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Smart Electric Tractor

Anish Rachcha[1], Arya Mishra[2], Kanchan Shinde[3]
[1, 2, 3]B.E (Department of Electrical Engineering), K K Wagh College of Engineering And Research, Nashik

Abstract: Due to the environmental threats associated with the combustion of fossil fuels, the hike in fuel prices and everyone is looking for an alternate energy sources to propel the vehicle. One such solution is the adoption of electric vehicles, which accounts for high degree of sustainability as compared to the conventional fuel vehicles. This work presents the working prototype of a Smart Electric Tractor. Description of the subsystems which includes the steering system, braking system, electric powertrain, and the chassis frame will be delineated precisely. Major focus will be to infuse IOT in dynamics and its automation. Design calculations will be carried out to obtain an optimized powertrain.
Keywords: Adoption of electric vehicle, Electric powertrain, IoT in automation

I. INTRODUCTION

This paper will give a brief idea about the subsystems used in the project. The main idea is to emulate the same performance as of conventional tractor. To emulate such kind of performance the following subsystems are required. This project is diverged into the main system and their respective subsystems that are:

1) Electrical System
2) Mechanical System
3) Electronics System

This paper shows complete overview of the entire system. Basically this system consists of three major systems that are Electrical system, Mechanical system and Electronics system. In electrical system Motor and Battery components are discussed.

II. OBJECTIVES

The objectives taken into consideration while working on this project are:

1) *Environmental Concerns:* The conventional tractors emit fumes that are very hazardous for the user as well as for the environment. Also the depletion of fuel is itself a threat to the environment and this battery operated tractor does not raise concerns of degradation of environment.
2) *Reducing Manpower:* These tractors would reduce the work load and extra efforts of the farmer since plan is to make the tractor smart, the physical involvement of the user
3) *Reducing Operating Cost:* Unlike conventional vehicles, electric vehicles cut a considerable amount of operating cost.

III. SYSTEM OVERVIEW

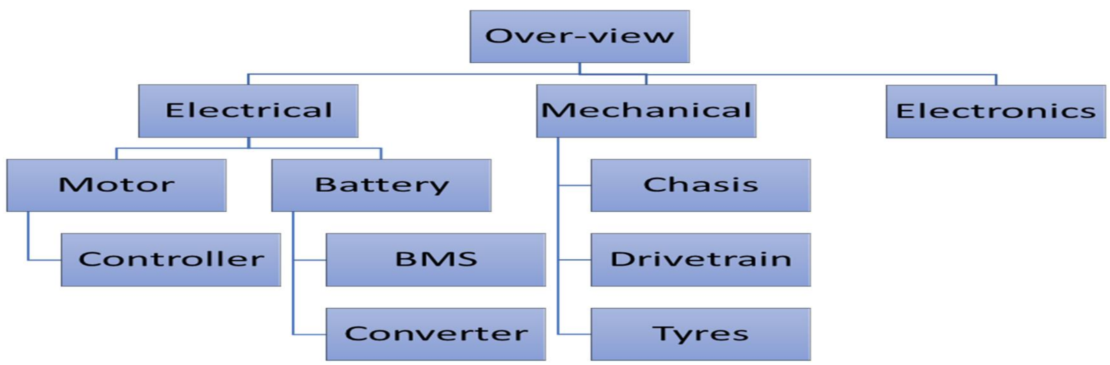

Fig 3.1 System overview Block Diagram

Fig 3.1 Shows the overview of block diagram of the system. The system consists of three major subsystem. Electrical, Mechanical and Electronics. Electrical subsystem consist of motor, battery, motor controller, BMS. Mechanical subsystem consist of chassis, drivetrain and tyres.

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Electrical Subsystem

Fig. 3.2 Electrical subsystem schematic diagram

Fig. 3.2 shows the electrical subsystem schematic diagram The power source here is the grid power we receive. The charger symbolises the charging path from the grid to the battery pack. The charging power is monitored by the Battery Management System(BMS) and thereby given to battery pack. The battery delivers power to motor and controller. The controller gives signals to control the motor functioning's. The motor then powers the differentials for propulsion.

