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Modular Farming With The Utilization Of Induced EMF For A Feasible And Miniaturized Single Device

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Abstract

India is developing technologically in every aspect and agriculture is no exception. Though there is a large scale mechanization of agriculture, there are only a few parts of country that have actually implemented them and are benefitted. Little to no use of mechanism is made and small and marginal farmers still rely on simple and conventional tools like wooden plough, sickle etc. for tilling, sowing the seeds and so on. This results in huge wastage of human labour, consumes more amount of time and low yields. This paper is an approach at developing a modular farming device to assist the farmer in agricultural processes like tilling, sowing the seeds and pesticide spraying. The paper aims at building the device whose operations can be controlled easily by the user with least manual labour. The system is built using Arduino microcontroller, motor driver, IR proximity sensor and servo motor, while the user controlling the device via bluetooth.

Keywords: EMF, Cultivator, Seed sower, Pesticide sprayer, Bluetooth, Motor driver

1. INTRODUCTION

Agriculture is the most important sector of Indian economy, which in turn accounts for 18% of Indian's Gross Domestic Product (GDP). The commitment of agri-business in the national income in India is more, hence it is said that agriculture is a backbone for Indian Economy.

This papermainlyfocusesondesigningafeasibleandminiaturizedsingledevice.Theideaproposed here combines different agricultural aspects implemented into a single device. In the present scenario, there are multiple agriculture equipments to carry out various tasks. These equipments are quite expensive, require high maintenance and need muscle powerfor handling. Wedesig nourmodel to incorporate thre emajoragri culturalequipment being cultivator, seed sower and

pesticide sprayer inasingle device making it smart and small inadaptability. The concepts of solarenergy and induced EMF generation make it possible to charge the battery backup there by avoiding the fuelconsumption. With the RPM (revolutionperminute) rotation soft heshaft, induced EMF voltage can be generated and this power can be stored in the battery backup which indeed power sup the motor forpesticidesprayer, device movementsetc. The device also consists of sensors to detect the obstacles if any. With the use of third party Bluetooth application [1], the device can be controlled in its movement and other functions. The conversion of RPM to power is a concept of mechanical to electrical energy conversion this also helps in the working of other conceptual of the device. In a nutshell, our paper puts forth combining the three main aspects of agriculture namely, cultivation, seed sowing and pesticide spraying into a single device that is powered by induced EMF and solar energy which is capable of detecting the obstacles on the way.

2. Methodology

With the knowledge of present technology inagriculturalsector, all thee quipmentsaredesignedfor a specific task. But this leads to problems in management and maintenance of these equipments. So this prototype is to overcome these number of instruments management. This prototype is designed to integrate theequipments inasing ledevice and hence place management is madefeasible and time required for installation of these equipments is reduced. Cultivator and seed sower is incorporated as single equipment and used for both thenecessities [2].

Basically farmers run sprayer motors with the help of electricity and petroleum fueled vehicles manually. But this prototype runs on a power stored in the backup battery. The battery backup is charged through the concept of induced EMF generated from the running shaft of the device. This concept helps in conservation of resources. And there is an alternative energy sources through solar panel fitted on the device to generate energy. The sprayer motor sprays the pesticide about an area at a certain angle. Obstacles found in the way of device is notified through proximity sensors and processed within the device and with the help of remote the path of the prototype is modified. Thus the entire prototype helps in simplifying the time and expanding the productivity of field.

3. Related Work

Obstacles found in the way of device is notified through proximity sensors and processed within the device and with the help of remote the path of the prototype is modified. Thus the entire prototype helps in simplifying the time and expanding the productivity of field:

- A driverless tractor was developed for the purpose of smart farming using Arduino Uno, magnetic compass for GPS location tracking, IR sensors and motors. It performs tasks such as tilling, sowing of seeds and pesticide spraying. The concept of master and slave is adopted here to transfer the control signals of direction from the compass [1].
- An agricultural robot has been constructed here using robotic technology. The commands are passed using IOT concept with Raspberry pi module to activate the irrigation circuit and to run the robot. It requires cloud access and good network strength for its effective operation [3].
- A robotic vehicle for agricultural applications is developed where a motor pump and a sprayer are placed at the top of the model. Image processing and video camera access is used to detect the presence of weeds, spraying of pesticides and to monitor the functions like tilling and sowing of seeds [4].

