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Fabrication of Agriculture based Smart Cultivation System

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Abstract: ***This study deals with the fabrication of the Smart Cultivation system which can plough the soil, cut the grass, and pump to spray chemical fertilizers and water, these whole systems of the vehicle works with the engine and specialized motors. The advantages of these vehicles gives better work output on the agricultural field. It is capable of performing multiple tasks at same time i.e. the developed prototype of multipurpose can plough, and spraying the water at the same time. As we observe normal tractors are able to perform only single task at a time that can be either to plough or level the land. But in our project, this vehicle performs multiple tasks and is only for the farming purpose. Farmers needs many labour to work on the agricultural field, because of this the cost of famers input is very high at the time of cropping. So, we designed this to minimize the work time of farmers and save the labour cost and for a better and efficient output. We hope that this Smart Cultivation system will be proven like a boon to farmers of India.***

Index Terms: ***Component, formatting, style, styling, insert.***

I. INTRODUCTION

A. Beginning Of Farming

Agriculture plays a vital role in India's economy. The Indian agriculture system began as early as 9000 BC. During this period techniques were developed for the settled mode of production in agriculture and wheat, barley and jujube were the popular crops that were domesticated in the subcontinent by 9000 BC. The farm sector is contributing greatly to the productivity and stability of the country's economy due to which it has been believed that agricultural prosperity is fundamental to national prosperity. It accounts for about 18% of India's gross domestic product, provides employment to 58 per cent of her working population and the rural households depend on agriculture as their principal means of livelihood. Agriculture, along with fisheries and forestry, is one of the largest contributors to the Gross Domestic Product (GDP). New techniques were developed in the Neolithic period to improve the method of agriculture system like threshing, planting crops in rows, cotton spinning and storing grains in granaries. And they passed their improved techniques of agricultural production to the next generation. This transformation of knowledge was the base of further development of agriculture and farming equipments in India.

B. Changing Scenario In Cropping Activities

After the period of cattle farming in the agricultural fields, there is a drastic change in the agricultural areas. The scientist Benjamin Holt designed the several farming equipments for cropping purpose at that time; these machinery equipments are done a tremendous job in the agricultural fields. He invented a specially designed tractor for the agricultural purpose to do several farming activities for better production. With this farming tractor, the economy from the cropping sector increasing annually which is very helpful to the field sectors. From that invention, the cattle usage in the agricultural areas is slowly decreased day by day in the farming sectors. By this farming vehicle, which is named as agricultural tractor is really a great change in the agricultural production within the short period of time.



Fig 1: Farm productions with using tractors

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C. Paper Overview

Agriculture is the backbone of our country. India is an agriculture based country in which, 70% of people depends on the outcome of farming. Economically, farmers are very poor due to which they are unable to purchase tractors and other costly equipments hence they use traditional method of farming. Basically, many farmers in India also use bullocks, horses and he-buffalo for farming operation. This will not satisfy need of energy requirement of the farming as compared to other countries in the world. So we are thinking that human and animal efforts can be replaced by some advance mechanization which will be suitable for farmer from economical and effort point of view. So we are developing this smart cultivating system which will satisfy all this need and to solve labour problem. India ranks second worldwide in farm output. The agricultural vehicles are gradually increasing its productivity in agriculture field. Some of the major problems in the Indian agricultural are rising of input costs, availability of skilled labors, lack of water resources and crop monitoring. To overcome these problems, the automation technologies were used in agriculture. Smart cultivation system mainly focuses on the basic problems faced by farmers. i.e. ploughing, fertilizers spraying, cultivation. We are looking this project as revolution in the farming sector in India.

