

DESIGN AND FABRICATION OF BLUE-TOOTH CONTROLLED MULTI-PURPOSE AGRICULTURE MACHINE

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Abstract: *In this project an attempt has been made for the design and fabrication of a multi purpose agriculture machine exclusively for small farmers at low cost. The machine is made versatile such that very simple components are employed in the fabrication and this is the reason for the low cost of the machine. This innovative machine works in both directions as pushed forward, ploughing the field with the help of the plough. The arrangement has been designed adjusted in an adjustable and portable manner, with the help of a screw and the seed sowing is mounted with the direct control from the motor. The motor rotates and the shaft attached to it has holes. The main objective of our project is to carry out the groundnut threshing operation, seed sowing, and fertilizer spraying simultaneously. The different components of this automatic portable groundnut planting machine are designed using the CATIA V5 software. The modeled components are fabricated and assembled to form a complete machine. The key innovative perspective of our project is the complete machine can be controlled remotely with the integration of Bluetooth facility. This machine has successfully validated in performing the multiple operations of farming (Ploughing, sowing, Weed removing, spraying) in the small scale farming. This machine has economically outperformed conventional farming operations with increased productivity.*

Keyword: *Design, Fabrication, Farming, Multi-purpose, Bluetooth, Productivity*

1. INTRODUCTION

The production and productivity of groundnuts, corns, etc., were quite low when India became independent in 1947. The production was not sufficient to feed the Indian population. The country used to import them in large quantities to fulfilling the needs of our people from many countries. The reasons 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 foreign countries. There were no machines for sowing the seeds like groundnuts, corns then and it is done by manpower only. The cost spent on manpower was more and the speed of the operation was very less. When small farmers with minimal physical resources or financial assets attempt to improve their productivity, they have a limited choice. The only resource they can maximize is knowledge in which they are not poor.

India is a world leader in groundnut farming with 8 million hectares of cultivated area in the year 2003. Groundnut cultivation has increased from 6.8 million hectares in 1980 to 8 million hectares in the year 2003. Groundnut is grown mostly in five states namely Andhra Pradesh, Gujarat, Tamilnadu, Karnataka, and Maharashtra and together they account for about 90 percent of the crops total. Agriculturalists will be inspired to undertake fantastic technologies for eco-friendly farming systems if the dissemination of statistics is efficient. There is a paradox right here one needs to bear in mind, however. On the one hand, ride in other sectors present process the transition to less polluting. To prove the above statement, Shivraj was

invented the first bullock driven sowing machine in the year 1987 at Madhya Pradesh to improve his productivity. It was lightweight and can perform up to six agricultural operations [1]. The sowing time is the most important non-monetary input influencing productivity. Delay in sowing by one-week results in considerable yield losses. Results obtained from all India coordinated research projects revealed that in most parts of the country, sowing should be done between the first week of June and the last week of July. Advancement of sowing by a fortnight with pre-sowing irrigation was found to increase the yield substantially. The government of India appointed a commission to assess the feasibility of increasing crop productivity under prevailing Indian ecological conditions. To develop the standard of living of small farmers we should make the machines at a low cost. Then only small farmers can implement the recent modern machines for farming purposes. Our suggested multi-purpose groundnut planting machine is used to plant groundnuts. They can be used to plant other seeds such as corn, peanuts, etc. So in this work an attempt has been made to provide the groundnut planting machine at low cost and of less weight compared to the machines available in the market. The past works have concentrated more on the integration of different facilities to the equipment, whereas in our project we have designed and fabricated the Bluetooth enabled multi-purpose agriculture machine.

2. MOTIVATION AND OBJECTIVES

2.1. Motivation

Innovative technologies in farming automation in many industrialized and developed nations, like the USA, Canada, and other European nations, witnessed the quick turn of events with, what's more, utilization of intensity worked machines [2]. Besides the pioneer realms of the nineteenth century brought some of these cutting edges advance to the developing nations of the world, with blended outcomes and increased social responsibility towards, needful ecological effects. Some of the shreds of evidence from the revolution of agriculture in the 20th century naturally underscored for the monocultures of improvised productive assortments necessitating the better utilization of substantial hardware, like trucks, tractors, mechanized sprayers [3]. These structures were mainly single objective function and have only general function in cultivating the farmlands. Thus, a small scale farming requires the economic and multi-functional equipment which cultivates better in the developing nations to compete with the developed nations. Consequently, the effective utilization of the human talent pool will noticeably be a significant driver for increasing affordability in the farming segment. Conversely, to apprehend their factual perspective determined hard work by the correct combination of investors and through perfect ideas will help in achieving faster results. These concerns motivated us to develop the novel multi-purpose farming equipment with blue tooth control.