4. Block Diagram

The core of this model is Arduino Uno microcontroller which accepts the signals from the third party applications and commands control over other connected components such as IR sensor,

motor drivers and servo motor. The power supply is provided by the back EMF generated and power from solar panel [5], stored in the battery.When the microcontroller is switched on, it starts processing the code load into its memory. And it gains the control over all ports. The microcontroller is to read the input process it and send the necessary command as output.

Proximity sensor detects obstacles on the way of the prototype. When the microcontroller receives the signal from proximity sensor in case of any obstacles, it alerts the buzzer. The agricultural equipments are cultivator and seed sower are incorporated as single equipment at the rear end of the prototype. The up and down motion of the cultivator is facilitated by the servo motor. The sprayer fitted at the top of the prototype, runs with the power provided by the induced EMF generated and stored in the battery, as shown in Figure 1.

Arduino Uno:
Arduino Uno Microcontroller is an open-source platform. Arduino is the core of the prototype. It receives the signals from the third party application via a Bluetooth module connected to Arduino and relays the control signals to respective components to carry out the tasks. While the input to arduino are power source, IR sensor and the control signals via Bluetooth module, the arduino outputs the commands to servo motor and motor driver. It acts as the control system for the entire model [5].

IR Proximity Sensor:
IR proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. IR sensor sends a signal towards the direction of movement and collects the reflected signals. Arduino receives the sensed signal from the sensor continuously and alerts the buzzer immediately in case of any obstacle on the way.

DC motors and drivers:
Motor converts electrical energy into physical motion. The motor driver in this system is connected to both the rear wheels and one of the front wheels. A shaft will be connected between the front wheels so that when the device moves, the other front wheel also rotates and the EMF generated as a result will be stored in the battery. This energy will be further used for running of sprayer unit. This unit is also responsible for the movement of the device by accepting the signals from the Arduino board. The movements like right, left, forward and backward is carried out by this motor driver.

5. HARDWARE IMPLEMENTATION

Bluetooth Interface:
A Bluetooth module is interfaced with Arduino board. With the help of command keys in the third party Bluetooth application, the device can be controlled in its operations. A code is fed into the Arduino board which acts as a bridge between the application and the Bluetooth module. The actions consists of left, right, forward, backward, start, stop. Up and down are also included for the cultivator positions.

IR Interface:
This interface consists of IR proximity sensor interfaced with the Arduino board. This unit is necessary to detect the obstacles on the path of the device. The IR sensor emits signals in the direction of movement of the device and continuously receives the reflected signals. In case of any obstacle detected, the Arduino triggers the buzzer to go off.

Servo motor Interface:
This interface deals with the servo motor interface with Arduino microcontroller for the purpose of positioning of the cultivator tool. The tilling tool connected to the servo motor can be positioned at the angles of 0 degree and 45 degree. The commands for these positioning is provided by the user via third party application which interacts with Bluetooth module connected to the Arduino microcontroller. This signal is then given to the servo motor for the positioning of cultivator tool.

Motor driver Interface:
Motor driver interface involves the motor drivers interfaced with the Arduino board. The commands from the application like start, stop, and left, right, forward and backward are provided to the motor driver for the movement of the device. When IN1 and IN3 are high, forward movement takes place. When IN2 and IN4 are high, reverse movement takes place. When only IN3 is high, the device moves in right direction. When only in4 is high, the device moves in left direction. When all the four pins are low, the device comes to a halt.

6. WORKING AND RESULTS

Model Design and Analysis (CAD):
The design of the model was done using CAED software Solid edge. Before building the actual prototype, it is necessary to design and verify the model in 2D so that construction errors can be rectified and minimized. Once the design of the prototype was decided, the measurements of the model were adjusted in such a way to accommodate all the hardware equipment necessary in building the prototype and also the standard size of thick fiber glass sheet was taken into consideration. The design of the model was done based on these parameters. The figure 2, figure 3, figure 4 and figure 5 shows the top view, 3D view, side view and the front view respectively. The figures such shown are the results of the model design done in the CAED software, Solid edge.

