HEXA FARM BOT

Arnold Sachith A Hans
B.E VIII MT Student, The Oxford College Of Engineering, Bangalore, INDIA

Mohit Bansal
B.E VIII MT Student, The Oxford College Of Engineering, Bangalore, INDIA

Nitin
B.E VIII MT Student, The Oxford College Of Engineering, Bangalore, INDIA

Robsom Jani Shikari
B.E VIII MT Student, The Oxford College Of Engineering, Bangalore, INDIA

Abstract : In the present world farmers have been facing problems in the field of agricultural activities such as irrigation, ploughing, providing the right amount of manure to crops and the removal of the weeds. All these problems could be solved by using this bot. The bot is provided with the ploughing mechanism to plough the field, it has a wireless connection with the irrigation system of the field where the bot checks the moisture content and simultaneously signals are given to the irrigation system of the field, manure and fertilizers are provided to the crops and the weeds are removed mechanically by the robot. The live video streaming of the activities done can be accessed using internet. This bot can connected to the internet and can be controlled from anywhere around the world, the activities performed by the bot is updated to the farmer periodically. Farmers can use this bot and can involve himself in some other activity like bee keeping, poultry, dairy farming etc; due to which his source of income can be increased which results in the overall development of the economy of a country.

Keywords: *farming, GSM, arduino, ploughing, irrigation, removal of weeds.*

I.INTRODUCTION

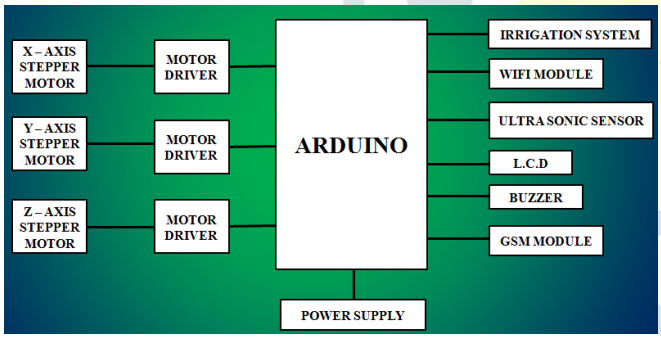
Agriculture, the backbone of Indian economy, contributes to overall economic growth of the county and determines the standard of living for more than 50% of the Indian population. Agriculture contributes only about 14% to the overall GDP but its impact is felt in the manufacturing sector as well as the services sector as the rural population has become a significant consumer of goods and services in the last couple of decades. Nearly 80% of the 140 million farming families hold less than two acres of land.

Large land holding enables the farms to implement modern agricultural techniques and boost productivity. Small landholdings restrict to use the traditional methods of farming and limit productivity. To overcome this Hexa Farm bot can be used in both large lands and small lands which can increase productivity in both cases. The agriculture records the domestication of plants and animals and the development and dissemination of techniques for raising them productively. Agriculture began independently in different parts of the globe and included a diverse range of taxa. The project is a response to the 60% increase food production needed due to the growth in world population to between 7-9 billion by 2050 and the potential of precision agriculture to reduce the environmental impacts of farming by reducing water use, energy and time required to grow crops. Hexa Farm bot is a precision agriculture CNC farming project consisting of a Cartesian coordinate robot farming machine and other electronic components. The project aims to "Create an open and accessible technology aiding everyone to grow food and to grow food for everyone".

Lack of proper of understanding of the need to grow crops sustainably will push farmers into a vicious circle – of debts, heavy use of fertilizers, water mismanagement, low productivity and thus more debts for the next cycle. All these problems can be solved with the help of one bot called "Hexa Farm Bot".

II.METHODOLOGY

The Hexa-farm bot can perform almost all processes prior to harvesting including ploughing, sowing, mechanical weed control, watering, providing manure/fertilizer and ensuring the safety of the crops from the external predators. It is a Cartesian coordinate robot farming machine which has X, Y and Z axis motions for the working of the bot during farming. The robot is provided with the NEMA 17 stepper motor in each and every axis i.e. there are three different motors for each and every axis respectively. Initially if we want the motion in the X axis then the motor which belongs to the X axis has a movement in that respective axis and the same is applicable for the Y and Z axis. Consecutively two/three motors can be made to work at the same time for better precision and the time required to complete a process can be minimized. There are different tools for different operations which is placed at one corner end of the farming machine, the (x,y,z) dimensions for the different tools are as follows ploughing tool (0,0,0), seeds container for sowing (1,0,0), mechanical weed control tool (2,0,0), watering tool (3,0,0), manure/fertilizer tool (4,0,0). All the information regarding the location of the tools in the field is fed to the microcontroller /microprocessor of the bot while it is programmed. The accurate pick and drop of the tools is performed by the stepper motors as per the programming done. Initially when we manually give the signal to plough the bot moves on to pick up the ploughing tool which is placed
at (0,0,0) at the end of the tool there is a locking mechanism provided which is aided by servo motor, when the bot tool end reaches the desired position the servo motor gets activated which rotates 90 degree and locks the ploughing tool to the tool end. Further the bot proceeds with the ploughing mechanism which is pre-programmed by keeping in mind the required distance to be maintained between two rows of the crop. After the ploughing is done automatically the bot moves on to perform the sowing operation again the same locking mechanism is used as explained above, now the seeds are sown at the pre-programmed regions of the field accurately so basically the bot knows where exactly the seeds are sown in the field. The robot moves on with the watering operation, here the watering tool is specially designed where the tool consists of the moisture sensor and a water pipe through which the watering is done. Only the required amount of water is fed to each and every crop this can be achieved by continuous monitoring of the moisture sensor while the watering operation is performed.



