

Design and Fabrication of Earth Auger with trolley

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Abstract

The purpose of this project is to design and fabricate an earth auger to overcome limitations on the existing earth augers. The earth auger is designed by introducing the trolley system. The project will be successful in providing the earth auger which is operator friendly and can be transported from one place to another by the single operator. The simplified mechanisms are implemented in the project including the winches and pulley systems for the feed and movement of the drill bit. The clamping systems are introduced to increase the stability and to decrease the vibrations which keeps the operator to be in a distance during the operations for the purpose of safety. Therefore, this project is made to reduce the fault and to improve the safety measures as well as the usability.

1 INTRODUCTION

Earth auger is used for making holes in the ground and are built with the rotating metal pipe on rod with one or more blades attached at the lower end. Earth auger is designed to scrape or drill through the ground soil. These augers are used by the farmers to drill the hole for the purpose of the plantations. The earth augers are versatile and can save hours of time and labor where otherwise have to dig the hole by the use of the traditional equipment that causes too much loss of energy as well as time wastage. In the purpose of agriculture, the earth augers are used to drill holes for planting saplings and this enables to increase the efficiency of the plantation as multiple holes can be drilled at very short period of time.

Metal augers have been used since the middle age to drill holes on the wood. In 19th century, the hand operated earth became a common farm tool in US and most of the inventors also filed the patents. One such example is design of M. Hubby of Mayfield, Texas, consisting open hollow cylinder with two blades at the bottom edge. The first known power earth auger was built in

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the 1943 by John Habluetzel a farmer in the Wamego including a 7-inch helical blade from the screw separator. It was attached to tractor and could be operated by the drive

from the seat. It dug 2.5-foot holes every minute. This invention was featured in Kansas state board of agriculture's 35th Biennial report. He went to dig hole for the farmers and for every dug hole he charged around 10 cents. It was his side business which operated well in 1950s. later he donated his invention to the Kansas museum of history in 1999.

2 METHODOLOGY

Study of current situation and problem statement: The method to study the current situations, problems and shortcoming in existing period and coming up with the solutions to the shortcomings.

Literature survey: To perform the literature survey by studying the different journals related to the topics and also going through the patents as the reference to get information and ideas for design. Each set of ideas are referred from different journals and had taken into work for the fabrication purpose. The problems in the olden day's techniques are deeply studied and made try to crack the problems faced by the farmers. Many problems like unsafety to the farmers, machining techniques, handling the machine, machining process are tried to improvise to make machining process easy.

Design: To design the model using the existing literature survey with suitable sketches and to list out the materials required for the project fabrication. The design is made simple in structure and made simple to operate with so that farmer can easy work easily. New structure is made to the auger and fabricated accordingly.

Fabrication: Required amount of mild carbon steel are purchased from the market and gathered in the workshop. Engine, winches and drill bit are also purchased. The required frame for the placement of accessories is fabricated in the workshop. Engine, winches and drill bit is fitted to the frame to form a earth auger machine.

Operations and testing: After fabrication the machine was tested. The fabricated earth auger is positioned near the workshop where it was fabricated and made to test it for the different soils. The machine is started and

fed into the soil with certain speed and tested.

Feedback and reviews: Based on the performance by testing, the feedback and reviews are noted and further changes to be made to reach the expected outcomes.

