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FABRICATION OF MULTIPURPOSE AGRICULTURE VEHICLE

[1]Krit Prakash, [2] Teegalapally Sai Charan, [3] Thota Uma Mahesh, [4] Palvancha Deekshith Goud, [5] Aenugu Aravindh Reddy

[1] Assistant Professor, [2]UG Student, [3]UG Student, [4]UG Student, [5] UG Student

[1]Department of Mechanical Engineering,
[1]Vignan Institute of Technology and Science, Deshmukhi,
Yadadri, Bhuvanagiri , Telangana, India

Abstract: Agriculture is basis of Indian economy. There is lot of scope for research in the field of Rice and Wheat to increase production. This field faces problems such as how to minimize the losses, how to increase the productivity and how to minimize the cost of production. In India, two types of agricultural methods are used: manual method (conventional method) and mechanized type method. Mechanization involves the use of a hybrid device between the power source and the work. The main aim of the project is to design and develop multipurpose agricultural vehicle for performing major agricultural operations like ploughing and seeding. The modification includes fabricating a vehicle which is small and compact in size. It can be concluded that the designed chassis of the vehicle performed well during the operations in the field while taking into consideration the cost factor.

Index Terms Ploughing, Sowing, Threshing, Chassis, Grinding.

INTRODUCTION

About 70% of Indian populations are either farmers or involved in some agricultural related activities. Agriculture includes rearing of animals, cultivation of plants and fungi used to sustain and enhance human life. Agriculture has been the key development in the rise of sedentary human civilization. The history of agriculture dates back to thousands of years the development of which has been driven and defined by different climates, cultures and technologies. Modern agronomy which includes plants breeding, agricultural chemicals such as pesticides and fertilizers and advancements in technology has increased yields manifold. At the same time they have caused widespread ecological damage. Agricultural food production and water management are constantly becoming global issues. Mechanized agriculture is the process of using agriculture machinery to mechanize the work of agriculture adversely increasing farm worker productivity in modern times. Also, powered machinery has replaced many farm jobs formerly carried out by manual labour or by working cattle.

The history of agriculture contains many examples of the use of tools, such as the hoe and the plough. But with the advent of industrial revolution farming has become less labour intensive. The current mechanized agriculture includes the use of tractors, trucks and harvesters as well as other types of farm implements, airplanes, helicopters and other vehicles. Precision agriculture uses computers in conjunction satellite imagery and satellite navigation to increase yields. Mechanization was one of the largest factors responsible for urbanization and industrialization of economies. Besides improving production efficiency, mechanization encourages large scale production. It also can improve the quality farm produce as it can displace unskilled farm labour.

LITERATURE REVIEW

Thange R.B et. al [2016] discusses that the available automatic machines are imported from foreign countries. The imported machines are not only bulk in size but also costing around rupees one Lakh. In this project an attempt has been made for the design and fabrication of maintenance free multipurpose agricultural equipment exclusively for small farmers at cost not exceeding rupees 20000 per unit. The modeled components are fabricated and assembled together to form a complete machine.

Dhatchanamoorthy.N et. al [2018] carried out a project to develop multipurpose agricultural vehicle, for performing major agricultural operations like ploughing, seeding, harvesting. The modification includes fabricating a vehicle which is small, compact in size. The project is about a machine design which makes cultivation much simpler. The design of the chassis of the vehicle is made in such a way that it is suitable for the operations. The design for automatic seed sowing equipment is made. The plough is designed and modified the currently available plough tool in such a way that it with stand the load. The harvester (cutter) is designed and working by scotch yoke mechanism.

D.Ramesh et. al [2014] discusses brief information about the various types of innovations done in seed sowing equipments. The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing, seed rate, seed to seed spacing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields. Seed sowing devices plays a wide role in agriculture field.

Jinlin Xue [2013] discussed about agricultural electric vehicle (AEV) based on photo voltaic, taking into consideration three aspects, i.e., power supply mode for agricultural electric vehicle , power of agricultural electric vehicle , and economy analysis. The power supply mode, whether on-board photovoltaic system or off-board photovoltaic system, is subjected to the size and the power of the designed agricultural electric vehicle , but the agricultural electric vehicle's power depends on the area of photovoltaic panels which affects the initial investment cost of the photovoltaic system and the agricultural electric vehicle . Three analysis indicators including payback period, net present value, and benefit-cost ratio were taken into consideration when comparing the projects of 10 kW and 30 kW agricultural electric vehicles based on photovoltaic system and the respective conventional tractors. Results show that the off-board photovoltaic system is more applicable to the agricultural electric vehicle, the photovoltaic based agricultural electric vehicle with low power is a wise, economical investment, and this type of system is particularly appropriate for rural and remote areas.