2.2. Objectives

The main objectives of the present work include:

- To facilitate the improvement in the small scale farming with the development of a multi-purpose agriculture machine.
- To facilitate the best possible and economic opportunity to farmers in our country without investing more money. The developed innovation could be able to work successfully with solar energy as an Eco-friendly concern
- To reduce the use of external power source like electrical energy and consequently contributing to the present world without occasioning air and water pollutions

- To mechanize the fertilizers spraying. These fertilizers are harmful and hazardous to humans while applying them to the crops causing respiratory disorders. To overcome these problems new mechanized fertilizer spraying has been integrated into our equipment.

3. LITERATURE REVIEW

The literature review has been classified into the different mechanisms and operations utilized in the construction of the multi-purpose agriculture machine. It has been compared and presented the differences between the conventional seed sowing procedure and modern seed sowing procedures through the developed machines in line with the better numbers of operations [1]. They also calculated the row-wise spacing, seeding rates, and fertilizer engagement which varies for each crop. These complicated are overcome with the development of their idea to the machine. This machine has successfully reduced skilled labor, sowing times, maintenance cost, and labor cost. In later years the design, development and the fabrication of the vehicle which can dig the soil, sow the seeds, leveler to close the soil and pump to spray water, these whole systems of the vehicle works with the battery and solar power, the vehicle is controlled by toggle switch [2]. It is also presented by past works the development of a multi-purpose agricultural machine for feeding seeds, spraying pesticides, fungicides and Fertilizers, and cuttings. This paves the way for cheaper and more targeted equipment for the farmer, which is also easy to use. Clean and well maintained, easy to use, and does not require fuel. This will cut costs and support farmers in their fields [3]. The multi-purpose agriculture machinery is doing four operations i.e. seed-sowing plowing, transportation, and irrigation purposes. The multi-purpose agriculture machine is driven by the 100-cc engine. The machine is divided into two parts assembly. Module-1 assembly is the major machinery. The Module-1 assembly is doing with the three primary operations mainly seed sowing (seeding), ploughing (loosening of land), and irrigation mechanisms [4]. One methodology is to use accessible data innovations as progressively canny machines to decrease and target vitality contributions to increasingly powerful ways than previously. The approach of new ideas offers the chance to build up a new scope of rural gear dependent on little brilliant machines that can make the best choice, in the opportune spot, at the ideal time in the correct manner [5]. The fundamental point of the task is to create a multipurpose agrarian vehicle, for performing major farming activities like furrowing, seeding, collecting. The alteration incorporates creating a vehicle that is little, minimal in size. The task is about a machine structure which makes development a lot more straightforward. The plan of the case of the vehicle is made so that it is reasonable for the tasks [6]. Environmental sustainability and energy efficiency factors are key factors for the better utilization of the resources [7]. This work expects to configuration, create and structure of the robot which can plant the seeds, cut the grass, and splash the pesticides, this entire framework is fueled by sun oriented vitality. The structured robot gets vitality from sunlight based board and is worked utilizing. This expands the productivity of seed planting and decreases the issue experienced in manual planting [8]. The past researchers developed a mechanism capable of activity operations like automatic seeding and dig. It additionally provides manual management once needed and keeps tabs on the wetness with the assistance of wetness sensors [9]. The study is to assess the productivity and cost-effectiveness in Latvian conditions of the M-Planter tree planting machine, recently launched in Finland. The productivity (E0) of the M-Planter achieved in field tests was 260 seedlings per hour. Increment in farming efficiency leads additionally to horticultural development and can assist with lightening destitution in poor and creating

nations, where agribusiness frequently utilizes the best part of the populace. Productivity plays a key role in determining the efficiency of the selected process [10]. The conventional technologies with mechanized site preparation and manual planting prove to be a viable alternative in forest regeneration [11]. The average diameter of the seeds compatible with the selected design is listed in Table 1.