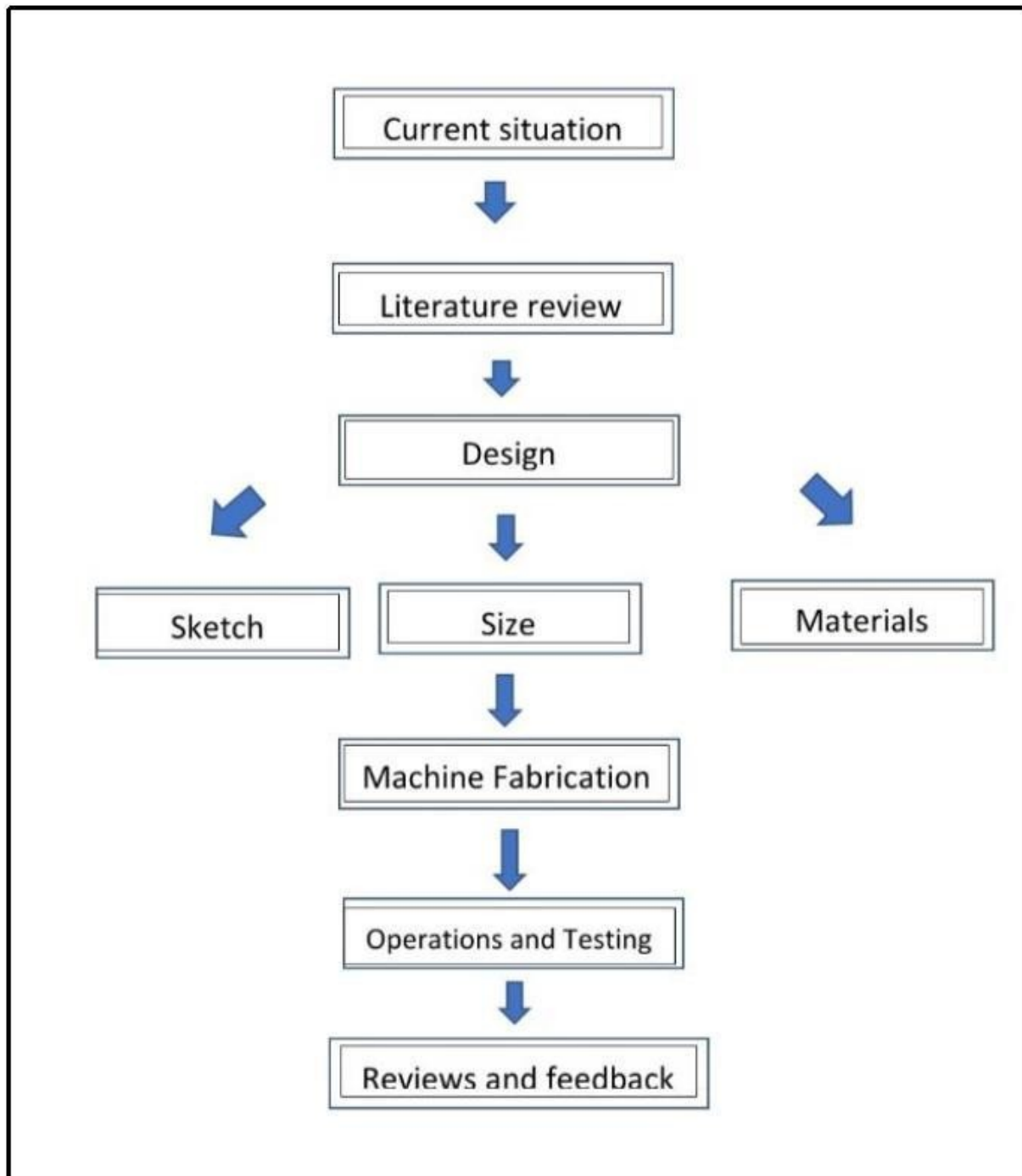


FIGURE 1
Methodology Flowchart

3 DESIGN, MATERIAL SELECTION AND FABRICATION

3.1 DESIGN

The material used in the frame of the trolley is the square mild carbon steel tubing which are measured and cut into required dimensions. The blades used for cutting the tubes is the Xtrapower 14" steel cutting plate sued for the industrial applications. The tubes are then welded using the arc welding techniques. The perpendicular angles are adjusted using the right angle. The outer frames are first welded using the arc welding using the welding electrodes of 3.15mm. the welded frame is then joined on the trolley wheel.

