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LAYOUT AND PACKAGING OF ELECTRIC TRACTOR

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Abstract - *Tractors are a major contributor to pollutants among most of the Farming vehicles. This not only causes health problems to the Farmer but also causes tremendous damage to the crops and the environment. To push India's effort in reducing Carbon emission forward we have come up with an efficient layout of an electric tractor.*

The inclusion of solar panels within the design of this tractor plays an essential role to increase the run time of the tractor. Also in places where power shortages are frequent, the tractor will run efficiently on the power supplied by the solar panel.

***Key Words*: Electric Tractor, Pollution, MPPT, Battery, Agriculture**

1. INTRODUCTION

Agriculture is an important sector in our country. Due to the vast agricultural land and development in the field of engineering and technology there are many machineries introduced nowadays to perform several agricultural tasks. But the most important and unavoidable machinery is the Tractor which is also known as Farm vehicle. By using a tractor, tasks like ploughing, tilling and planting etc. have been carried out every day. These tractors cause a lot of pollution due to emissions from diesel engines, which may directly affect the crop.

1.1 Emissions from tractor engine-

Tractors use petroleum based fuels mainly diesel. Hence these tractor engines emit exhaust that contains a combination of nitrogen oxide indicated by NOx, unburnt hydrocarbons, carbon monoxide (CO) .The average value of CO, HC, and NOx emissions are as follows:

CO = 1188, 65 ppm/s, HC = 68, 78 ppm/s and NOx = 139, 28 ppm/s.

1.2 Effects of air pollution on agricultural crops and human life.

Air pollution injury to plants can be evident in several ways. Injury to foliage may be visible in a short time and appear as necrotic lesions (dead tissue), or it can develop slowly as a yellowing or chlorosis of the leaf. There may be a reduction in growth of various portions of a plant. Plants may be killed outnight, but they usually do not succumb until they have suffered recurrent injuries.

It is a well-known fact that NOx is a major contributor to the formation of acid rains. High concentration of NO2 to the atmosphere may cause respiratory illnesses like bronchitis, asthma and other breathing problems.CO reacts with hemoglobin that reduces the oxygen carrying capacity of the blood.

2. Components

2.1 Electric Motor

Electric motor is used as a power source instead of an IC engine. It is directly coupled with the clutch plate so that other systems of the tractor have no need of alterations.

The motor selected is a 25 HP, three- phase induction motor, the motor is rated to be IP67 water and dust resistant, this will make sure that electrical systems are not affected by the splashing water while working in mud and flying dust while working in dry field.

Fig -1: Motor

Table -1: Specifications of motor

Power	25 HP
Speed	2000-6000 rpm
Voltage	415 V
No Of Phase	Three Phase
Frequency	50 Hz
Material	Cast Iron

2.2 Batteries

A battery is a device consisting of one or more electrochemical cells with external connections for powering electrical devices.

The battery to be used is the Panasonic NCR18650GA. These batteries have a max voltage of 4.2V and nominal voltage of 3.6V with a rated capacity of 3300mAh.

2.3 Battery Pack

There are 3 battery packs in the designed tractor.

The battery packs are designed in such a way that concealed coolant lines can pass through them. This would ensure that the system is not overheated and batteries do not lose its efficiency.

Fig -2: Battery pack

Battery packs are located

1. On the Rear Axle
2. Above the Gearbox casing
3. Under the hood above the Front Axle

2.4 Solar Panel

Tractors will usually be set off in bright and sunny atmosphere, but this natural energy is wasted so we have decided to utilize this energy, hence we have placed the solar panels on the hood and on the top of the drivers cabin.

This will convert the solar energy into electricity and store it into the batteries.

This system will increase the operating time of the tractor.

2.5 Motor Controller

Motor controller is the electronics package that operates between the batteries and the motor to control the electric vehicle's speed and acceleration much like a carburetor does in a gasoline-powered vehicle. The controller transforms the battery's direct current into alternating current and regulates the energy flow from the battery.

Fig -3: Motor controller

2.6 Battery Management System

A Battery Management System is an electronic system that manages a rechargeable battery (single cell or battery pack) by monitoring its state, calculating secondary data, reporting that data, protecting the battery, controlling its environment, and/or balancing it

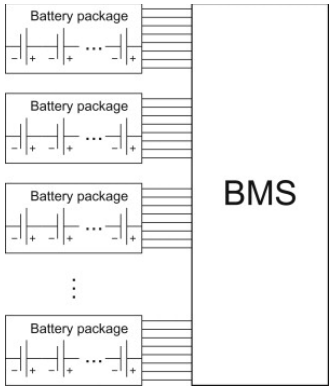

Fig -4: BMS

2.7 Maximum Power point Tracker

MPPT regulates the current generated by the solar panels, if solar panels are working at maximum efficiency then MPPT supplies current directly from Solar panels to motor cutting of the supply from battery, if solar panels are not at full efficiency then it charges the battery and does not provide supply directly to the motor. If the tractor is not working then it charges the battery.

