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Assembly of Electric Vehicle and It's Optimisation

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ABSTRACT: The electric car (EV) is a relatively new concept in the world of the automotive industry. Although some companies have based their entire model of cars around being proactive and using electricity, some also offer hybrid vehicles thatwork off both electricity andgas.An electric car is a great way for you to not only save money but also help contribute towards a healthy and stable environment. Cars produce a lot of carbon emissions that are ejected into our natural atmosphere, leaving us vulnerable to things like pollution and greenhouse gases. In order to positively help the environment, we live in, an electric car is a great step forward.The electric vehicle industry in India is a growing industry. The central and state governments have launched schemes and incentives to promote electric mobility in the country and some regulations and standards are also in place. While the country stands to benefit in a large way by switching its transport from IC engines to electric motor-powered, there are challenges like lack of charging infrastructure, high initial cost and lack of electricity produced from renewable energy. Still, e-commerce companies, car manufacturers, app-based transportation network companies and mobility solution providers have entered the sector and are slowly building up electric car capacity and visibility.

KEYWORDS: Electric vehicle, optimisation, high mileage, electric battery, tesla, electric car

I.INTRODUCTION

People pay more attention to a zero-polluting electric vehicle with the development of environmental protection consciousness. The exploration of driving security of the vehicle is one of the most imperative subjects on the planet.The main aim of the project is to assemble the vehicle with the most adequate parts available in the market. This project focuses on the assembly of the vehicle and testing of the vehicle. This project includes assembly of tyres, assembly of shock absorbers, reinforcing the chassis, assembly of steering mechanism, assembly of the brake mechanism, assembly of powertrain, and assembly of the electrical component.This project's aim is to design an electric vehicle with 4 people seating capacity which runs on batteries as well as solar panels if modified as a future extension. The need for a car isn't just using it in the smooth road or transportation conditions, not for the hospitality industry, and providing low cost of charging with increasing mileage as technology advances. In this project, the aim has been to put forth an industry-standard assembly for an electric cart that can run exceedingly well on grassy/muddy terrains as well as wetconditions and concreteroads. So in this project, the assembly, as well as testing of an electric vehicle, is presented.

II. PROBLEM STATEMENT

The electric vehicle is now becoming the future of transportation globally, but there are many problems faced by EVs in different scenarios. The Charging Infrastructure is the biggest problem so we are focusing on the adaptation of vehicle to vehicle or vehicle to grid this will provide a large scope for charging the vehicle. Another implementation will be the use of solar power and concepts like regenerative braking to fulfil the power demand required by the vehicle so this will increase the consumer attraction. This project aimed to assemble a high-speed travelling vehicle that is cost-efficient, energy-efficient and also non-polluting.

OBJECTIVES:- The project aims to assemble a highly cost-effective, maintenance-free, easily transportable, pollution-free vehicle prototype applicable for Electric vehicles.

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III.METHODOLOGY

A vehicle frame also known as its chassis is the main supporting structure of a motor vehicle, to which all other components are attached, comparable to the skeleton of an organism. Since the 1930s, virtually every car has had a structural frame, separate from its body. This construction design is known as body on frame. Over time, nearly all passenger cars have migrated to unibody construction meaning their chassis and bodywork have been integrated into one another. Nearly all trucks, buses, and most pickups continue to use a separate frame as theirchassis.

Chassis Extension: Chassis extension is the most crucial part process in the assembly of a vehicle, chassis extension features an easy installation of body panel to chassis. The extension of the chassis features some hardpoints on which mounting of accessories can be done. For making a skeleton of the outer body chassis extension is performed. Its extension a light weight steel box pipe of 1.5 inches may be used as to save weight and also to maintain the structural integrity at the same time.