A. Motor

Low weight and excessive energy density is a prime attention in electro mobility. The maximum not unusual place traction vehicles for car packages are synchronous vehicles or induction vehicles while synchronous vehicles are favoured due to their benefit concerning energy density and weight. But every of the motor principles has its blessings and disadvantages. With this adaption it's miles viable to lessen the load and because of this defining parameter the induction motor has in precis extra blessings as compared with the synchronous motor. Therefore it could be the higher desire for electro mobility. After comparing Power to weight ratio, starting torque, Efficiencies of motors at different load, Motor controller cost, and cost of various motors including DC Brushed, DC Brushless, Induction motor, Synchronous Motor and SRM motor, Design D 3-ph Induction motor according to NEMA standards turned into maximum appropriate option.

B. Battery

Because the terminal voltage of Lithium Phosphate primarily based totally cells is 80 % to 300 better than different normally to be had chemistries, cells using lithium provide a far better electricity density, each gravimetric and volumetric than all different non-exotic, rechargeable battery chemistries. While the amp-hour ability of the numerous lithium cells is comparable to NiMH and NiCd, the electricity density of lithium is a good deal better because of the better terminal voltage. This function is the overriding purpose for the arrival of lithium primarily based totally batteries in EVs in current years.

Table 3.1 Comparison of various cell chemistries [Ref.- P ISSN: 1938-8756]

Battery Chemistry	Energy Density (Wh/kg)	Terminal Voltage (Volts)
Lead Acid	12.3	2.0
NiMH	46	1.7
NiCd	56	1.2
NiZn	75	1.7
LiMnO4	100	4.0
LiFePO4	100	3.3
LiNiO2	130	3.6
LiCoO2	140	3.7

After comparing various batteries, $LiFePO_4$ chemistry is most suited.

IV. HARDWARE SPECIFICATIONS

Table 4.1 Tractor Specification Sheet

Sr no.	Parameter	Values
1	Vehicle mass	500kg
2	Supplementary mass	200kg
3	Velocity(max)	5km/hr
4	Radius of tyre	18 inch
5	Frontal area	1.65 m^2
6	Motor efficiency	85%
7	Gear ratio	50:1
8	Wheel Rpm	57.7 rpm
9	Motor Rpm	2885 rpm
10	Wheel Torque	570.72 Nm
11	Motor Torque	13.43 Nm
12	Wheel Power	3446.7 W
13	Motor Power	4055.36 W
14	Battery voltage	48 V
15	Battery Current	25 A
16	Battery Capacity	300 Ah
17	N_{Series}	13
18	$N_{parallel}$	15
19	N_{total}	195
20	Battery weight	150 kg

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V. OUTPUT

Table 5.1 Result Table

Sr. No.	Specification	Remark
1	Charging Time	5 Hrs
2	Range	100 Kms
3	Operating Time	22 Hrs

Table 5.1 shows trial and testing of the electric tractor, output results are mentioned in the Result Table.Charger used is of 60W , therefore time needed to charge battery to its full capacity is 5 Hrs.Range is of 100 Kms

Fig 5.1 Front view of field ready tractor

Fig 5.2 Side view of field ready tractor

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VI. CONCLUSION

The aim of this project was to overcome flaws in conventional tractors and to give a contribution in greener, cleaner and economically stable country. To the reduce fuel consumption, electric tractors are important for farming. It operates on batteries, making farming easy and economical. Even as farming income is to some extent boosted by the use of technology, more can be done to lessen the burden on the farmers.

VII. FUTURE SCOPES

1) *Efficient Transmission System:* Transmission system can further be improved by implementing more gears of the ratio 15:1 or 10:1.
2) *Solar Implementation:* Solar can be installed to charge LV system of the tractor.
3) *Cost Reduction:* Cost reduction can be implied by using other battery chemistries which are cheaper.