Ben McFADZEAN et. al [2017] carried out research on feasibility of hybrid and all-electric agricultural machines. This project used a three-stage approach to investigate whether current hybrid and all-electric drivetrains could feasibly replace the diesel engine in an agricultural tractor. Firstly, a current systems review, gathered information from a range of industries where alternative powertrains have been successful, to gain an understanding of the properties and capabilities of available systems. The second element; a series of real-world practical tests, collected data about the requirements of agricultural tractors in use, this would be used to determine whether the alternative technology currently available could cope with the demands placed on a machine. Finally, a questionnaire, collected data from those working in the agricultural sector; this would be used to gauge attitudes and opinions towards alternative power systems.

M. Kamaraj et. al [2017] says as until now most of implemented ideas for cultivation were found out of reach or unaffordable for poor farmers or small scale cultivation. But now a days Indian government is focusing more on new techniques and technologies to boost up agricultural activities in cheaper way basically up till now for any type of fast cultivation techniques farmers had to depend on tractors or any other fuel consumable devices or vehicles, which by the side increases air pollution, just to speed up the process. We found a cheapest and easy way for poor farmers and cultivation on small land. The design of multi-purpose farming tool equipped mobility cycle was done after consider some major factors i.e. decreasing cost of cultivation, making cultivation pollution free.

Dr. C.N.Sakhale et. al [2016] has carried out project to develop a multipurpose equipment. In this equipment a 24cc engine is used for digging operation. And for spraying a motor with 12V battery is used. Next two operations are manual base which is cultivation and sowing. This machine performs four farming operation digging, sowing, cultivation, spraying which is used for small scale farming. By using these attachments one may perform various farming operations in less time and economically.

Kyada et, al [2014] has designed a manually operated template row planter to improve planting efficiency and reduce drudgery involved in manual planting method. Seed planting is also possible for different size of seed at variable depth and space between two seed. Also it increased seed planting, seed/fertilizer placement accuracies and it was made of durable and cheap material affordable for the small scale peasant farmers. The operating, adjusting and maintaining principles were made simple for effective handling by unskilled operators.

Ms. Trupti A.Shinde et, al [2017] have discussed the seed sowing processes and tried to solve the problem. In seed sowing machine system they are used battery powered wheels and dc motor inbuilt in these wheels. When the seeds are empty it detects the level of storage seed and indicates the alarm. When any obstacle comes in the in-front of machine or divert path the seed sowing machine can detect this obstacle very easily. In each complete rotation of rotating wheel there is seeds falls from this seed drum and the seed plantation process can take place smoothly as well as without wastage of seeds. The end of system machine reached and it create alarm. this system provides all the facility which can work efficiently.

Jacek Caban et, al [2018] has discussed the market of electric field tractors. There are individual models in offers dedicated to the agriculture made by foreign producers. However, these offers are presented mainly at agricultural fairs. The article presents the research on the needs of farms for electric tractors and presents the possibilities of developing electro mobility in this sector of the economy. Questionnaire was presented, data were collected from those working in the agricultural sector. The data will be used to gauge attitudes and opinions towards alternative power systems implemented in agriculture.

METHODOLOGY

The choice of material of chassis for the vehicle is the first and most important factor for automotive design. There is variety of materials that can be used in automotive body and chassis. The most important criteria that a material should meet are lightweight, economic effectiveness, safety, recyclability, and life cycle consideration. Some of these criteria are the result of legislation and regulation. The material for the frame and chassis is steel. The main factors for selecting material specially for body is wide variety of characteristics such as thermal, chemical and mechanical resistant which are ease for manufacturing and durability. In the frame only the main supporting structures such as engine of the vehicle, the harvester and ploughing tool are mounted. It supports the tool static and dynamic load of the vehicle.

PLOUGH

The plough is made by 10 mm bar having rectangular cross section where one end is made in shape of trowel and other end is fitted to a common rod. The plough is designed to sustain the resistance of soil. The common shaft is then connected with a lever that is placed next to the driver seat.

SEED TRAY

A vessel used to store seed is mounted on the upper bed of the chassis. A revolving bucket like mechanism is made to deliver seeds at fixed intervals. This shaft is driven by a 12-volt DC motor that is rotated at lower rpm. The speed of motor is controlled by an Arduino based motor controller that controls the speed of motor with respect to speed of vehicle.

SPRINKLER

A 20Ltr vessel is mounted on the upper bed of chassis. A 12V submersible pump is placed inside the container. The outlet of pump is connected to a T shape sprinkler that is fixed just behind the driver seat. A flexible pipe is used to deliver the water/fertilizer.