Transmission: A transmission is a system that transmits power and provides controlled application over that power. In layman terms, a transmission usually consists of a set of a gearbox that uses gears and gear trains to provide speed and torque conversions from a rotating power source to the output The main components of our transmission assembly are Transaxle, Motor and its Controller In an electric car the need for using a separate gearbox is eliminated because of electric transmission and use of motor in place of an engine.
Insteada single-speed reduction Transaxle is used. A transaxle is an assembly of differential gear with one step reduction coupled with a rear axle and hub which is used to directly mount on the chassis. With market research, there are various standard transaxles for electric golf carts with preset reduction gear. One such transaxle with a reduction ratio of 10.45 is chosen for our electric golf cart from various reduction ratios already available. The reason for choosing this ratio was it gave us the best speed for our cart with full loading condition and its cost-effectiveness.

Brakes: Brakes are used to reduce the velocity of a vehicle within less possible time with fewer disturbances in stability of the vehicle. As per the design requirements; all wheels should be stopped at the same time and should be equipped with hydraulic disc brakes The disc brakes are chosen over drum because to provide a disk brake calliper mechanism that is easy to service, and that requires minimal disassembly to change the replaceable brake pads within the brake calliper assembly. A further object is to provide an extremely compact construction for a robust hydraulic disk brake assembly that is able to fit within the very confined space in the vicinity of the wheel hub and wheel rim of a small-size off-road vehicle. After a thorough market research, certain parameters and industry-standard components were selected to meet the required comfortable braking distance and ride quality-assuring safety standards

Steering: The steering system is the key interface between the driver and the vehicle. The main requirement is that the steering should be precise, with no play. In addition, the steering system should be smooth, compact and light. It must also provide the driver with a perfect feel for the road surface and help the wheels return to the straight-ahead position. Among two basic steering mechanisms i.e rack and pinion and recirculating ball mechanism, rack and pinion method was chosen considering various parameters such as availability, widely used and cost . In the rack and pinion system, a pinion gear is attached to the steering shaft, i.e. turning the steering wheel turns the pinion gear which then moves the rack. The rack and pinion gear is enclosed in a metal tube, with each end of the rack protruding from the tube.

Suspension system: Suspensions are very important in any automobile. We know that any system used in vehicles to reduce road shocks and vibration is known as a suspension system. Springs, shock absorber torsion bar etc. are components of the suspension system. So the Suspension Springs are used to separate the Wheel of the vehicle to the body so when the vehicle feels that vibration it transfers to the spring and the spring starts oscillating without transmitting this vibration to the vehicle body. In our electric car, we had the option to choose independent or dependent suspension systems but we chose independent ones for various benefits of. We have used two types of suspension systems for the front and rear.
The MacPherson strut is a type of automotive suspension system that uses the top of a telescopic damper as the upper steering pivot. It is widely used in the front suspensionof modern vehicles and is named for American automotive engineer Earle S. MacPherson, who invented and developed the design. To clear these types of obstacles with ease and without damage to the vehicle systems for a long period suspension system should be that rigid and effective to sustain at any adverse condition. This suspension system is designed by considering 1500 kg which is more than the actual weight of the vehicle.

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Rear Suspension: Their primary task is to compensate for uneven road surfaces and thus provide assurance of high levels of ride comfort. Secondly, they must ensure that the wheels always have safe contact with the road regardless of its condition. Reliable transmission of drive, braking and transverse forces relies on these requirements being met. As such, suspension springs are one of the most safety-critical components of modern vehicles. They affect handling, road holding and braking performance. The other splined end is fixed to the frame. The splines stop the bar from turning in its fixings. Instead, the bar has to twist as the suspension deflects.