Table 1. Average Diameter of the Seeds Compatible with Design

Seed Size (Average diameter of seed compatible with design)	
10 mm Diameter (Large)	5 mm Diameter (Small)
Sunflower	Pearl Millet
Groundnut	Black gram
Cowpea	Raagi
Castor	Pigeon Pea
Soya bean	Jowar
Field bean	Cotton
Maize	Wheat
Pea	Sesame

Table 2. Differences between Conventional Farming and Multi-purpose Farming (Modern Methods)

Manual Farming (Traditional Method)	Muti-purpose farming (Modern Methods)
1. More use of farm laborers and less number of machines	1. More use of machines and less use of laborers
2. Less Production	2. More Production
3. Many species, including neglected and underutilized species	3. Fewer commodity species
4. Limited low-technology post-harvest processing	4. Advanced and Hybrid mechanisms utilization
5. Traditional Knowledge system	5. Scientific knowledge system
6. The plough tool is made up of wood and the life of the tool is less	6. The plough tool is made up of iron and the life of the tool is more
7. Seed-to-seed distance is varying and depth of seed also varying, therefore, maximum the number of seeds is damage.	7. Seed-to-seed distance is uniform and depth of the seed is also uniform or the depth is adjusted as per requirement. Therefore, no wastage of seed.

4. Materials and Methods

The major parts that are effectively employed in the design and the fabrication of the multipurpose solar agro-machine seed sowing with groundnut seeder, fertilizer-sprayer are described below:

4.1. Bearings

The 6202 is a 15 mm Ball Bearing that can be used in many rotary and factory automation applications. The 6202 Deep Groove Ball Bearings is an open style bearing. The 6202-Z ball bearing is a single row raceway and single shielded. This bearing has been selected in the project owing to its above-said importance. The bearing utilized in the present work is represented in Figure 1.

4.2. Frame

The frame is made of mild steel material. The whole parts are mounted on this frame structure with a suitable arrangement. Boring of bearing sizes and open bores did in one sitting to align the bearings properly while assembling. Provisions are made to cover the bearings with grease.

4.3. Motor

The primary advantage of the DC motor is that it can develop constant torque over a wide speed application. The power supply is an important consideration in the application of DC motors. The most common way to provide DC voltage to a motor from an AC line is through the use of an electronic drive. By the term torque, it is meant the turning or twisting moment of a force about an axis. It is measured by the product of the force and the radius at which this force acts.

4.4. Battery

The constant voltage of 24V comes from the solar panel controlled by the charge controller so for storing this energy we need a 24V battery so two 12V battery are connected in series. This is a long steady overcharge, bringing the battery to a gassing or bubbling state. Do not equalize sealed or gel type batteries.

4.5. Gearing

At the point when a machine has two apparatuses of various sizes, the littler rigging turns quicker than the bigger apparatus. At the point when the main rigging (the driver gear) turns, the subsequent apparatus (the determined or output gear) turns accordingly. The distinction between the velocities of the two riggings is known as the speed proportion or apparatus proportion.

4.6. Belt drive

As a source of motion, a conveyor belt is one application where the belt is adapted to continuously carry a load between two points. A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium—the conveyor belt—that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more.

4.7. Grasscutter

This is the setup of the cutter blades which is operated by a motor. these blades have sharp edges that are used for cutting the grass. The blades rotate at higher speeds so that the grass present in the path of the vehicle movement is cut by the blades continuously. A Solar grass cutter is a machine that uses revolving blades to cut a lawn at an even length. We have made some changes in the existing machine to make its application easier at a reduced cost. The fabrication of the project is innovative and also economical. The Bluetooth transmitter cum receiver circuit is utilized in this project for Bluetooth controlled operations.

4.8. Wheel arrangement

The simple wheel arrangement is fixed to the frame stand. Near the wheel, the cutter and the battery are fixed. This wheel arrangement is set up for showing the successful working of our project. But the real implementation can be done in the real working model.

4.8. Seed feeder

This is simply a circular plate with a suitable arrangement. This circular plate is placed inside the hopper. The motion to this plate is delivered with the help of the motor. When this seed feeder rotates, it carries the groundnut seeds by the suitable arrangement provided and delivers it to the planting hose. By using this technique, the manual planting method is eliminated and thus the planting operation is automated.

4.9. Planting pipe

This is the pipe that is connected from the seed feeder. The seeds are fed to this pipe with the help of the seed feeder and the pipe delivers the seeds to the ground. Before delivering a suitable cultivator arrangement is made to cultivate the land for planting the seeds. And a flat plate is provided behind the pipe for making the cultivated and even.