1) Benefits Of Farm Mechnization

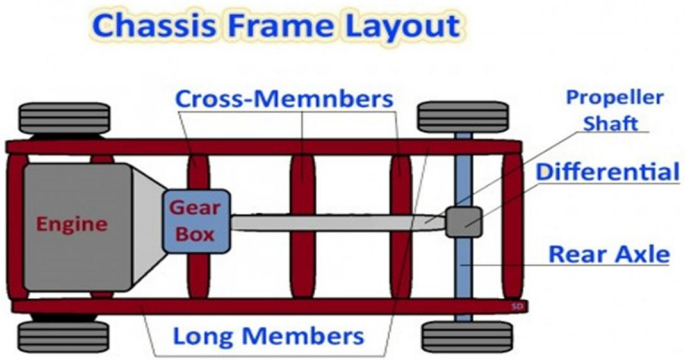
a) Timeliness of operation
b) Precision of operation
c) Improvement of work environment.
d) Enhancement of safety
e) Reduction of drudgery of labour
f) Reduction of loss of crops and food
g) Increased productivity of land
h) Increased economic return to farmer
i) Improved dignity of farmer
j) Progress and prosperity in rural areas

II. SMART CULTIVATION SYSTEM

A. Importance Of Chassis

It is the back bone of the vehicle. A vehicle with out body is called Chassis. The components of the vehicle like Power plant, Transmission System, Axles, Wheels and Tyres, Suspension, Controlling Systems like Braking, Steering etc., and also electrical system parts are mounted on the Chassis frame. It is the main mounting for all the components including the body. So it is also called as Carrying Unit.

Layout of chassis and its main components:



B. Smart Cultivation System Chassis

In Smart Cultivation system, we use the chassis frame and body which should be very strong to work in the agricultural fields. Choice of material 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. The material for the frame and chassis is iron. 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.

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In the frame only the main supporting structures such as engine of the vehicle, the fertilizers sprayer, grass cutter and ploughing tool are mounted. We made several welding to the chassis frame because in the agricultural vehicle there may be many tasks to perform on the agricultural field. So we are taking this consideration for chassis design purpose. The weldings are done very strong to the chassis body, with this the maximum load which are mounted on the chassis can resists. The smart cultivation system chassis mounts the various agricultural equipments that are mounted on the frame which are the ploughing frame is attached to the chassis frame and placed on the backside of the vehicle, whereas the grass cutter is welded on the front portion of the chassis. The chemical fertilizers sprayer which is having high capacity is mounted on the chassis back portion. When compared to the weight of plough frame and grass cutter, the water sprayer which is fill with fertilizers have heavy weight, so we take measures to weld strongly at the back portion of the chassis. We also extended the chassis frame, because the chassis needs to be very strong to carry all the components of the vehicle. In these criteria the extension of chassis is done with some scrap iron rods on the arc welding process, the extension of chassis is done carefully on the front portion of the vehicle with one feet elongation.



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C. Engine Of Smart Cultivating System

In this smart agricultural cultivation system, we use the engine with a displacement of 125cc i.e., 125 cubic centimeters and the type of an engine is 4-stroke single cylinder engine .125cc is the volume swept by the piston of an engine when it goes from top dead center to bottom dead center. The piston reciprocates inside the cylinder of an engine .When the piston is at the lowest end of the cylinder it is said that the piston is in bottom dead center. Dead centers are the two ends of the engine cylinders and the volume between them is "cc" (here 125cc). Generally for the four wheeler vehicle the engine is placed on the front portion of the vehicle, in this vehicle we placed the engine on the back portion of the vehicle which is fixed by two bolts and nuts into the welded part on the chassis. The power of the engine is 6500 rpm when it runs on the agricultural field it may varies. This engine consists of kick start and self start switch also. In this engine we remove the kick rod which is apply to start the engine and we fix the self start switch on besides the steering and it is used to starting the engine.

1) Engine Specifications

a) ENGINE DISPLACEMENT: 125cc
b) POWER: 6500 RPM
c) STARTING: KICK AND SELF START
d) MILEAGE: 60KMPL
e) WEIGHT: 108Kgs



Fig 5: 125cc Engine

D. Fabrication Of Fuel Tank

A fuel tank (or petrol tank) is a safe container for flammable fluids. Though any storage tank for fuel may be so called, the term is typically applied to part of an engine system in which the fuel is stored and propelled (fuel pump) or released (pressurized gas) into an engine.