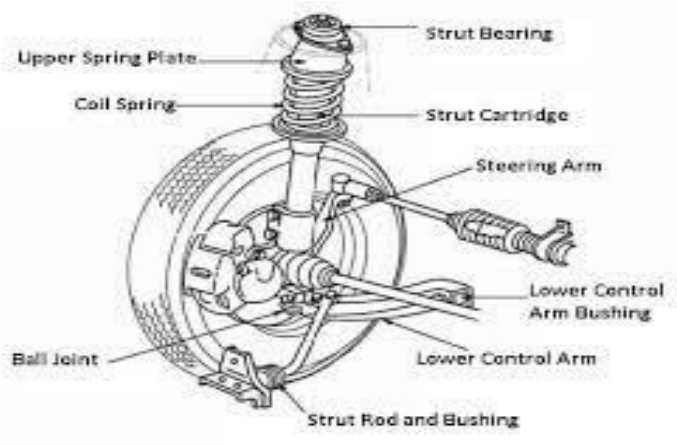

Fig 1. Suspension Fitting

In all forms of steel spring, the forces set up by road shocks are stored by the spring deflection rather than passed on to the passengers. The forces are then released gradually to restore the car to a level ride. Rubber springs can perform the same function, but they do not store as much energy and are therefore used on light vehicles only. A form of hydraulic suspension can be combined with rubber springs to refine the system. The up-and-down movement of the wheel pumps

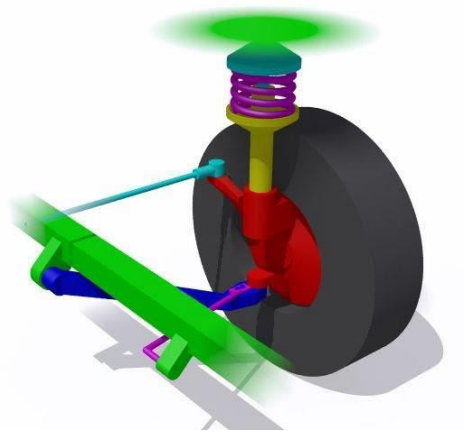

Fig 2. MacPherson Suspension

fluid from one chamber to another through a damper valve. Each chamber has a flexible diaphragm with compressed gas on the other side of it. The gas is compressed further as fluid comes into the chamber through the valve. In effect, the gas is acting as a pneumatic spring. There is usually a link tube through which some of the fluid pumped out of a front-wheel chamber travels to the rear wheel on the same side to equalise the suspension. Citroen hydraulic suspension can be pumped up and down to raise or lower the car to the desired height.

Drivetrain Fitting: The drivetrain or powertrain of a vehicle is the system of a vehicle that provides power to the vehicle to overcome its inertia and set up itself in motion. The drivetrain contains mechanical linkages to transform the energy from the source to the wheels. The source might be an engine in the case of a traditional drivetrain or a motor in the case of an electric drivetrain. The source might be fed by the naturally found earth petroleum products which are currently scarce in today's world and also cause pollution in the environment, or the source can be fed by a cleaner and

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greener energy like electrical energy or hydrogen fuel cell energy. The drivetrain contains mechanical linkages like power transferring CV shafts in the case of typical front-wheel-drive petrol engine vehicles or in the case of heavy vehicles there is a power transfer shaft that transfers power from the engine to the rear differential which is the next link in the drivetrain system. The next linkage in the system is the differential, differential consists of rear axel and a gear arrangement so that the rear wheels can spin independently when the vehicle is making a turn, as during a turn there is a relative speed difference between the wheels of a vehicle is the rear wheels are connected by a solid axel then the inner wheel will experience a loss in traction while the outer wheel will spin normally. So to overcome this problem engineers and automobile manufacturers invented a differential. The differential distributes the power to the rear wheels in the case of rear-wheel-drive vehicles while giving freedom to spin the rear wheels freely during a turn. It also distributes power to the rear wheels equally. These mechanical links are good for the delivery of power and are tried and tested for years but these links also come with a drawback and that drawback is losses. Every mechanical link may it be a CV axel or a differential have the inertia of the internal parts and also friction between the gears. In our case, we have used a different mounting motor that is directly mounted on the differential so to reduce losses in the system.