4.11. Fertilizer sprayer

This is a long pipe with holes placed horizontally on the machine. The water from the water tank is connected to this sprayer employing the hoses so that the water from the tank enters this pipe and comes out through the holes with some greater pressure so that the water or the fertilizer is sprayed onto the ground effectively.

4.12. Solar panel

The photovoltaic effect is defined as the generation of an electromotive force as a result of the absorption of ionizing radiation. Energy conversion devices, which are used to convert sunlight to electricity by use of the photovoltaic effect, are called solar cells. The solar panel used in this work is shown in Figure 1. In recent years' photo-voltaic power generation has been receiving considerable attention as one of the more promising energy alternatives.



Fig. 1. Solar panel

4.13. Blue tooth ARDUINO transmitter

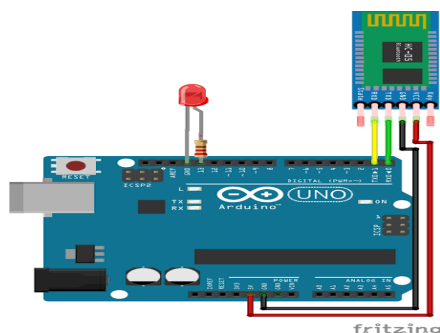


Fig. 2. Bluetooth ARDUINO Transmitter

Arduino is an open-source hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its products are licensed under the GNU Lesser General Public License, permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form or as do-it-yourself kits. The Bluetooth ARDUINO transmitter used in this work is represented in Figure 2.

5. RESULTS AND DISCUSSION

As it is a known fact that the main intention and purposes of the developed multi-purpose agricultural machine are effectively utilized for real-time working, ploughing, weed-removal, fertilizer spraying, and it could be utilized for seeding purposes. All the parts are associated in such a route that in each phase of agri-business the integrated design could be revised flexibly and effectively assembled with mechanical clamping to the required height and length based on the selected agro-activity. This multipurpose agro machine is wireless remote operated & designed and fabricated as a piece of multipurpose equipment that is used for agricultural processes like ploughing, sowing seeds, and sprinkling water. This machine works in both directions when it is pushed forward it ploughs the field with the help of plough. The height of the plough can be adjusted, with the help of a screw arrangement and the seed feeder is mounted directly to the motor. The motor rotates and the shaft attached to it has holes. The motor is directly attached to the shaft with holes. The design of the Bluetooth controlled multipurpose agriculture machine developed in this work is shown in Figure 3. When we push the agriculture machine in a backward direction, we can pick the plough up from the ground and the pump which is attached to the front shaft will start pumping the water from the tank and it will sprinkle water over the field. The added advantage is that multiple seeds can be sown at the same time which makes the tiring work simpler and more economical.

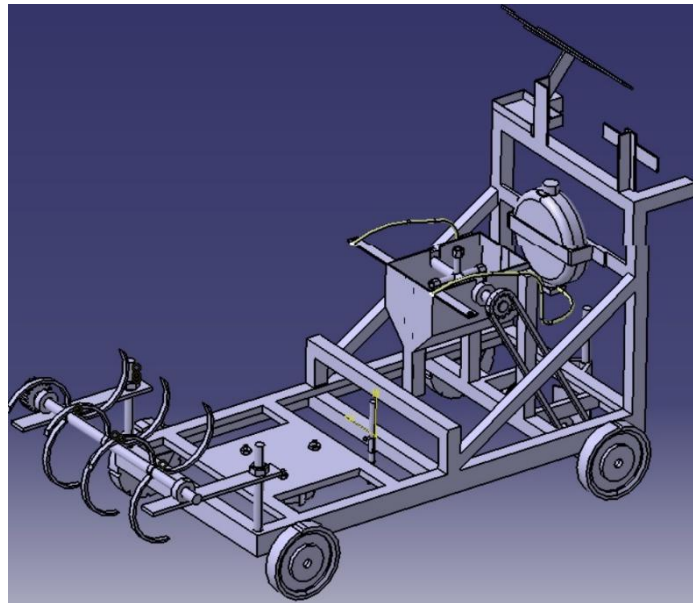


Fig. 3. Design of Bluetooth Controlled Multipurpose Agriculture Machine

5.1. Validation of the project

Design verification is a technique for affirmation by inspecting and giving proof that the structure yield meets the plan input details. A basic procedure during any item advancement that guarantees the structured item is equivalent to the proposed use. Design validation is the process of evaluating the software during or at the end of the product development, to ensure the manufactured system satisfies the specification in the end-user application or product and environment. The parts utilized in the development of multi-purpose agriculture machine are listed in Table 3. The differentiation between the two terms is generally to do with the job of determinations. Approval is the way toward checking whether the particular catch the client's needs.

