



**Inventors**  
 OOI JUN HAO  
 DAVID MOK MUN KIT  
**Supervisor**  
 HJ. WAN SHAHRIZAL BIN WAN NADHARI



SCHOOL OF MECHATRONIC ENGINEERING,  
 Pauh Putra Campus, UniMAP, 02600 Arau, Perlis,  
 w.shahrizal@unimap.edu.my

DIPLOMA PROGRAMME COORDINATION UNIT,  
 LEVEL 1, BLOCK A,  
 KOMPLEK PENGAJIAN SEBERANG RAMAI  
 02000, KUALA PERLIS, PERLIS



# HYDROGEN FUEL CELL POWERED ELECTRIC VEHICLE

## SUMMARY OF INVENTION

Fuel cells (FCs) is device that utilize an electrochemical process to convert chemical energy of the fuel into electrical energy. This electrical energy can be used to power vehicles, electronic devices, houses and etc. Hydrogen is the most common fuel in the fuel cell system, but hydrocarbons such as natural gas and alcohols like methanol are sometimes used. This project is about developing a Hydrogen Fuel Cell Electric Vehicle (HFCEV) that run by electric current that produce from the Polymer Electrolyte Membrane (PEM) fuel cell which is being carry onboard in the vehicle.



Figure 1: Overall view of Electric Vehicle



Figure 2: Hydrofill Refueling Station

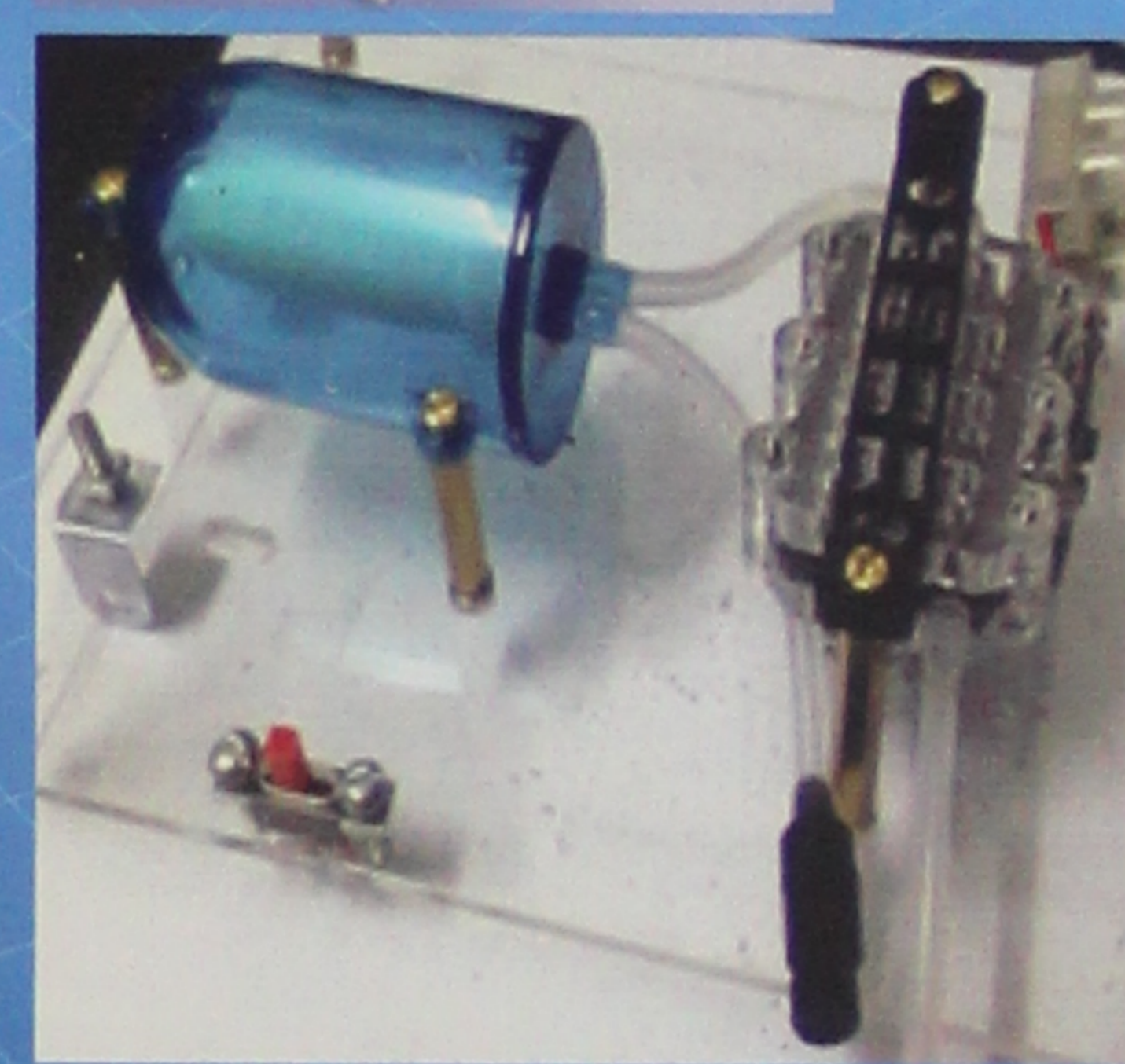


Figure 3: Full Set of Connection of PEM Fuel with H<sub>2</sub> Storage Tank

## ADVANTAGES

1. Operating times are much longer than with batteries, since doubling the operating time needs only doubling the amount of fuel and not the doubling of the capacity of the unit itself.
2. Low temperature fuel cells (PEMFC, DMFC) have low heat transmission which makes them ideal for military applications.
3. Fuel cells can eliminate pollution caused by burning fossil fuels; for hydrogen fuelled fuel cells, the only by-product at point of use is water.
4. Reduce economic dependence on oil producing countries and creating greater energy security for the user nation.