Typically, a fuel tank must allow or provide the following:

1) Storage of fuel: the system must contain a given quantity of fuel and must avoid leakage.
2) Filling: the fuel tank must be filled in a secure way, without sparks.
3) Provide a method for determining level of fuel in tank, gauging (the remaining quantity of fuel in the tank must be measured or evaluated).
4) Venting (if over-pressure is not allowed, the fuel vapors must be managed through valves).
5) Feeding of the engine (through a pump).
6) Anticipate potentials for damage and provide safe survival potential.

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E. For Smart Cultivating System

Proper construction of a fuel tank plays a major role in the safety of the vehicle. Here we use the fuel tank which is made of light weight iron material that stands on the left side on the engine. If the fuel tank is move while the moving of the vehicle , it leads to the improper working of the combustion inside the engine , so in this vehicle we take good measures to place the fuel tank properly. Because of using the light weight material for making fuel tank, we reduced the weight burden on the vehicle. The capacity of the fuel tank which we are using for this vehicle is approximately three liters. We using two bar rods which are in scrap to the fitting for petrol tank and these rods are bent by ourselves in a U shape to fold around the fuel tank. These two rods gives a great support to the fuel tank for standing properly. We use another L shaped rods for standing the petrol tank on it, these rods are welded to one another with arc welding very accurately to give strong support to the fuel tank.

The capacity of Smart Cultivation System fuel tank is approximately 3 liters. In this fuel tank the storage portion is divided into two sections, their capacities are different to each other. We are also fill with this fuel tank with one of the portion with petrol and other portion with diesel, this is one of the major advantage for this fuel tank. If the petrol is completed in one portion the fuel tank, then we use the fuel which is stored in the other portion of the fuel tank. Though the capacity of the petrol tank is medium in this vehicle which is about three liters, we are expecting that this capacity is enough for small scale agricultural farms. We also taken different safety measures to protect from flammable conditions. The fabrication of this small capacity fuel tank is of high strength material, and the usage of fuel tank is in long run with no form of rust inside the fuel tank.



Fig 6: fuel tank

F. Rear Axle Of Smart Cultivating System

A vehicle does not get far, if it has a damaged rear axle, so in this vehicle we manufacture the rear axle very strongly and effectively. The rear axle is used to carry the rear weight of the vehicle, as well as to facilitate to transmit the drive to rear wheels. Generally for rear axle drives, the power obtained from the differential is transmitted to the rear wheels through the rear axle half shafts. The half shaft is connected to the differential to the one end and other end is connected to the wheels. In most of the automobiles, real axle is the driving axle. It lies in between the driving wheels and the differential gear and transmit power from the differential to the driving wheels. It has two half shaft connected to the differential gear, one for each wheel. In general arrangement of rear axle, the rear axle assembly supports the vehicle weight and also drives the rear wheels at the same time. The most important aspect to the rear axle is to be effective working with no bends and rotate very properly without any fluctuations.

The propeller shaft is provided with two universal joints and also a sliding joint. The spring is fixed rigidity in the middle, to the rear axle. The Rear axle assembly includes in the differential assembly, the rear drive axles and the rear axle housing. Rear axle assemblies are subjected to heavy loads from the engine and road. The front end of the spring is fixed rigidity on the frame, while the rear end is supported in a shackle. The driving thrust is transmitted to the frame by the front half the springs. Rear axle transmits power from differential to the wheels so that vehicle may turn. Rear axle isn't a single part but it consist two parts which are connected to the differential all parts of rear axle is called half shaft. Outer end of the rear axle carries the wheel while inner end is connected by sun gear of the differential. In vehicles which employ rear wheel drive, which are driving wheels. However, In front wheel drive vehicles, front wheels are driving wheels. Rear axles and differential are completely enclosed in a housing to protect from dirt, dust, water and any accidently damage.