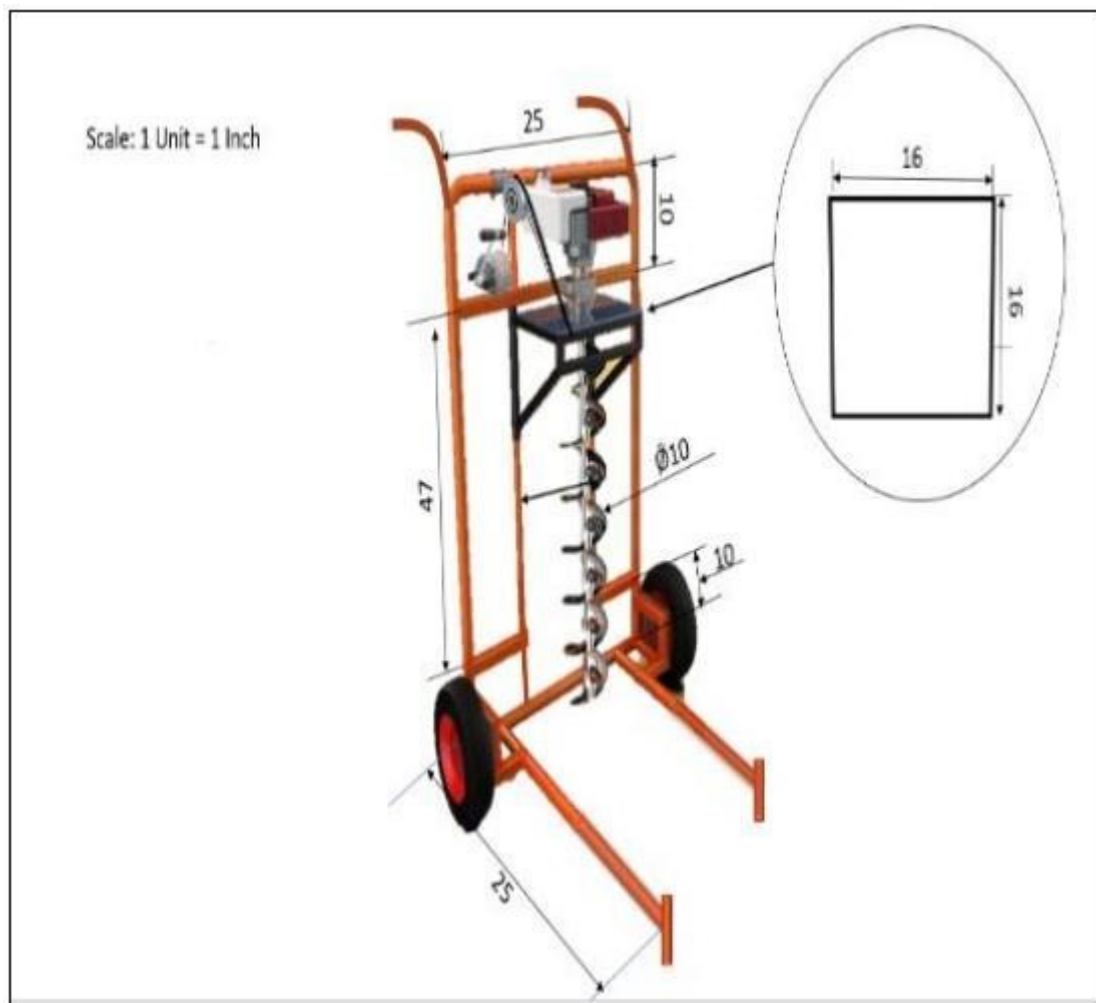


FIGURE 2

Design of Earth auger with trolley

3.2 MATERIALS

The square tubing of a full length of 6 feet + 3 feet is used for building the frame. The main use of the square tubing is for the trolley frame. The tubing is measured to the required dimension and the cut using the cutting machine and the joined them by welding. The two-stroke petrol engine is used of 45cc, speed 6000RPM. The power of the engine is 2.2 Bhp. The drill bit of diameter 12 inches and depth of 3 feet used for digging. Two tyres are fitted to take the trolley from one work position to another. Pins are provided at the front most part of the bit which helps in scratching the hard ground. The winches used is the Breewell 800lb (362 Kg) Gear hand winch hand crank nylon strap gear ATV. The material used is iron. The pulling capacity of the winch is 362 kg. A wheel with a grooved pin around which a cord passes, which acts to change the direction of a force applied to the cord and is used to raise heavy weights. The drive element we have used in our pulley is the wire rope. The round MS rod of 10mm diameter is used as the guide rail on which the guide wheels roll. It is either a wheel or pair of wheels used to guide a moving structure, rather than supporting its weight. The guide wheels which has clearance of 10 mm are used in order to roll on the round rod. A length of rope made from wires twisted together as strands. The wire rope is replaced with the nylon strap in the winch and is wound to the crank. The diameter of the wire rope opted is of 3 mm and length is 6 feet.

3.3 FABRICATION

The trolley frame is made up of mild carbon steel square tubes of $\frac{3}{4}$ inches. The required measurement is taken by using a measuring tape and then the square tubing's are cut using cutting machine. The square tubing's are joined using metal arc welding technique according to the design. The equipments like right angle, fluid level guage etc., are used in order to maintain the level and dimension. The grinding process is done for good surface finish. Stand is made using mild steel plate of 2mm thickness and angulars are used for giving support. It is joined to the frame using arc welding process. The pair of round hollow tubes are filled with sand and bent into required angle by using the gas torch for heating. Then it is welded on the frame to act as handles for transportation of the machine. A pair of wheels are attached to a solid shaft using roller bearings. The length of the shaft is same as that of the length of the frame base. The pair of wheels are joined to the frame by welding for portability. A MS plate of 2mm thickness is cut into 16*16 dimension using gas cutter. Metal stripes are welded below the plate to provide strength to the plate. A hole of 36mm is drilled in order to place the drill bit. Two guide wheels

