CHAPTER 5
RESULTS AND DISCUSSIONS

Urbanization has caused many affects on public life. Presently, the daily activities are mainly dependent on vehicles. So the density of vehicles in city areas is increasing day by day. Mainly, many of these vehicles are all dependent on non-renewable energy sources like petrol and diesel. These sources are extinguishing day by day and may not last long. People are also taking war in certain countries because of oil crisis with political instability. With all these factors of oil, we are seeing the prices of oil going high day by day making the common man’s life unbearable.

In a country like India the usage of two wheelers for daily activities are high. To bring the advancements in these two wheelers, Hybrid Electric Vehicle prototype is being developed. In Presently all two-wheeler vehicles are running on Internal Combustion Engine (ICE) for which the propulsion is derived from petrol fuel. Only small in number the two-wheelers driven with electric motor whose propulsion is derived from electric batteries. The mixture of both is named as Hybrid Electric Vehicle. Generally ICE driven two-wheelers can attain high speed, high torque with trustable attributes in maintenance, replacements. Electric motor driven vehicles can attain comparatively less speed, less torque with feasible maintenance and replacements. ICE can serve more life time comparatively to Electric motors. Charging the batteries in electric motor driven vehicles will consume more time and become unavailable for usage in terms of emergency. Though ICE is efficient comparatively to electric motor, because of petrol prices the availability to common man is least in usage. The batteries used in electric vehicles will have a valid life cycle for charging and discharging and has to be replaced after that. The battery cost will be about 25%-35% of actual electric vehicle cost which makes the consumer to think twice before buying these types of vehicles.

With respect to all above said factors, considering any ICE driven two-wheeler vehicle, the front free wheel is replaced by electric motor in-wheel a Hybrid Electric – ICE vehicle can be developed. Here both the wheels of the vehicle will gain individual propulsions. Front wheel will gain propulsion by electric motor with
electric batteries as source, whereas rear wheel will gain propulsion by ICE with petrol as source. The vehicle complete motion will be derived by summing both the propagations derived. The rear wheel motion is controlled by accelerator whereas the front wheel motion is controlled by motor speed controller similar to accelerator. By synchronizing the propagations of both the wheels the required propulsion for the gradient movement in the vehicle can be easily obtained. Consumption of petrol by only ICE driven vehicle for driving through one KM distance can be minimized in this case by moderately operating the ICE accelerator in Sync with Electric motor speed controller. Consumption of battery power by electric motor through a distance of one KM will be minimized here as its speed is in sync with ICE propulsion.

Considering one ICE driven vehicle, whose front wheel is replaced by 250W hub in-wheel motor. The motor controller and 60V electric batteries are connected to this electric motor. In this vehicle, to attain motion from rest only ICE is used, once it attains motion, ICE accelerator is minimized energizing the electric motor. As the electric motor has inverse Speed-torque characteristics, the amount of power consumed by electric motor already in motion will be less as the torque required at that speed will be low. Minimizing the ICE accelerator on one end saves the petrol, and energizing the revolving motor minimized the power consumption. The sum of these two propagations will be the ultimate propulsion attained by the vehicle with less petrol and power consumption for a specific distance comparatively to only ICE and only Electric Motor driven vehicles.

In India more area is of hilly gradient, where this type of vehicle can be made run without any issues with respect to any upper or lower gradients. In this type of vehicle both the hands of the driver are used to control the total propulsion. In urban areas where there are more stops and starts this type of vehicle suits more. Since there is synchronization between the electric motor and ICE propagations, less petrol consumption can be seen with less charging cycle of batteries (long life per charge).

Throughout this designed vehicle analysis, With an average speed of 40Kmph in the derived driving cycle, for flat road, if the vehicle is propelled completely by only ICE (engine provides complete tractive effort, both resistance overcoming and with respect to acceleration), then it should deliver 2.05KW of power for the vehicle
propulsion. With constant $g_e = 250-350 \text{ g/KWh}$, and $\gamma_f = 0.737 \text{ Kg/ liter}$, the petrol consumption by the engine in whole driving cycle derived will be approximately 90ml for engine-only mode. By considering the combined operation of both ICE (in overcoming the road resistances) and motor operations (tractive effort with respect to acceleration) for complete propulsion of the vehicle, with an average speed of 40Kmph, with a motor tractive power of 1.52KW and engine tractive power of 0.52KW (1.52KW+0.52KW=2.04KW), the fuel consumption by the engine in the driving cycle derived will be approximately 25ml. About 50% to 70% of the fuel for ICE can be saved in this derived driving cycle of the test route chosen if this type of hybrid ICE-electric vehicle is being designed and followed in driving. As everything is dependent on fuel resource in this age, if conservation of these are promised then our country can compete globally.

These types of vehicles are also more trustable, reduces noise and air pollution. By using this type of designed vehicle an average of 50%-70% of petrol can be saved. The time of charging the batteries are also reduced. The drawbacks of only ICE driven and only EM driven vehicles can be overcome by using this type of vehicle. Batteries can are charged either by plugging into AC outlet through suitable charger or through designed LT based solar charger. Proved that, Solar charging saves money and time hence utilizing the renewable energy.

The government has to take steps in commercializing these types of vehicles framing the schemes for common man’s availability.