The length of the rear axle = 850mm

Rear axle shaft diameter = 26mm

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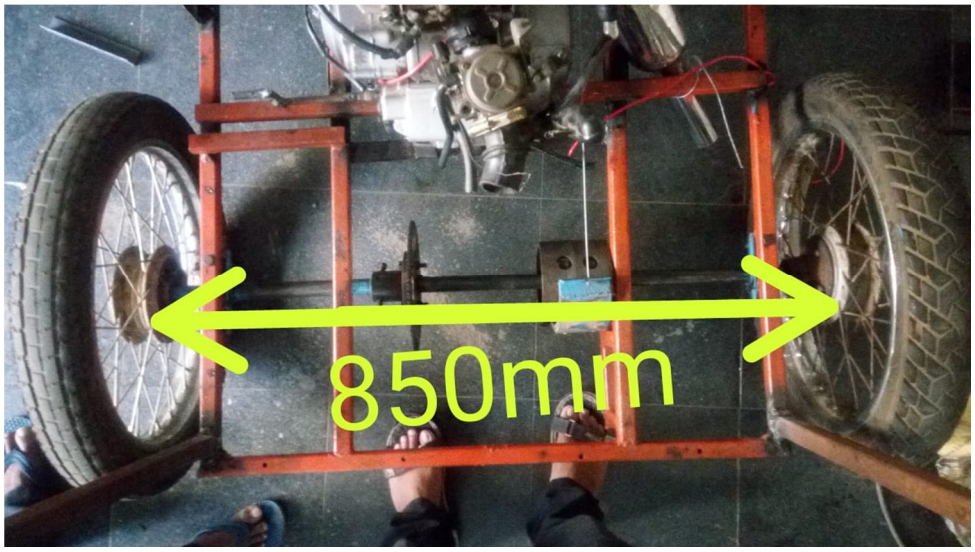


Fig 23: Rear axle length

G. Front axle of smart cultivating system:

Front axle carries the weight of the front part of the vehicle as well as facilitates steering and absorbs shocks due to road surface variations. The front axles are generally dead axles, but are live axles in small vehicles of compact designs and also in case of four-wheel drive. The steering system converts the rotary motion of the driver's steering wheel into the angular turning of the front wheels as well as to multiply the driver's effort with mechanical advantage for turning the wheels.

The steering system, in addition to directing the vehicle in a particular direction must be arranged geometrically in such a way so that the wheels undergo true rolling motion without slipping. Front axles can be live axles and dead axles. A live front axle contains the differential mechanism through which the engine power flows towards the front wheels. For steering the front wheels, constant velocity joints are contained in the axle half shafts. Without effecting the power flow through the half shaft, these joints helps in turning the stub axles around the king pin. Front axles are subjected to both the bending stresses and shear stresses The front axle is to transmit the weight of the vehicle from the springs to the front wheels, turning right or left as required. We fabricated this front axle very effectively for providing greater stability and safety in the low lying agricultural farms.

The length of the front axle = 850mm

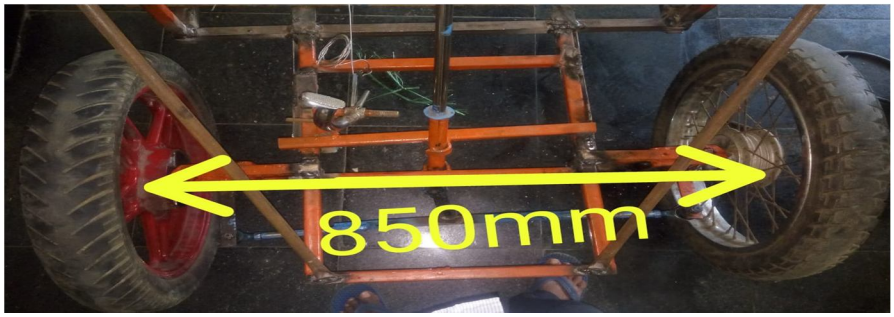


Fig 24: Front axle length

H. Plough Tool

A plough is a tool or farm implement used in farming for initial cultivation of soil in preparation for sowing seeds or planting the loosen or turn the soil. Ploughs were traditionally drawn by working animals such as oxen and horses, but in modern times are mostly drawn by tractors. A plough may be made of wood, iron or steel frame with an attached blade or stick used to cut the soil or loosen it. In our smart cultivating system, we are using iron to manufacture the ploughing tools which are very strong to dig in the soil areas.