At the first cycle all the three operations are performed and the data such as date and time at which the operations are performed and saved in the memory of microcontroller/micro- processor. Next the same cycle which includes watering is performed as per the needs specified by the user or as per the data provided to the processor regarding the crop. Once the ploughing and sowing seeds is done the bot in the next cycle proceeds only with the watering operation. The weed removal is done once in a week. For the weeds removal a specialized weeds removal tool is attached to the tool end by the above mentioned process. In the process of weed removal our bot aims at removing the weeds which are grown in between the rows of crops. The weed removal tool moves in between the rows of two crops eliminating all the weeds grown. By this technique we can eliminate 60-70% of the weeds growing in the field. Therefore once in a week after the watering operation is performed the weeding operation takes place. The amount of manure/fertilizer required for the crops is fed to the processor and accordingly the same is fed to the crops at regular intervals. We have used the ultrasonic sensors (HC-SR04) for the detection of the physical movements happening between the boundaries of the field.

In our bot we are placing the ultrasonic sensor at all the edges of the field. When practically examined each sensor can detect the physical movements up to 40cm. So placement of two ultrasonic sensors facing opposite to each other are done at the edges of the field which safeguards the field by monitoring the unusual movements happening during night time or in the absence of the farmer. This safeguarding system is fully controlled by the farmer biometrics. The farmer has the full authority to activate and deactivate the safeguarding system. When an unusual movement is found by the system an SMS is sent to the farmer using GSM system and an alarm sound is activated to scare away the predators from the field. Whenever the farmer is working inside the farm to perform the harvesting process the system can be deactivated through his biometrics by placing his finger at the fingerprint sensor which is placed at the controller end. All these operations can be performed manually and if the above process is adopted in an automated environment then the entire system is connected to the internet and the bot is updated regarding the weather climate, date, day and time and accordingly various processes are carried out. The Cartesian co-ordinated system based farming gives the precision of the work done. For the automated process the farmer can communicate to the bot using internet or by sending an SMS through the GSM module. The power consumed for the operation is too low and is beneficial for the farmers who stay in the rural areas. For the continuous working of the system a backup battery is provided as a power source.

III.COMPONENTS USED

1. ARDUINO UNO

Fig: Arduino Uno microcontroller

Arduino Uno is a microcontroller board developed by Arduino.cc and based on

Atmega328. Microcontrollers are widely used in embedded systems and make devices work according to our needs and requirements. Arduino Uno is a very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6 analog pins, and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins. It is an open-source platform, means the boards and software are readily available and anyone can modify and optimize the boards for better functionality. The software used for Arduino devices is called IDE (Integrated Development Environment) which is free to use and required some basic skills to learn it. It can be programmed using C and C++ language.

2. ULTRASONIC SENSOR

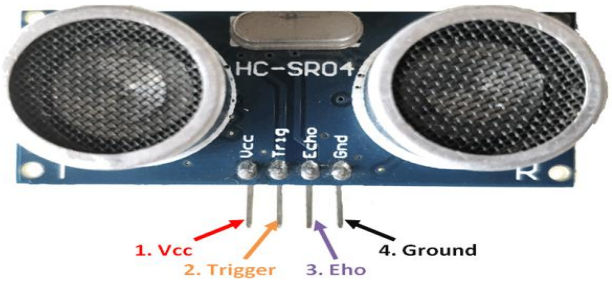


Fig : Ultrasonic sensor

The HC-SR04 Ultrasonic (US) sensor is a 4-pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module.

3. STEPPER MOTOR

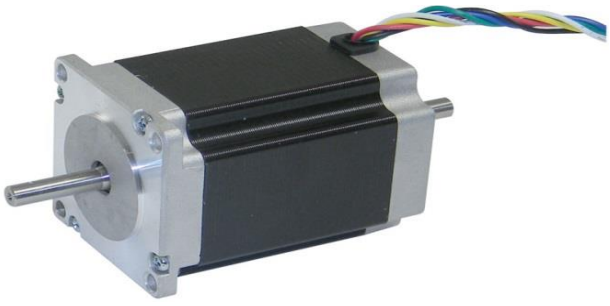


Fig: Stepper motor

A stepper motor or step motor or stepping motor is a brushless DC motor divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed. In Hexa farm bot we have used 3 set of NEMA 23 dual shaft bipolar stepper motor so that the robot can move in Cartesian coordinate that is X, Y, Z linear axis.