Movement Unit*:*
Figure 6 shows the movement unit. The movement unit deals with the movement of the designed system. The actions like start, stop, forward, backward, left and right can be controlled with the help of interface between third party application and Bluetooth module connected to arduino. The system is also capable of detecting any obstacles on its way. When IR proximity sensor detects the obstacles, it sends the signal to Arduino which triggers the buzzer to go off.

Cultivating Unit*:*
As shown in the figure 7, a custom made cultivator made from thick fiber glass sheet is connected to the servo motor to carry out the task of cultivation and seed sowing. The servo motor positions the cultivator at the angles of either 0 degree or 45 degree, 0 degree being the cultivation position and 45 degree being the non-cultivation position. Through tiny holes and tubes in the plough, the seeds are sown into the ground.

Sprayer Unit*:*
The figure 8, shows the sprayer unit. The pesticide stored in a small tank has a pipe and a nozzle connected to it. With the power from the power source to DC water pump, the pesticide is sprayed to the crops.

EMF Unit:
As shown in the figure 9, the motor driver is connected to three wheels of the device, that is, two of the rear wheels and one of the front wheel. A shaft has been connected between motor driver connected wheel and the other wheel. The motor is connected with a belt. Thus, energy is generated using induction in the motor. The energy thus generated is stored in the battery so that the same can be used in running the prototype.

7. Advantages and Applications

The designed system is equipped with multiple agricultural tools like cultivator, seed sower and pesticide sprayer, making the device useful for multiple purposes and therefore, multitasking is one of its advantages. As the system is controlled using the third party application, it is very easy to handle the device. The system is designed to run on induced EMF generated thereby eliminating the need of fuel and making the device environmental friendly. Another advantage is that it reduces human labor as the device can handle the strenuous tasks in farming.

This is an agricultural device, designed to carry out three main tasks of agriculture. It can carry out the strenuous task of cultivating the land with a small amount of human monitoring. The plough like servo motor controlled tool tills the land preparing it for seed sowing process. Seed sowing and pesticide spraying are the other applications of this device. The nozzle of the sprayer, tool used for cultivation can be replaced with any other suitable nozzle or different type of cultivation tool respectively making the device suitable to adapt to a wide of crop cultivation processes

Figure 1. Block diagram of the prototype

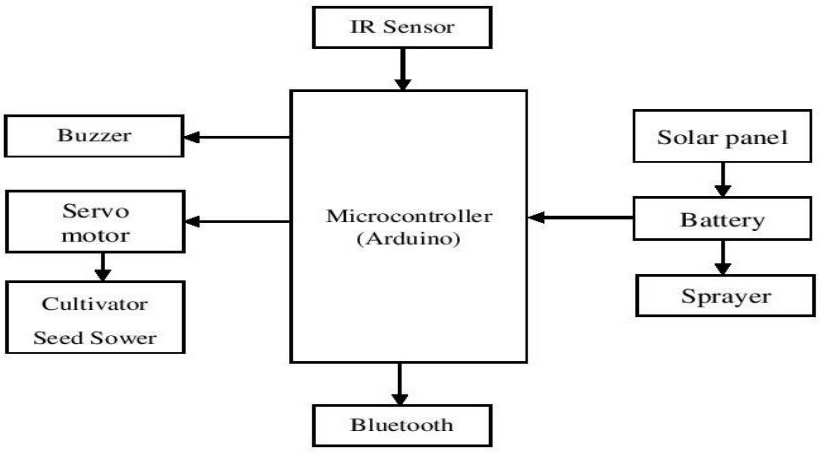
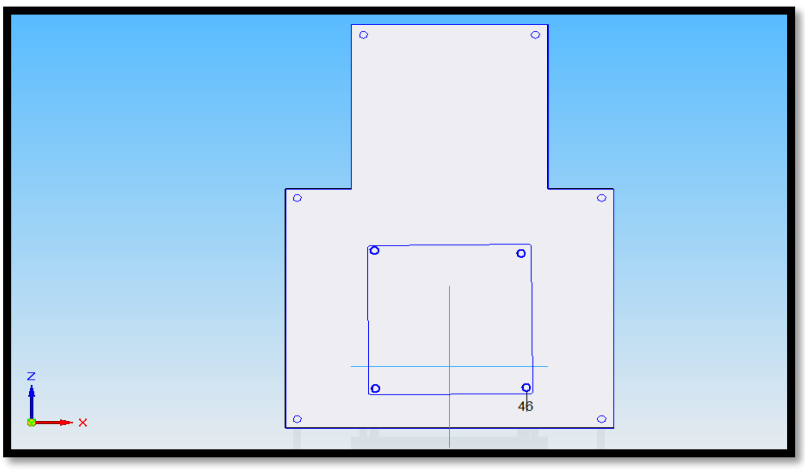


