ELECTRIC MOTORBIKE

- GREEN
- SMART

Welcome to the future!
Powering **India's Electric dream.**

FACTS:

- Electric motorbikes were commercially available as early as 1990's.
- But till date we don't see an electric motorbike on road.
- Three primary reasons are:

1. Price!
2. Range!
3. Charging and discharging time!

- It's expensive because of the batteries .
- Its range is less (also) because of the batteries.

Although these days we are able to spot an electric scooter on road !
It just says that the world is catching up with the EV's.
Tesla being the game changer!

Recent policies by the Indian government shows that India is Electric Ready!

E-MOTORCYCLE

- It's a disruptive technology (innovation)!
- Disruptive technogies are more like a Marketing challenge.
- Market doesn't exist yet(very negligible) in India.
- Companies leading the race right now:-

Zero motorcycles.

Tork motorcycles.

Ather energy.

WHAT DOES THE FUTURE HAVE IN STORE FOR US?

- Electric Scooter and Motorcycle market is estimated to reach 55 billion USD by 2024. About 60 million electric two wheelers would be on the roads.
- The cost of lithium ion batteries are falling and also the energy density (more energy for a smaller size of the battery) is increasing.
- Indian government's plan to electrify the vehicles on the road in by 2032.
- Growing awareness among people about the benefits of EV's.

THE MOST IMPORTANT PART:- WHY E-MOTORCYCLE?

E-MOTORCYCLE

- Air pollution:- Completely green and clean.

Infact it's a zero emission vehicle (ZEV). Its 18 times more energy efficient than an SUV.13 times more energy efficient than an sedan.6 times more energy efficient than rail transit and of equal impact to enivironment as conventional bicycle

- Noise pollution:-Error 404 :- silencer not found, and hence zero noise pollution.

About 85 percent of energy is utilised in electric motorcycle whereas 85 percent of energy is lost in conventional vehilces having internal combustion engines.

CONVENTIONAL MOTORCYCLE

- BY 2020 India alone would have approximately 205 million motorbikes.This doesnt include mopeds and scooters.According to delhi statistical handbook 2014, 2 wheelers pollute 50% more than 4 wheelers.A recent study revealed motorbikes emit 16 times the amount of hydrocarbons compared to cars.

- Although the manufactures almost maintain and abide by the rules of noise pollution its sometimes the consumers who modify the silencers to get attention and what not. You must've seen the modification of royal Enfield bullet silencers.

OBJECTIVES!

- Making of E-motorcycle:-

1. First lets make a simple e-cycle.
2. Conversion of an old motorcycle into electric motorcycle (with very basic features like moderate speed and range).
3. The final product (improved performance with smart features like ride modes).
4. All this within the reach of a common man!

- Then let's think about setting up conversion centres cause not everyone can purchase a manufactured product, let's save time , effort and resources by converting old conventional bikes into electric.
- Setting up of charge stations across the country!

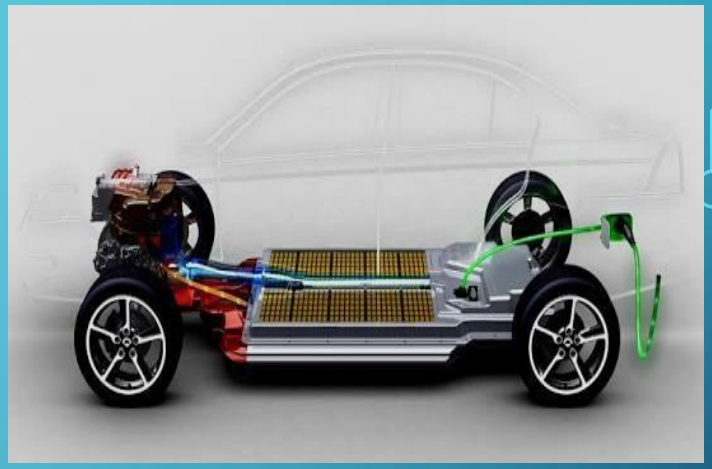
THINGS TO BE CAREFUL ABOUT:-

- Design complications can be avoided by choosing a right donor bike.
- Including regenerative braking is a bad idea because it gives only 6% more range while increasing the budget by 30%.
- Choosing Lithium batteries is a bad idea as it almost doubles the whole project budget!
- Lots of power would be wasted in tackling air resistance (drag) so the design of the chassis should be in a way to reduce the drag (modern efficent methods can reduce by 30%).
- The chassis has to be lightweight as it would decrease the burden on motor and batteries.
- We should think of increasing range by utilising renewable energy methods which could charge the bike while on road!
- The most important thing is to choose right combo of battery, motor and controller!

COMPONENTS:-

1. Batteries.
2. Charger and battery management system.
3. Motor.
4. Controller.
5. DC to DC converter.

BATTERY:



The battery is the most crucial part of an EV. Most of the cost for the project goes for the battery and battery related components. Things to be taken care of while choosing a right battery:

1. Battery energy density.
2. No. Of Cycle before a battery dies. Many batteries have a lifetime from 1.5 to 10 years.
3. Time(charging time should be less and discharging rate should be less , it shouldn't discharge much energy when kept idle).