The primary purpose of the ploughing is to turn over the upper layer of the soil, bringing fresh nutrients to the surface, while burying weeds and the remains of previous crops and allowing them to break down. In this smart agricultural system, we made the ploughing tool at a size of 12 inches and quantity is 5 tools, because we assume that this size of ploughing tool is used to dig effectively in the soil.

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The farmers use iron plough because of the fact that it is highly durable. Iron is a strong material and therefore will not break no matter how much force you apply. But the same is not true in case of wood as it can break if more force is applied to plough the fields. Iron plough is very heavy and strong, heavy and clay soil could turn over better with the help of iron plough. With the help of iron plough more grains should be produced. We also fabricate the iron tools and the iron plough frame for the smart cultivation system, because iron plough tools can plough very efficient than other ploughs in the agricultural cultivation areas.



Fig 9: Iron plough tools

By using hydraulic press, the bending operation is done on the iron plough tools at their edges. The depth of cut of iron plough is five centimeters and this depth is bent the hydraulic press setup. The ploughing frame is perfectly fabricated for the vehicle and using a spring for supporting the ploughing frame on the back side of the the vehicle. We also place this ploughing frame at certain heights and it depends on the land area and the height of the land soil to the plough frame. The horizontal bar which the iron tools are welded very strongly on the arc welding process with suitable amount of current, and the vertical bar which is named as plough shaft which is attached to the spring and the horizontal bar and the iron plough tools are mounted on this plough vertical bar.



Fig 20: Gap between plough teeth



Fig 10: ploughing frame

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I. Smart Cultivation System Fertilizer Sprayer

In our smart cultivation system, we use the advanced chemical fertilizers sprayer which pumps the chemical fertilizers or water with pressure of about 0.75mpa. The spraying method which is used in this smart cultivation system is bullet santi spraying method, which is the placing of the sprayer on the back side of the vehicle. We take a huge capacity sprayer because there is a high need of chemical fertilizers and water in the cropping areas, so with the low capacity of sprayer the farmer fill the sprayer with chemical fertilizers and water again and again until the work is completed. The main advantage of high capacity sprayer is to fill only one time with huge amount of water or chemical fertilizers.

With this, the farmers complete the spraying within the less time when compared to the sprayer with low capacity. Our smart cultivation system water sprayer can also used as backpack sprayer. We place the chemical fertilizers sprayer on the back portion of the vehicle and this weight is also mounted on the rear axle of the smart cultivation system. The water is filled in the sprayer and mounted on the vehicle, the spraying gun which is used to spray the chemical fertilizers is attached to the bottom side of the sprayer. With this spraying gun, the water comes out with the ranging pressure of the spraying gun. The capacity of our smart cultivation system fertilizers sprayer is about 18 liters. The spraying gun which is used to spray the water and chemical fertilizers is about 0.75 mpa and this spraying gun contains several small minute holes and from this holes the water or the chemical fertilizers are exit from that holes. This fertilizers and pesticides are very important for any of the agricultural areas, so by using a good fertilizer sprayer we can reduce the maximum amount of pesticides in the cropping areas, and we fabricate the special pumps for this chemical fertilizer sprayer which holds on the top side of the vehicle, when the spraying machine is starts, the whole amount of water or the chemical fertilizers are splits out from that pumps very high pressure and this fertilizers can spread on the agricultural areas. The spraying pumps are placed on the back side of the vehicle.