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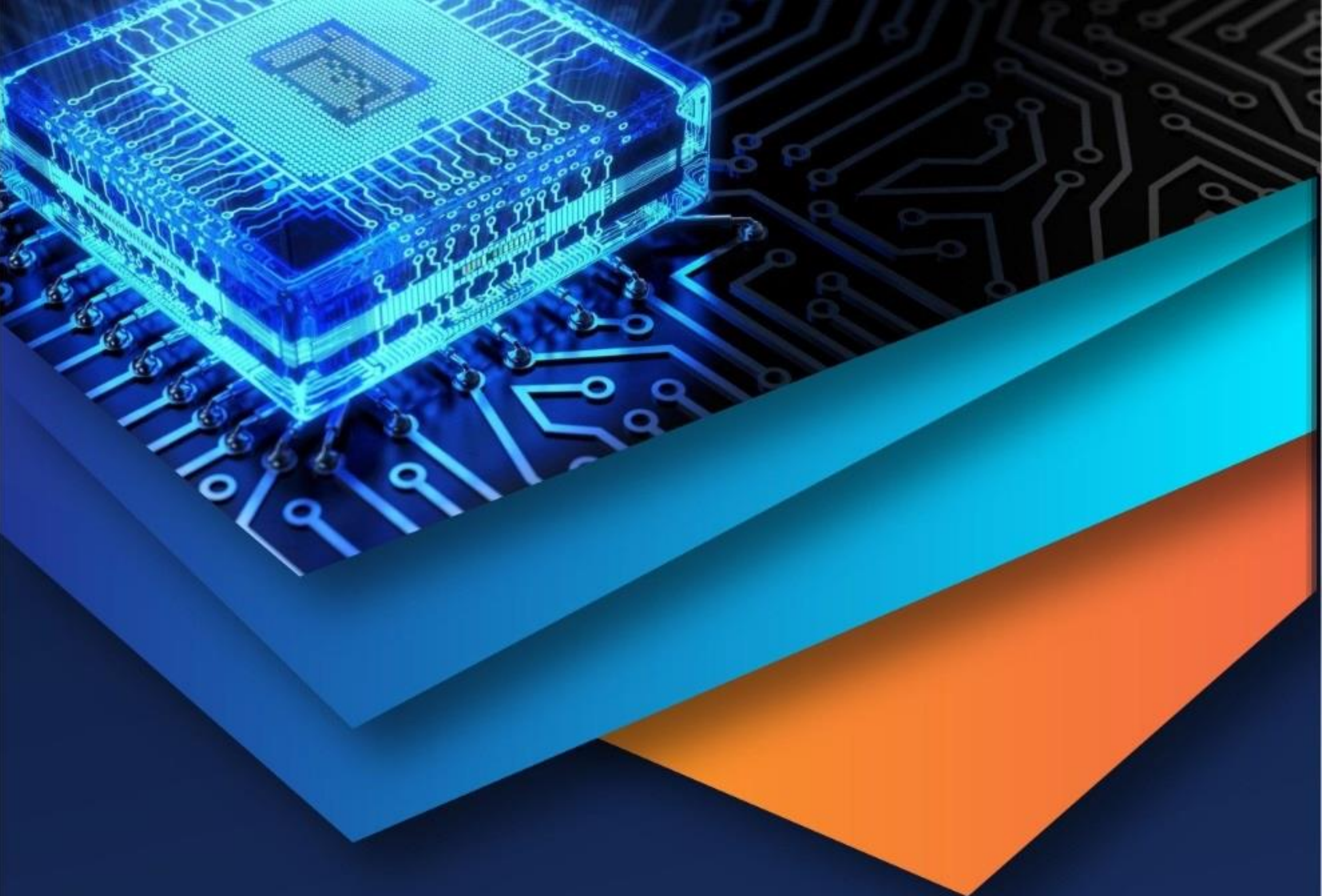

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