Motor: In this project we have used a BLDC(Brushless Direct Current Motor) motor which consists of rare earth neodymium magnets in it's rotor which have stronger magnetic fields than a ferromagnet and at the stator side there are three phases which controls the RPM and torque of motor. The commutation of the motor is done with the help of electronic switches like MOSFET, FET's, etc. By giving timing pulses with the help of a timer circuit to the gate proper commutation can be achieved. With the commutation circuit the reverse and forward operation of the motor can be performed and regenerative braking can be achieved. All these circuits are contained in a box called a controller. The controller also contains some protection circuits like over current protection, over-temperature protection.

Controller: Controllers are one of the essential parts of an electric vehicle. In this project we have used the Kelly KLSM series controller. This controller consists of commutation and timing circuits also some protective circuits are present inside it. Also inbuilt extended fault detection is present, a low voltage, the controller keeps monitoring battery recharging voltage during regen braking. Monitoring battery voltage. It will stop driving if the battery voltage is too high and it will progressively cut back motor drive power as battery voltage drops until it cuts out altogether at the preset "Low Battery Voltage" setting. 5 switch inputs which are activated by

Fig no 3. Chassis prototype

IV. TESTING

During the testing of the vehicle, we did ensure to put the vehicle in the real-world scenarios so to assess the vehicle in the real world scenarios. During the phase1 of the project while testing the chassis we encountered problems like

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differential gear slip, etc. After solving the problems, we tested the vehicle on various surfaces to measure it's durability and agility.

Some tests performed during testing of vehicle are as follows:

Standardized driving manoeuvres : Some manoeuvres like straight reverse, pulling up on the right, pulling up on the left, forward bay parking, parallel parking, reverse around a corner these manoeuvres are normally done during the driving license test therefore are the basic manoeuvres which any vehicle can handle. By this test we come to know the handling capacity of the vehicle.

Lateral, vertical and longitudinal dynamics : By driving on various gradients we come to know the gradient dynamics of a vehicle. Driving on an ascending gradient will give the loading capacity of the vehicle, during the ascend testing we tested the vehicle on ascending gradient of upto 40 degrees with two passengers. The vehicle performed well carrying the load with a max speed of 20km per hour. On the descent test, we tested the vehicle on a descending gradient of 40 degrees with electronic braking switched on. During the descent testing, the vehicle performed well with maintaining the speed by breaking through the motor. By these tests we come to know the gradient dynamics of the vehicle.

No-load test: Testing the vehicle on no load will give the losses which will contribute to the running of the vehicle. There are mechanical losses in the vehicle which comprises bearing losses and gear losses, the bearing losses are present at all four wheels and the gear losses are present at the rear differential. To minimize the gear losses in the diffentrial a thick oil of high viscosity is poured in the diffentrial container where the gear arrangement is done. The no-load losses consume 10 percent of the total power.

Terrain test: Modern vehicles face different types of terrains in lifetime. There are three types of terrains that are normally faced by any vehicle during its lifetime, and they are dry, wet, and muddy. Our vehicle is tested on all these terrains. We have done 50kms of dry terrain test, 20km of wet terrain test and 5km of muddy terrain test. Our vehicle withstood all the conditions. Also, we tested our vehicle on uneven roads, to benchmark the comfort and the overall durability of the vehicle.

Fig 4. Final prototype of EV

V. CONCLUSION

Thus, designing the design of the chassis and trying to innovate with different pipe sizes and shapes giving a unique looking car with considerable strength and balance. In addition to reducing the weight of EV so it can cover the maximum distance in less charge and achieve the highest possible efficiency . The performance of overall vehicle

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including its speed , braking distance , and turning radius was achieved. Henceforth, the braking was improved a lot by this alignment design moreover with better speed according to peer EV in today's world with better and small turning radius. After completion of all kinds of work the vehicle can run with 5-person weight at a good speed and can easily cover 28-30km distance in a single charge with this light EV and efficient one.