WEEDING

Growth of Weed wastes excessive proportion of farmer time.. Weeding is one of the most important farm operations in crop production system. Weeding is an important but equally labor incentive agricultural unit operation. Weeding accounts for about 25% of the total labor requirement (900-1200 man h/ha) during a cultivation season. The labor requirements for weeding depend upon on weed flora, weed intensity, time of weeding and efficiency of worker. Delay and negligence in weeding operation affect the crop yield up to 30 to 60 percent. In India about 4.2 billion rupees are spent every year for controlling weeds in the production of major crops.

Designing of the model:

Whole model design is done in the CATIA software

Steps involved:

- Sketch drawing in front plane
- Extruding the sketch to add thickness
- Chassis is drawn through extrude structure feature
- Adding of different parts in main assembly
- Chassis
- Wheels
- Components like hooper, seed box, solar panel
- Mating all the parts with bolts and nuts

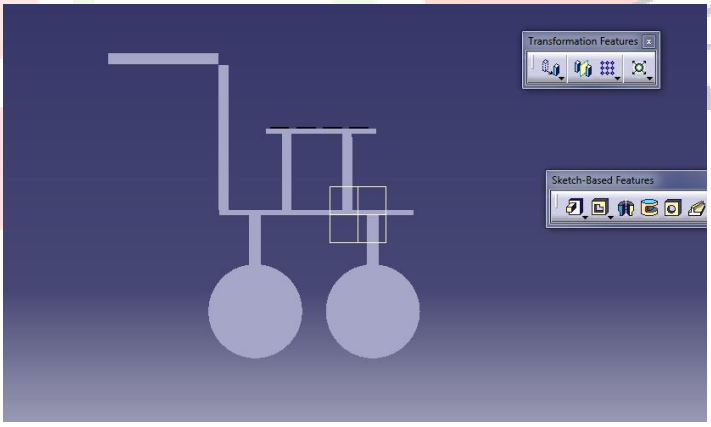

Fig: 1 model

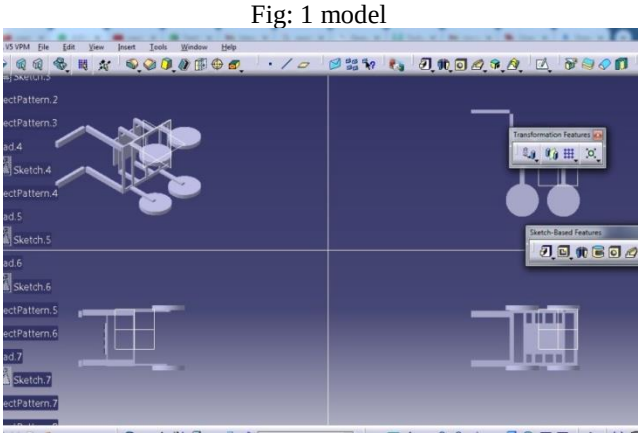

Fig: 2 model analysis

Fabrication and model construction

Chassis and frame mounting is the main frame skeletal structure of the seed sower on which all other components are mounted. The two design factors considered in the determination of the material required for the frame are the weight and strength. In this model, we have used mild steel having a cross-section of rectangular frame to impart rigidity. Arc welding has been used to weld the chassis.

Components:

Frame pipe

Section pipe

Chassis frame

12mm shaft bushes

Seed hopper

Seed box

Tank

Battery

Solar panel

Dc Motor 12v, 10 rpm

Ploughs teeth

Blades

Wheels

Nozzles

Fig: 3 frame cutting pipes

Fig: 4 single pipes

Fig: 5 pipes cutting

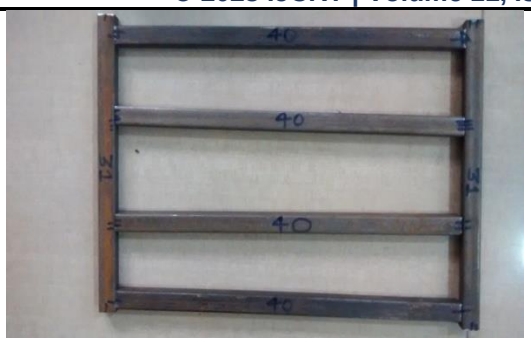

Fig: 6 welded frame

Fig: 7 table welding frame

Fig: 8 12mm shaft bush

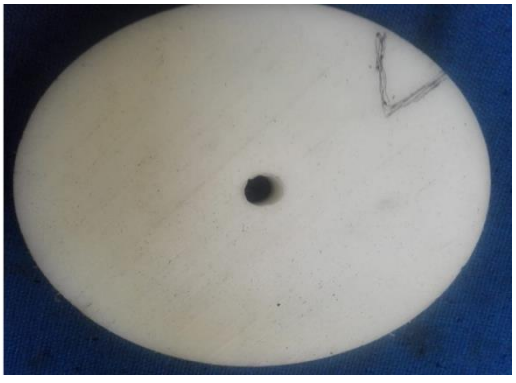

Fig: 9 seed hoper

Fig: 10 seed box

Fig: 11 roll support bushes

Fig: 12 seed motor roller motor 12 v, 10rpm

Process:

Surface grinding:

The surface grinding process is done to to the material to remove the surface hardness for better finishing

Fig 13 Cylindrical Shaft Surface Grinding

Arc welding:

The arc welding process is opted to weld the mild steel materials and join the pipes as required shapes.arc welding is used for the whole fabrication process

Fig: 14 joining of pipes Arc Welding

Fig: 15 Cutting Surface Grinding After Joining Process

Fig: 16 Coupling

Fig 17 Arc Welding Process

Cutting:

Cutting the frames and pipes are done by hand grinding machine with cutting wheel 12”

Fig 18 Cutting of Arm @ 115 Mm

It is a plate that bolsters the engines with the assistance of screw fittings. They are welded to primary casing utilizing one of its bases.

Drilling:

Drilling process is done through the drill machine for required hole specification

Drill pieces of 12.5 mm, 5 mm and 6 mm are utilized.

Fig 19 Marking of Dimensions on Motor Support Plate

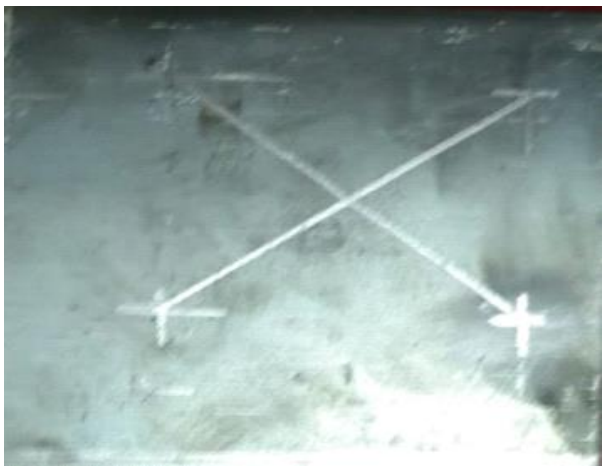

Fig 20 View of Motor Support Plate after Marking

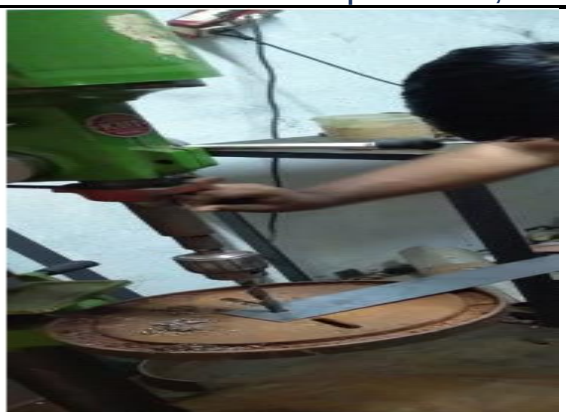

Fig 21 Drilling Centre Hole Using Drill Bit @12.5 Mm

Fig 22 Drilling 4 Holes Using Drill Bit @ 5 Mm

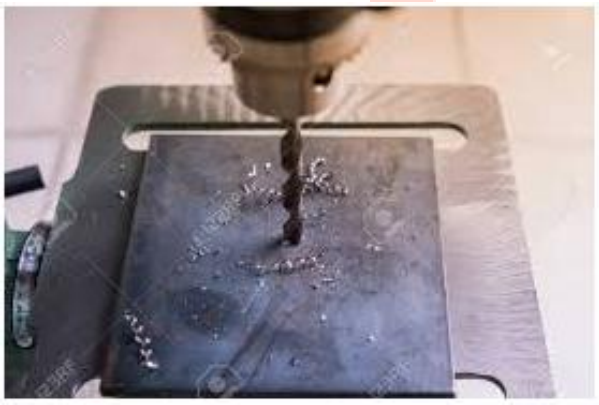

Fig 23 drilling 4 holes using drill bit @ 6 mm if oversize is required

Fig 24 Reducing Screw Length To Fit Exactly Into Motor Threading

CONCLUSION

The designed and developed multipurpose agricultural equipment can be used for tilling, fertilizing, sowing, leveling and also for weed removal purposes. All the parts are connected in such a way that in every stage of agriculture, the equipment can be rearranged or easily assembled with fasteners to required length and specifications as per requirement of field operations. Our team has combined many ideas from various fields of mechanical engineering and agricultural knowledge to improve the yield and by reducing the labor effort and expenses.

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