Design and Development of Small Electric Vehicle using MATLAB/Simulink

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ABSTRACT

The issue of the depletion of oil reserves in the world, and the problem of air pollution produced by motor vehicles, motivate many researchers to seek alternative energy sources to propel the vehicle. One promising way is to replace combustion motor with an electric motor, which is known as an electric vehicle. First stages of this research is to model the flow of power in the electric vehicle energy system to obtain its characteristics. Power flow efficiency in electric vehicle is very important because this type of vehicle is highly dependent on the limited electrical energy supplied by a battery. Therefore it should be managed properly. This study is to look into the power flow calculation so that the amount of electrical energy is in accordance with the needs of electric vehicle. The design of small electric vehicle model using MATLAB/Simulink software is to get the best power flow response to the electric vehicle energy system.

Keywords

Electric vehicle, power flow, state of charge, Simulink

1. INTRODUCTION

The indicators of success of development characterized by high levels of population mobility. To increase mobility services required a means of transportation. One of the means of transportation used in the cities and villages is a vehicle. In Indonesia, the vehicle is used mostly with oil fueled. Vehicles with fuel oil is grow in line with lower world oil prices at the time and too much supply of fuel oil [3]. Consumption of fuel for vehicles is more increasing. More than half of world energy consumption is used for transportation. Figure 1 illustrates the differences are striking between fuel demand and world oil production after the year 2020 [8].

Increased consumption of fuel oil to fuel the vehicle affect fuel supplies are running low [8],[11]. Besides, the use of fuel oil on the vehicles produce exhaust gases that potentially pollute the environment. Flue gases produced by vehicles consist of 18% solid particles, 27% mixture of volatiles (comprising 28% Pb, 32% NO and 62% CO) and CO_2 by 25% [2].

Another deficiency of this type of vehicle is the noise level is high enough. Air pollution also impacts on the environment [1] and human health [5]. Of these problems need to be a change in energy source from fuel oil to electricity as a source of power driving a vehicle.

Human effort in order to reduce dependence on petroleum fuels and environmental pollution is to make electric vehicle [3],[6],[12]. The main components of the electric vehicle is an electric motor as drive systems, electrical energy sources, control systems as a central control, and power converter as a device that converts electrical energy source with variable needs of the electric vehicle by switching devices. Meanwhile electric vehicles generally use a battery as its main energy source [2],[3],[6]. But the batteries on electric vehicles have a weakness that has the capacity and service life is limited so that necessary arrangements for charging batteries do not work hard. Power flow model of electric vehicle energy system is needed to obtain the energy needed by an electric vehicle that can determine the required battery capacity.

The experiments to determine the capacity of the battery when the battery in working condition also has been done [10]. While the development of hybrid electric vehicle with energy from the battery and flywheel also been conducted[7]. Flywheel energy is used as an alternative if the vehicle is in acceleration phase. Through this flywheel as well as the remaining energy is used for regenerative braking is stored in the battery. Dynamic model of a complete electric vehicle consists of controllers, inverters, traction motors and batteries and braking have also been developed [9]. The model was developed with model Matlab/Simulink (Mathworks). The prediction model of electrical energy in electric vehicle with MATLAB / Simulink was also developed with statistical methods [4].
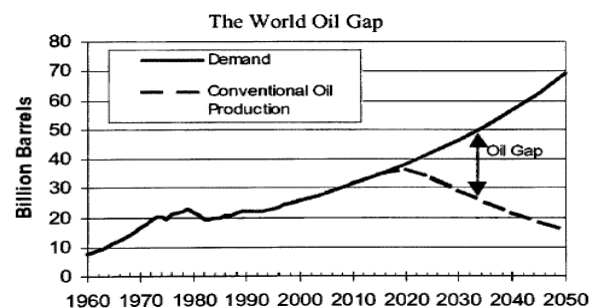

Fig 1: World oil demand by 2050 [8].

We developed an electric vehicle adapted to urban conditions in Indonesia which densely populated and narrow streets. This type of vehicle is expected to be solution for urban transportation later. The electric vehicle which we developed can be seen in Figure 2.