1) Capacity of the chemical fertilizers sprayer = 18 liters
2) Pressure force of the liquid which is exerted from the pump = 0.75Mpa
3) Number of pumps to be used = 2 pumps
4) Each pump diameter = 13mm



Fig 16: Water pumping setup

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J. Grass Cutter

In this project the grass cutter is one of the most important function and we fabricate this grass cutter are especially for small scale farmers. With this there is one more step to develop in the mechanization of agricultural field. The cutter focuses to unwanted cutting of grass for small scale farmers. In the olden days the grass is cut in the agriculture field by manually, the manual process of grass cutting takes a long time, so the production efficiency decreases with this manual grass cutting process. Actually this project aims to develop the multifunctional tasks in the agricultural field. One of the task is in this smart cultivation system is grass cutting.

Grass cutter is the main important function in the farming field. The fabrication of grass cutter blades must be very sharp to withstand the force which is run by the motor, as the cutting blades are more sharpened the cutting effectiveness is high, by using grass cutter we reduce the working burden on the farmers by replacing the hand using blades with these grass cutters. In this smart cultivating system, we fix the grass cutter in front of the vehicle which is very suitable for the cutting of the grass. We arrange the grass cuter to the motor which is welded on the front portion of the vehicle, the motor which is used for grass cutter is 700 rpm motor. We use this grass cutter to cut the unnecessary grass on the agricultural field.

1) RPM of the grass cutter motor = 700rpm
2) Length of the motor shaft = 20mm
3) Diameter of the motor shaft = 10mm
4) Dimensions of the rectangular cutter blade
a) Length of the cutter blade = 250m
b) Height of the cutter blade = 60mm



Fig 17: Grass cutter setup

III. EXPERIMENTATION

Traditionally human power has been the major source of power on the field from the Stone Age. Hand held tools are predominantly used on operations performed at different phases of crop production on and off the farm. Hand power tools used in farm operations include axe, digger, knife etc. The predominant of human power in the agriculture of developing a country is an important factor to addr3ess in dealing with overall economic development of that country. In this smart cultivating system, the overall operation of the vehicle reduces the hand power of the farmer in the field. The working of the smart cultivating system is just like a farming tractor but our vehicle is more advanced when compared to that by performing multi functions. The engine used in this vehicle is four stroke single cylinder engine comprises of four strokes i.e., induction stroke , combustion stroke , power stroke and exhaust stroke and we arranged the starting system of the vehicle by self switch arrangement beside the steering.

In this smart cultivating system, the engine is placed in back portion of the vehicle. when the clutch is in engaged position, the engine power flows to the transmission to it and the brake is placed to the side of the clutch. We make holes on the rod which is used to fix for the gear system commonly known as gear rod to change the gears while running the vehicle. We choose the tyres very carefully because in the farming field the land is not in a proper way i.e., the land may be low lying area or sand area. So the tyres need to be very effective for moving of the vehicle on the field. The chassis frame of the vehicle is welded very effectively to withstand the load of the entire parts of the vehicle. When the smart cultivating system is moving, the ploughing which is arranged on the back side of the vehicle can be dig into the farm area and perform their work efficiently, with this the grass cutter also cut the grass with their respective motor placed on the front side of the vehicle. On the other hand the fertilizers spraying machine sprays the fertilizers and water in the cropping areas. The three functions performing at the same time while the vehicle is running on the field. The overall working of process of our smart cultivating system will definitely give very profitable results on the agricultural field.