of 10mm clearance are welded on the edge of the platform. The angular stripes with other two guide wheels are welded at 45 degrees below the plate to provide support to the platform. The round MS rod of 10mm diameter is welded on either side of the frame which acts as a track for the movement of the platform carrying engine with the help of these guide wheels. Four guide wheels are welded at the back side of the existing wheels to provide the stability and to prevent the platform from dislocating from the track during feeding operation. A simple hand crank winch wound with 3mm diameter and 6 ft length wire rope is clamped to the earlier constructed platform by running it through the pulley. The wire rope is hooked to the platform using fasteners. In order to increase the stability and to make the entire machine to be fixed at a certain point during digging process, a clamping system is employed by joining two square tubes of 25mm long on either side of the frame base. The hollow cylindrical pipe is welded on the ends of the square tubes in order to pin the element to the ground. Smooth movement of the carriage is important during the digging process. This can be achieved by greasing on the guide wheels and round rod which acts as track for the movement of the platform. The 2-stroke petrol engine is mounted on the movable platform by using C-clamps and fasteners. The drill bit mounted to the shaft of the engine with the help of the pin. The welded parts are surface finished using buffing and grinding process. The platform is surface finished for the smooth movement of the guide wheel during digging process.

4 TESTING AND RESULTS

The design and fabrication of earth auger with trolley system is completed using necessary materials using different processes. By running the petrol engine, the drill bit digs the soil and necessary results are noted. The testing process is repeated to get the accurate result and efficiency of the engine. The fabricated earth auger was tested in order to note down the capability of it to create number of holes in the agricultural field containing red and black soil. The auger was taken to the agricultural land for testing its performance. The auger was successful in digging hole of 1 foot 4 inches diameter and the depth of 1.5 feet in 45 seconds. The earth auger with the trolley system is fabricated in such a way that it is can be transported from one place to another by a single operator. The fabricated trolley was tested by moving it from one place to another to check its mobility and ease of handling of the machine by single operator and resulted in the smooth handling of the system by the operator. The platform on which the engine and the drill bit rests must give the smooth movement in order to give the proper feed while digging a hole. The wheels are welded to the platforms which slides over the rod with the help of hand



FIGURE 3

Final fabricated machine

winch. The hand winch was operated and the testing of the entire mechanism resulted in the successful smooth movement of the platform.

5 SCOPE FOR FUTURE WORK

By using the new technologies, complete automation of the earth auger can be achieved like by adopting the mechatronics systems. Shock absorbers can be used to minimize the shocks while drilling, which brings even more convenience to the operator. Air tyres can be used for further ease portability Water sprayer can be installed in the machine which can spray water to the drill bit during the operation to settle down the dust and also to loosen the soil for the easy feed operation. Stronger materials can be used in order to operate the machine in complex

conditions as the tough soil, so that the entire frame can withstand the vibrations. Lighter materials can be used for the further betterment of handling and portability of the machine.

6 CONCLUSION

The ease in transportation with the pair of wheels is achieved through the use of an earth auger fabricated from fabricated earth and utilizing trolley systems. The improvement in the operator's comfort during the operation is taken care. Clamping systems for maintaining the stability and to fix the machine at its spot of operations is used in the machine. The simplified mechanisms for the feed movement are introduced with less maintenance. The improvements are done to ensure the safety of operators. The overall machine can be efficiently used in the field of agriculture which reduces the labor charge especially for the small-scale farmers and further developments can be done by using the advanced techniques to boost the improvements and to fulfill the needs of farmers.

References

- [1] Ming Su, Research on The Rapid Development of The Use and Maintenance of Earth Auger, 2016.
- [2] Nitin Kukreja. Design and implementation of soil drilling machine using NX 12 and CATIA V5 fabrication techniques. *Materials Today: Proceedings*, pages 1–5, 2021.
- [3] S W Sajjanwar, A Tayade, H Khade, S Borker, A Mate, P Ingole, A Shende, and K Basewar. Engine Powered Modified Earth Auger Machine. *Annals of the Romanian Society for Cell Biology*, 24(2):184–189, 2020.
- [4] Elementary Analysis on One of the Possible Drilling and Sampling Techniques for China Lunar Exploration Project. *Geological Science and Technology Information*, 6, 2009.
- [5] G Boldyrev and G Novichkov. Evaluation of Tip Resistance to Auger Drilling. *5th International Conference on Geotechnical and Geophysical Site Characterization*, pages 5–8, 2016.
- [6] D Hariprasad and K Prahlada Rao. Solar Powered Ground Driller for Agricultural Purpose. *Multipurpose farm machine*, 6:787–791, 2019.