HEXA FARM BOT

Project Reference No.: 42S_BE_2790

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Abstract :
In the present world, farmers have been facing problems in the field of agricultural activities such as irrigation, ploughing, the removal of the weeds and spoilage of the crops due to the invasion of the wild animals. 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, the weeds are removed mechanically by the robot and the bot is equipped with the system which detects the motion of the foreign objects into the field and flashing light and particular sounds are generated which scares away the animals. This bot is connected to the user 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 beekeeping, 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: Agriculture, Irrigation, Ploughing, Manure, Poultry, Moisture sensor, weed removal etc;

Introduction:
Agriculture, the backbone of Indian economy, contributes to overall economic growth of the country 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. There were certain researches carried out with reference to the agricultural sector to eradicate the problems faced by the farmers, here in this project we are trying to combine all the solutions to various problems faced by the farmers aiming to solve 60-70% of the problems faced by the Indian farmers. Our Indian farmers walk carry out the ploughing under the hot sun which makes them feel tired very soon, the removal of weeds has been a major problem in the field of agriculture, the damage of the crops due to the invasion of the wild animals has resulted in loss to the farmer. Randomly the water has been fed to the crops without knowing the exact amount water needed for the crops. This project aims at eradicating the problems as mentioned. The ploughing tool has been used to loosen the soil, the weed removal tool has been used to remove the weeds growing between the rows of the crops, the moisture sensor is used for the irrigation purpose, the ultrasonic sensor has been used to detect the entry of the animals inside the farm and specific actions has been taken to scare away the animals from the farm.
**Objectives:**

1. 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.
2. Precision farming implies a management strategy to increase productivity and economic returns with a reduced impact on the environment, by taking into account the variability within and between fields.
3. Variability description, variable-rate technology and decision support systems are the key technologies for precision farming. Precision farming on a regional level is one way to apply this approach to small-farm agriculture.
4. It may not only improve farm management but may also promote the development of rural areas. Small landholdings restrict to use the traditional methods of farming and limit productivity. This project can be used in both large and small lands which can increase productivity in both cases.
5. There is a growth in world population to between 7 – 9 billion by 2050 this clearly indicates the increase in the necessity of food production and therefore advancement in the agricultural is a must.
6. 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”.
7. Hexa farm bot is a precision agriculture 3-D printer based farming project consisting of a Cartesian coordinate bot farming machine, Software and documentation including a farming data repository. The project aims to "Create an open and accessible technology aiding everyone to grow food and to grow food for everyone”.
8. The bot (prototype working model) is able to plant different crops in an area of 1 meter × 0.6 meters (the dimensions can be modified) with a maximum plant height 0.35 meter (height can be modified for different crops).
9. It can cultivate a variety of crops within the same area at the same time and is able to operate indoors, outdoors and covered areas. This project can also be used to grow vegetables for domestic purpose in the garden area.
10. Hexa farm bot is capable of performing 6 main operations like ploughing, sowing, irrigation, removal of weeds, and ensuring the safety of crops which can solve at least 70% of overall farmer’s problems.

**Methodology:**

1. The Hexa farm bot can perform almost all processes prior to harvesting including ploughing, sowing, mechanical weed control, watering and ensuring the safety of the crops from the external predators.
2. It is a Cartesian coordinate bot farming machine which has X, Y and Z axis motions for the working of the bot during farming. The bot is provided with the NEMA 23 stepper motor in each and every axis i.e. there are three different motors for each and every axis respectively.
3. 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.
4. There are different tools provided which have undergone brazing and are made up of metal coated with paint to prevent the tool from getting rusted for different operations which are
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). 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.

5. The accurate pick and drop of the tools are performed by the stepper motors as per the programming is 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 magnetic locking mechanism provided which is aided by ring magnets, when the bot tool end reaches the desired position the magnets get attached to the tool and picks up the tool.

6. 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.

7. After the ploughing is done automatically the bot moves on to perform the next operation let’s say weed removal operation again the same locking mechanism is used as explained above, now the weeds which grow in between the rows of crops are removed from the weed removal tool.

8. The bot moves on with the watering operation, here the watering tool are 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 particular area of crop this can be achieved by continuous monitoring of the moisture sensor while the watering operation is performed.

9. 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 100-150cm. So, placement of two ultrasonic sensors facing opposite to each other is 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.

10. When an unusual movement is found by the system an SMS is sent to the farmer using the GSM system and an alarm sound is activated to scare away the predators from the field along with a flashing light during the night. 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 the internet or by sending an SMS through the GSM module.

11. The power consumed for the operation is too low and is beneficial for the farmers who stay in rural areas. For the continuous working of the system, a backup battery is provided as a power source.

Results and Conclusions:

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. A farmer can control the bot anywhere around the world. Ploughing, irrigation, sowing seeds can completely be done by only one bot. There will more accuracy and flexibility in the bot. It helps to save water by providing only the required amount. An adequate amount of manure is provided. The accuracy is maintained at the most. Safety of the crop is ensured at the night time from the wild animals. This bot is aimed to solve at least 70% of the 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 manpower required is
minimized especially for the weed removal activity. An attempt is made to save the water which is a precious source on earth.

Scope For Future Work:
We further aim at bringing our Indian farmers to the modern world by implementing the Automated speech recognition (ASR) is a technology that allows users of information systems to speak entries rather than punching numbers on a keypad. In recent years, ASR has become popular in the customer service departments of large corporations. It is also used by some government agencies and other organizations. Basic ASR systems recognize single-word entries such as yes-or-no responses and spoken numerals. This makes it possible for people to work their way through automated menus without having to enter dozens of numerals manually with no tolerance for error. In a manual-entry situation, a customer might hit the wrong key after having entered 20 or 30 numerals at intervals previously in the menu, and give up rather than call again and start over. ASR virtually eliminates this problem. Just like how the Amazon has a command saying “Alexa, Play my favourite music” similarly our bot can be installed with the speech recognition module and when the farmer says “Hexa, start ploughing” the bot understands the command provided by the farmer and performs the commanded operation. The solar panels can be installed in the bot which adds up for the eco-friendly feature and utilises the solar energy to carry out the operation.

Drawings/Diagrams
Block Diagram:

The placements of the X-axis and Y-axis motor:
The placement of the Z-axis motor:

The Z-axis motor which helps in the tool movement.
The tool holder attached along with the ring magnets:

The bot performing the ploughing mechanism along with the ploughing tool:
The X-axis and Y-axis motor along with the belt mechanism (The tool holder is visible in the image):

Side View of the Project:

- X AXIS MOTOR
- Z AXIS MOTOR
- TOOL
The top view of the project along with the placements of the ultrasonic sensors:

- **X AXIS MOTOR**
- **Y AXIS MOTOR**
- **Z AXIS MOTOR**
- **ULTRA SONIC SENSOR**
- **BELT**
- **SOIL**
- **CROP**