% of time reduced for seed sowing. It costs around Rs.8000/-. Moisture content in the soil is measured. As per the requirement farmer has to supply the water to the field. The water can be saved.

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