- The type of material (toxicity and recyclable).
- So after going through all the suitable battery types are:-
- Lead acid batteries:- Best choice as of now due to its cost effectiveness but those are very heavy.
- Lithium ion batteries:- These are expected to dominate the future , with advancements going every now and then, they are set to become much affordable and with more energy density. The only drawback as of now is it's cost. Actually we can make a lithium ion battery from the cells of an old laptop and similar electronic gadgets.
- Futuristic battery technologies to look for:-

1. Na ion batteries.
2. Lithium air batteries.
3. Solid state batteries.

- Each battery has a 12v rating and different Charge Storage Capacities. If a battery is rated as 12kwh it doesn't mean we can use full capacity, in practice it's about 70-80 percent of the stated capacity.
- When two batteries are connected in series the voltage is added up but the current drawn is the same.
- When two batteries are connected in parallel the current drawn is doubled,but the voltage is the same.
- The battery may also need a thermal management system to increase it's life.
- It's considered ideal if the weight of the batteries account for 30 percent or more of total weight of bike . It just ensures max storage capacity and optimum range.
- When batteries are connected in series the voltage gets added not storage Capacities, when in parallel the storage capacity get added not voltage.

CHARGER:-

- Charger is the lifeline of EV.
- Charger depends on type of battery.
- Charger must be programmable and smart.
- Charging for 1hr or 8hrs both would count as one cycle.
- We can even opt for solar or wireless charging.
- Not every time we would be at home so setting up of charge stations is required.
- Charger are of two types :- constant voltage and constant current.

THE BEST CHARGING METHOD!

- Limit the battery current in first 90 percent and limit the battery voltage in last 10 percent.

Lets examine the four state of phases(of fully discharged battery:-

0-20 percent:-

its a critical phase and so handle with care. lets say a battery can handle c/20 rate

you can charge with c/1 rate and charge in 1 hour but it will damage the battery.

so c/20 is preferred.

20-90 percent:-

c/10 is efficient.

90-100:-

drop back to c/20.

lets say c is 200

10a(c/20 for 5 hours)=50

20(c/10 for 7 hours) middle=140

10(c/20 for 1 hour)=10

total=13 hours.

middle part can be charged at max rate of c/5 which can cut the total to 9.5 hours.

A BMS or battery balancer ensure that each battery gets charged according to its storage as all cannot have equal charges it has to adjust the charging rate for each and every battery.

MOTOR:-

- Types:-
- 1. Crank drive motors.
- These power the bike through pedal cranks same way as the rider does.They are more powerful than hub.It provides more central weight distribution and lower centre of gravity.
- Pros: everything else.
- Cons:- initial price.

- 2. Hub motors.
- As the name suggests these have motor in front or rear wheel. It either pushes or pulls the bike just like a car.
- pros: Price, little or no resistance when not using electric power.
- cons: evereything else.

As we have to make the product affordable we would go with the hub motors.

HUB MOTOR:-

- **Types:-**
- 1.Direct drive hub motors:- These are very powerful but very heavy.
- The motor rotates at exactly same speed of that wheel.
- These provide large amounts of torque and power. But these are big and so decreases the range.
- Its easy to find a 1000 watt of this kind.
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- 2. Geared hub motors:- These have gears inside.
- The motor rotates at many times of that wheel.
- These are smaller and lighter so range can be increased.
- But it cant be more than 350 watts.
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ITS A HUB MOTOR BUT ON REAR OR FRONT??

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- Weight matters: Batteries are most likely to be placed at back or in middle so having a hub motor on front is generally considered conventional. But as the weight on the front wheel is less the front hub motor would have less traction.

- So the rear hub motor has greater traction. Traction is the grip of tyre.
- Ease of installation: Front motors can be installed easily.
- **Conclusion:**
- **Weaker hub motors are used on front and Powerful ones are placed in rear.**

CONTROLLER:

- A controller is the brain for the E-motorcycle.
- A controller is what controls the power to the motor.
- The controller voltage must match with the batteries.
- Speed control can be achieved by a throttle!

DC TO DC CONVERTER:

- A **boost converter** (**step-up converter**) is a **DC**-to-**DC** power **converter** that steps up voltage (while stepping down current) from its input (supply) to its output (load).
- It's used when there are different components like GPS, lights, horns etc which require different voltages.

SPECIFICATIONS OF OUR E-MOTORCYCLE

- Battery:- Lead acid batteries , 24v in the initial and can be upgraded to 72v lithium ion battery in later. lets Say the charge is 24Ah.That implies it has 576 Watt hours.
- Motor:- 24v hub motor. Which can be upgraded to 48 v in near future.Lets say the wattage is 350W. The current is therefore 350/24=14.58 A(approx)
- Motor controller:- 24volt with max 25amp.
- https://robokits.co.in/e-bike/e-bike-dc-geared-motor-24v-300rpm-350w-with-controller
- So at full throttle it will last for approx 1.5 hr(576/300).(Average it to 300 as we don't go at high speed always).
- Let's say the rpm is 300.Lets say the diameter is 0.5 meter , linear speed=300×3.14*0.5/60=7.85m/s=28kmph(approx)
- Therefore range is 28×1.5 = 42km(approx). In practice considering user weight and air drag the range would be atleast **30km.**

LAST OBJECTIVES:-

- Think about a way of setting of fuel station across the country.
- Introduction of smart panel with features which keeps the user always connected with the bike.(GPS and custom riding profiles)
- Not everyone can afford a bike so think of setting up of conversion centres.
- Inclusion of foldable solar panels etc which can help in charging the bike whenever feasible.
- Increase the range , speed and storage capacity of batteries.
- The charging time should be less and battery must last for long.