Figure 2: Top View



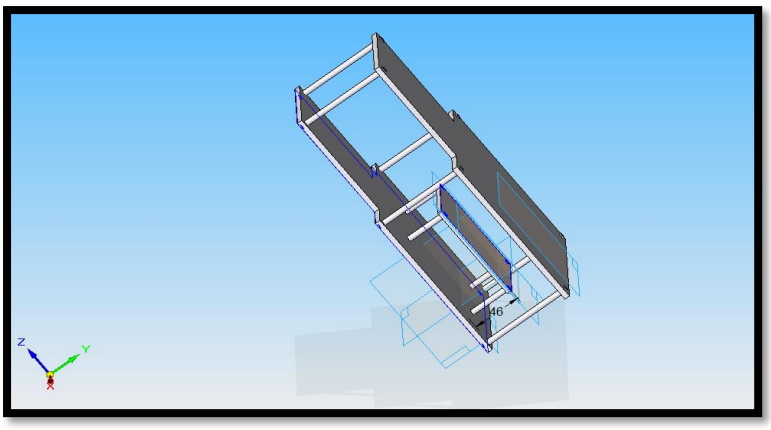


Figure 3:3D View

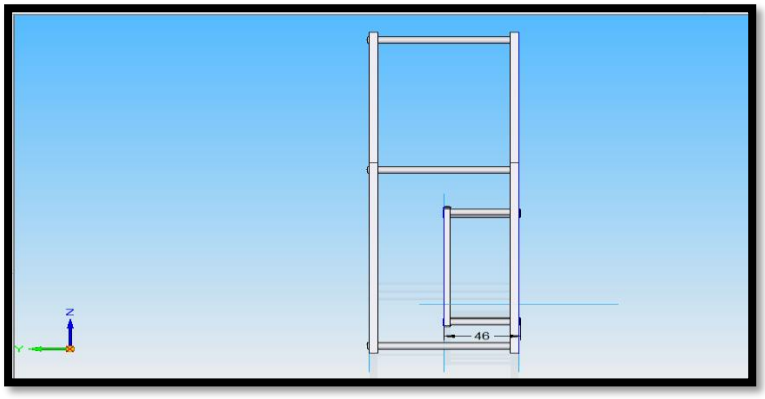


Figure 4. Side View

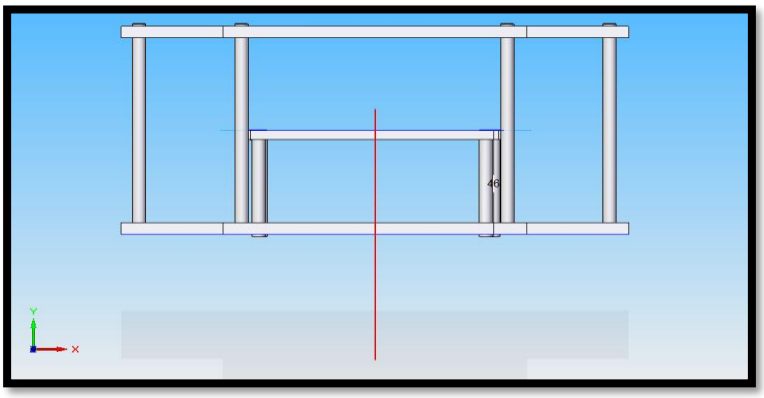


Figure 5. Front View

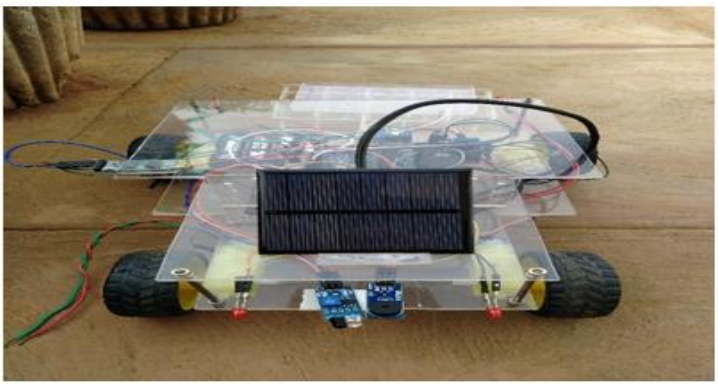


Figure 6. Movement Unit

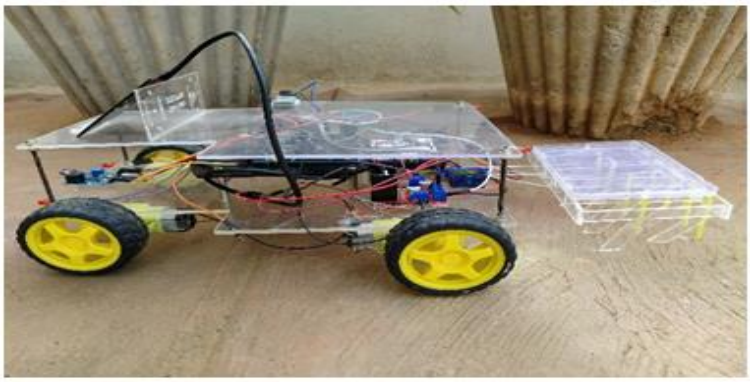


Figure 7. Cultivating Unit

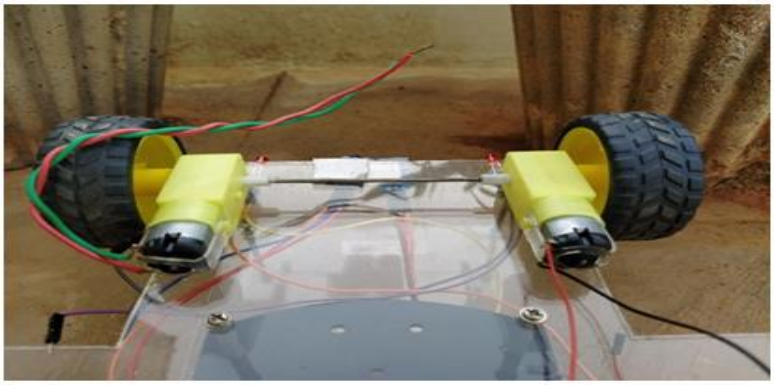


Figure 8. Sprayer Unit

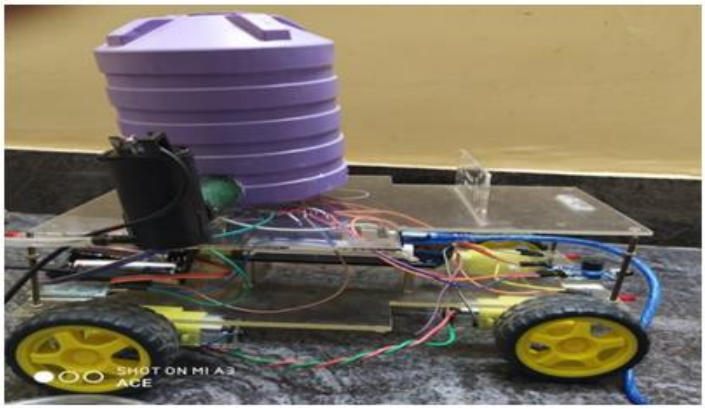


Figure 9. EMF Unit

8. CONCLUSION

This paper brings out a new take on modular farming with a single device that uses induced EMF and can handle multiple strenuous tasks involved in agriculture. The device is designed to carry out agricultural tasks like tilling, seed sowing and pesticide spraying by using induced EMF generated by the device itself. It has easy user interface allowing common people to control the device without any difficulties. The system designed allows further modifications in sprayer nozzle and cultivation tool by replacing it with different styled equipment. With the reduced manual labor, this device can be found essential in the agricultural field.

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