4. MOTOR DRIVER (TB6560) :

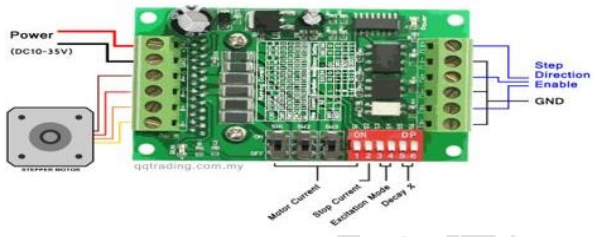


Fig: Motor Driver (TB6560)

A motor driver is a circuit which is used to drive or run a motor. In our project we have used TB6560 motor driver to run NEMA 23 dual shaft stepper motor.

5. SOIL MOISTURE SENSOR

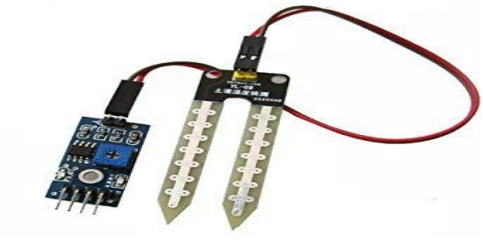


Fig: Soil Moisture sensor

The soil moisture sensor consists of two leads that are used to measure volume of water content in soil. These leads allow the current to pass through the soil and in return calculate the resistance value to measure the moisture level. If there is more water in soil then soil will conduct more electricity, means less resistance value along with high level of moisture. In the same manner if there is less water in soil then soil will conduct less electricity, means high resistance value along with low level of moisture.

6. SUBMERSIBLE WATER PUMP

Fig: Submersible water pump

A submersible pump, also called an electric submersible pump, is a pump that can be fully submerged in water. The motor is hermetically sealed and close-coupled to the body of the pump.
A submersible pump pushes water to the surface by converting rotary energy into kinetic energy into pressure energy. This is done by the water being pulled into the pump: first in the intake, where the rotation of the impeller pushes the water through the diffuser. From there, it goes to the surface.

7. L293D MOTOR DRIVER

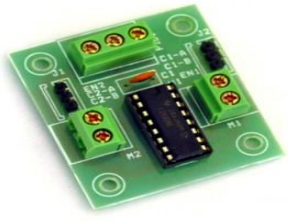


Fig: Motor driver

A motor driver is an integrated circuit chip which is usually used to control motors in autonomous robots. Motor driver act as an interface between Arduino and the motors. The most commonly used motor driver IC's are from the L293 series such as L293D, L293NE, etc. These ICs are designed to control 2 DC motors simultaneously. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor. We will be referring the motor driver IC as L293D only. L293D has 16 pins. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively. Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

IV.CONCLUSION

This project aims at providing technological affordability for the farmers so that it is affordable to them at a very low price and it is beneficial in several ways. This bot is aimed to solve at least 70% of overall farmer's problems. It is undergoing a process of transition to a market economy, with substantial changes in the social, legal, structural, productive and supply set-ups, as is the case with all other sectors of the economy. The physical man power required is minimized especially for the weed removal activity. An attempt is made to save the water which is a precious source on earth.

V.REFERENCES

[1]. Shibusawa, S., Precision farming approaches for small scale farms. Proceedings of 2"d IFAC-CIGR Workshop on Intelligent Control for Agricultural Applications, 22-24 Aug., Bali, Indonesia.
[2]. Shibusawa, S., Community-based precision pp.22-27, 2001.farming for small farm agriculture, Proceedings of the 6'th International Conference on Precision Agriculture, July 14-1 7, Bloomington, Minnesota, USA, 2002.
[3]. Yamashita, J., S. Yuki, S. Arima, I. Matsumoto and T. Tsurusaki, Development of Gantry Systems for Strawberry Cultivation (Part I), Journal of the Japanese Society of Agricultural Machinery, 64(2),.
[4]. Bak, T. and Jakobsen, H. 2003, Agricultural botic Platform with Four Wheel Steering for Weed Detection. B iosystems Engineering 87 : 2125-136.
[5]. Blackmore, B. S., Fountas, S., Tang, L., and Have, H. 2004 a, Design specifications for a small autonomous tractor with behavioural control, The CIGR Journal of AE Scientific Research and Development http://cigrejournal.tamu.edu/ Volume6 . htm l :Manuscript PM 04001.
[6]. Barker, Allen V., and D. J. Pilbeam. *Handbook of Plant Nutrition*. Boca Raton, FL: CRC/Taylor & Francis, 2007. Print.
[7]. SamySadeky, Ayoub Al-Hamadiy, Bernd Michaelisy, Usama Sayedz," An Acoustic Method for Soil Moisture Measurement", IEEE 2004.
[8]. G. Singh et al., "Real Time Image Processing System", Proc. *IEEE VLSI Design and Test Symposium*, pp. 151-158, 2005.
[9]. R. C. Gonzalez, P. Wintz, "Digital Image Processing-Second Edition", Addison-Pearson Education Publishing Company, 2005.