Fig -5: MPPT

3. Working

The motor is connected to the clutch plate via the flywheel. Batteries provide the required power to the motor. This power supply from the battery is regulated by the Motor Controller for varying the speed of the motor which is in turn done by varying the frequency of the supplied current. The Motor Controller works on the input of the throttle pedal which is under the command of the driver. As the motor is directly connected to the flywheel, there is no need to make alterations in the gearbox and other output shafts as they take power directly from the gearbox which in turn takes it from the motor.

Usually tractors are used in bright sunny days. Hence we have placed the solar panels on the hood and the roof of the driver's cabin. There is a maximum Power point Tracker (MPPT) which regulates current generated by the solar panels. If the solar panels are at their maximum efficiency, power generated by them is directly supplied to the Motor controller and the supply from the battery is Cut Off. At this point of time the battery pack is kept in the Standby Mode. If the power generated by the solar panels is not sufficient to power the motor then the power from the solar panel is supplied to the battery packs and the battery packs power the motor.

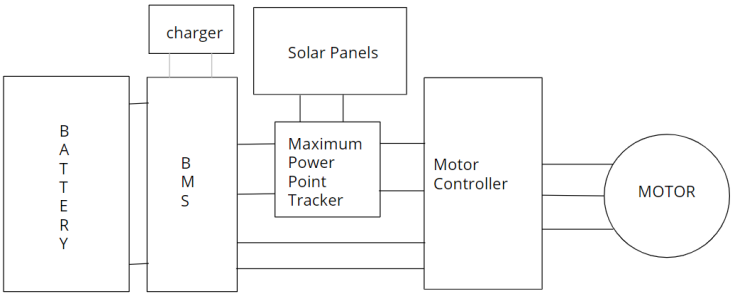

Fig -6: System Layout

4. System Packaging

Tractors must have maximum traction on its driven wheels; ie rear wheel in most of the cases. We have placed the battery packs in such a way that there is maximum traction at the rear wheel and also in such a way that the front wheel do not lift due to less weight.

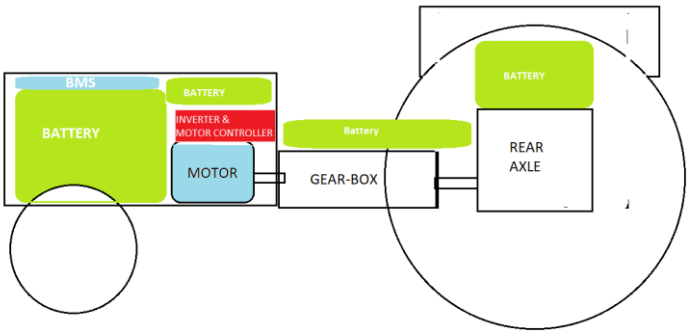

Fig -7: System Packaging

5. Special features of solar panel coating

5.1 Easy Clean & Anti Soiling.

During ploughing and tilling operations, a lot of dust is formed. The accumulation of dust, or other debris on the surface of solar panels leads to a significant loss in light reaching the active semiconductor, reducing power output by up to 50%. There are 17 types of dust pollutant of which 6 types are likely to have significant impact on the power generation of a solar cell, including sand, dust & ash .Our solar panels are coated with easy clean coating which, when applied, eliminates surface contamination, optimising energy efficiency and PV yield.

5.2 Anti Reflective and Resistant To High Temperature

Tractors will usually be set off in bright and sunny atmosphere so the reflections from the solar panels may distract the driver and also hamper the efficiency of the solar panels, so the panels are coated with an anti-

reflective coating. The anti-reflective properties of Solar panels leads to an improvement in transmittance to enable over 93% of all available light to reach the PV semiconductor.

5.3Hydrophobic-

Sometimes tractors are also used for wet tilling operations so solar panels may get damaged so they are coated with a hydrophobic coat. This coating readily repels water and water-borne contamination. Rather than wetting the surface, water droplets form beads on the coating and readily roll-off at low angles. Solid contamination such as dust and sand cannot bind to Solar panels and so are easily removed by the action of wind or by the use of minimum amounts of water

6. CONCLUSIONS

Electricity is provided free in some states of India for Agricultural purposes. Hence the operation cost of tractors for the farmers will be bare minimum as all the states provide electricity at a subsidized rate. There won't be any direct emissions unlike diesel powered tractors due to which environmental damage and carbon emission will be substantially reduced. Reduced pollution will also result in better crop yield.

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