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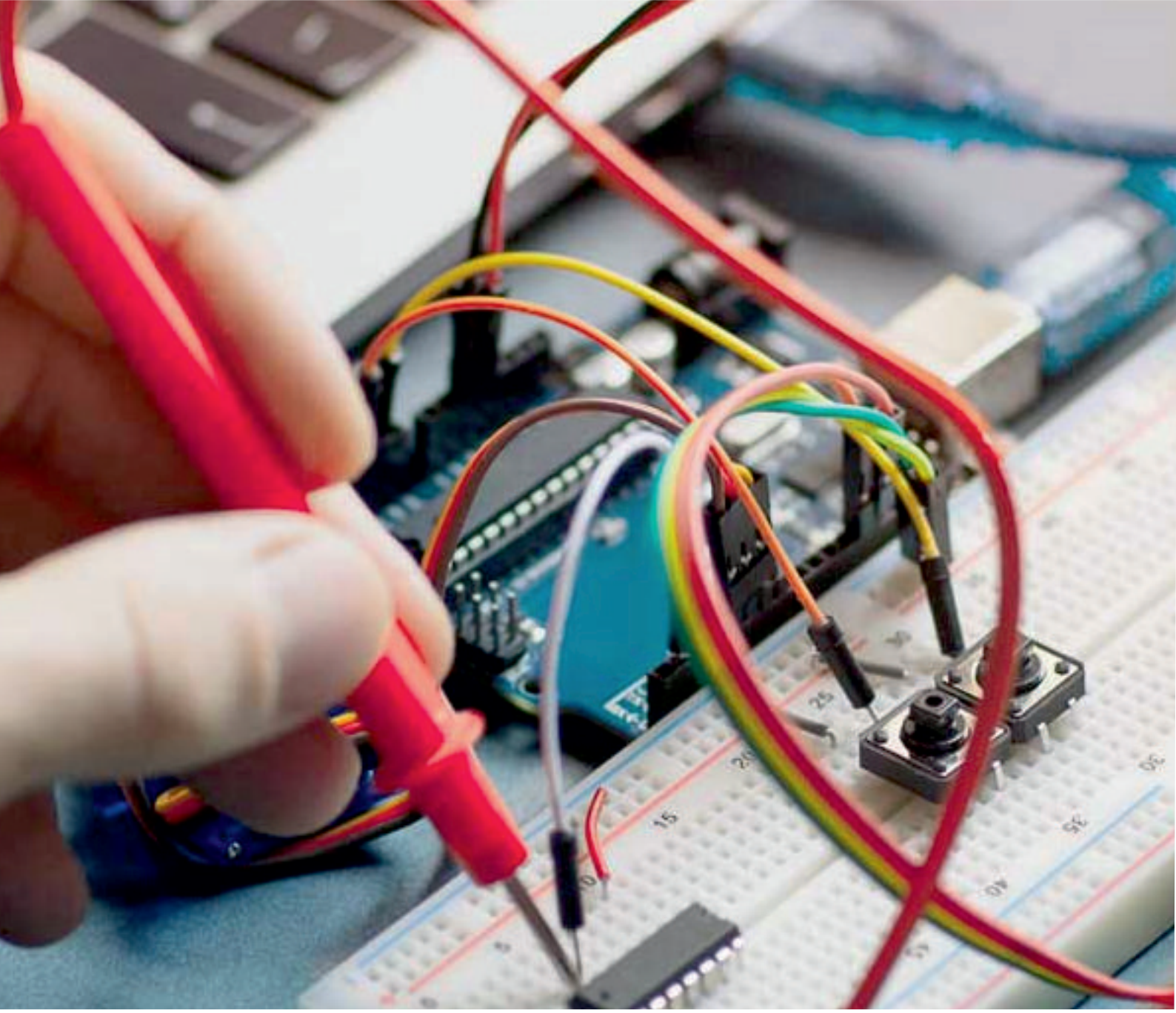

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