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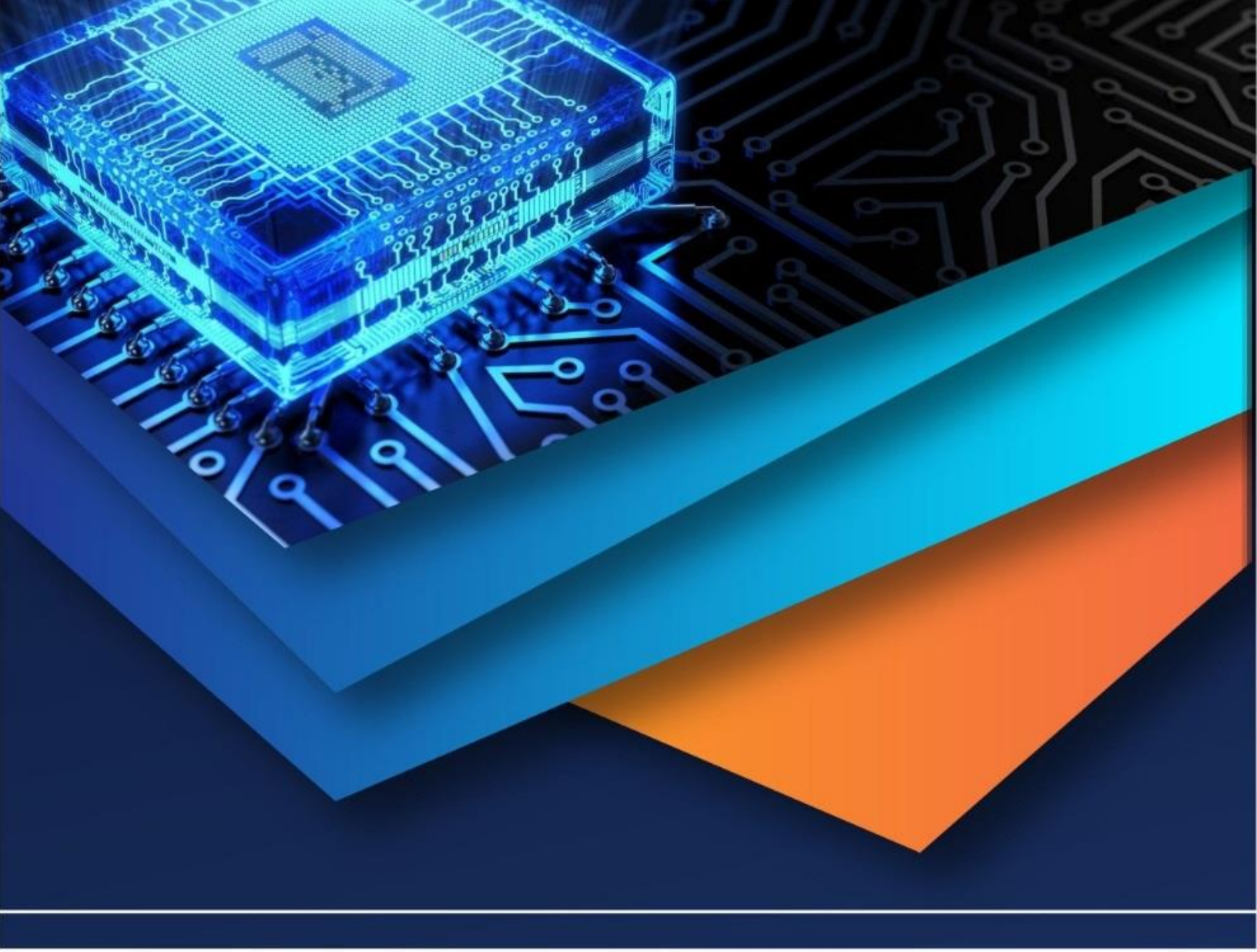
IV. CONCLUSION

This project entitled fabrication of Smart cultivation system is successfully completed and the results obtained are satisfactory. It will be easier for the people who are going to take the project for the further modifications. It very useful for small scale farmers. The cost can be reduced by using this type of vehicle. The agricultural operations are made easier. The reduction in cost of the plough tool is done and the life is also increased. The grass cutter equipment is also made with very low cost and it is very use for small scale farmers for the cropping purpose. For small scale farms, the farmers don't need huge tractors to cultivate the land, so in this aspect for small scale farms the low mechanical equipment is enough to cultivate the small scale farms. So smart cultivating system is the one to cultivate the small scale farms very effectively in a way to give good production economy to the farmers and also it is profitable to them. Because of it performs multi functions i.e., grass cutting, ploughing and chemical fertilizer spraying, the farmers don't need separate machines for these activities. The machining operations of all these activities are very effectively done in a way to give better cropping productions. So we hope that this Smart Cultivating System will perform its functions very accurately and gives the best yielding production operations in the agricultural field.

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