Table 3. List of Constituents Utilized in Development of Multi-Purpose Agriculture Machine

Sl. No.	PARTS	Qty.	Material
1	Motor	1	DC
2	Battery	1	Lead acid
3	Tank	1	Plastic
4	Bearings	6	CI
5	Spur gear	2	CI
6	Sprayer	1	MS
7	Cultivator	1	MS
8	Belt	1	Rubber
9	Pulley	2	MS
10	Hopper	2	MS

11	Circular plate	2	MS
12	Thresher	1	MS
13	Blades	4	MS
14	Solar panel	1	PV panel
15	Wheel	4	Rubber

5.2. The basic shaft design formula

The drive shaft with multiple pulleys experiences two kinds of stresses, bending stress and shear stress. The maximum bending stress generated at the outermost fiber of the shaft. And on the other hand, the shear stress is generated at the innermost fiber. Also, the value of maximum bending stress is much more than the shear stress. Then Eqn. (1) and Eqn. (2) representing the bending stress and moment of inertia for calculations. So, the design of the shaft will be based on the maximum bending stress and will be driven by the following formula:

$$\text{Maximum bending stress} = \tau_b = \frac{M * r}{I} \quad (1)$$

Where ‘M’ is the maximum bending moment on the shaft

‘r’ is the radius of the shaft

‘I’ is the area moment of inertia of the shaft

Input data:

Maximum allowable shear stress for the shaft material= 40 N/mm²

From the bending moment diagram, the maximum bending moment (M) is calculated as 66666.67 N/mm². Area moment of inertia (I) of the circular shaft is:

$$I = \pi * r^4 * 0.25 = 0.785 * r^4 \quad (2)$$

From Eqn. (1) we can write:

$$40 = \frac{66666.67 * r}{0.785 * r^4}$$

r= 12.85 mm

So, the minimum radius of the shaft should be **12.85 or 13 mm**.

5.3. Design for the plate for stability in deflection

Calculating the load on the plate (P)

Maximum load acting at the 430 kgf (from the Manufacturers catalog)

center of the plate at $5 \text{ Kg} / \text{cm}^2$

Maximum load acting at center of the plate at $7 \frac{\text{kg}}{\text{cm}^2} = \frac{430 \times 7}{5} = 602 \text{ kgf}$

Load distribution to the front half of the plate $= P = \frac{602}{2} = 301 \text{ kgf}$

$$P = 3010 \text{ N}$$

$$\text{Deflection of plate at maximum} = v = \frac{3010 * 300^3 * 301}{48 * (2.08 * 1065) * (9 * 10^5)}$$

$$v = 9.04 * 10^3 \text{ mm}$$

This deflection is under the safe limit. So the design is safe.

6. CONCLUSIONS

India is the developing nation that depends mainly on agricultural activities to feed our population. As a developing nation our nation is not having large-scale farmers. Farmers must be educated and updated with the latest technologies available and there is a need to bring innovations to sustain the agriculture for future generations. As an engineer with good knowledge could develop many machines according to the customization of the farmers. With the new technological improvements, the present developed machine, the farming activity could be more possible for economical and more user-friendly. Precision agriculture is a related concept where connected sensors can be used to facilitate, e.g. more effective farming. Bluetooth is wireless radio communication between the farmer's Smartphone and the Arduino. Bluetooth is preferred because of its cost-efficient so that it can be affordable to almost all farmers. Based on the real-time evaluation we have the following conclusions are arrived.

- Multi-purpose agriculture machine is designed and fabricated with ease, simple to utilize, and compelling hardware for agri-business activity.
- This multipurpose agro machine is wireless remote operated & designed and fabricated as a piece of multipurpose equipment that is used for agricultural processes like ploughing, sowing seeds, and sprinkling water.
- Agriculture yield development might be improved and less expensive with a multitude of little machines than with a couple of enormous ones. One of the upsides of the littler machines is that they might be increasingly adequate to the non-ranch network

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