5. Fuel cell has a higher efficiency than any diesel or gas engine.
6. Most fuel cell operate silently, compared to internal combustion engines and suitable in indoor application.
7. The maintenance of fuel cell is simple since there are a few moving parts in the system.

## NOVELTY OF INVENTION

1. Using Hydrogen Fuel Cell system to replace the battery function for moving of a vehicle.
2. Hydrogen Fuel Cell system will produce zero carbon emission on environment.
3. High efficiency of conservation of energy.

## MARKET & FUTURE POTENTIAL

1. Increasing amount of stack of the fuel cell so that it will produce a higher current and voltage. Therefore the vehicle is able to move in a greater speed and higher mobility.
2. Integrating the vehicle using smartphone to control manually the movement of the vehicle.

### Calculation for Chemical Energy of Hydrogen

Mass of Hydrogen = Density of Hydrogen (H<sub>2</sub>) \* Volume of tank

$$= 4.356 * E^{-8}$$

Molar mass = Mass of Hydrogen / mol

$$= 2.178 * E^{-8}$$

Total of (Energy Carries) = Molar mass \* Enthalpy of Energy H<sub>2</sub>

$$= 4.356 * E^{-8}$$

Molar mass = Mass of Hydrogen / mol

$$= 2.178 * E^{-8}$$

Total of (Energy Carries) = Molar mass \* Enthalpy of Energy H<sub>2</sub>

$$= 6.228 * E^{-3} \text{ J}$$

Calculation for Kinetic Energy of Chassis Moving :

Kinetic Energy Formulae [ Ek = 1/2 \* m \* v<sup>2</sup> ]

Calculate Ek = 1/2 \* m \* (d/t)<sup>2</sup>

$$= 4.8578 * E^{-3} \text{ J}$$

Calculate Efficiency of Conservation of Energy :

Efficiency % = Eoutput / Einput \* 100 %

$$= (4.8578 * E^{-3}) / (6.228 * E^{-3}) * 100 \%$$

$$= 77.99 \%$$

The Result Show The PEM Fuel Cell is High Efficiency

[www.unimap.edu.my](http://www.unimap.edu.my)