

IPRO 304 Fall 204 – Project Plan

1. Objectives

The main objective and purpose of this IPRO is to create a hybrid system using a hydrogen PEM fuel cell and Lithium-Ion batteries to power a wheel chair so that it will be capable of transporting one person for at least 100 miles without experiencing any major difficulties.

This project has been split into two periods due to an important event requested by one of our sponsors:

The first period involves preparing the wheel chair so that it will be able to complete a 100 mile drive in roughly one week's time. Due to the limited time available before this event the wheel chair will not be using a hybrid system. Instead, the wheel chair will be using a design created by the previous IPRO that was working on this project. Their design essentially used 2 banks of Li-Ion batteries. While one bank is being used to power the wheel chair, the other bank will be charged using the hydrogen PEM fuel cell. The Li-Ion batteries that will provide the power have been designed and built by the previous IPRO. They will be using a phase change material as a passive cooling system. Our main goal for this first period is to complete the system that was provided to us so that the wheel chair will be fully functional at the day of the 100 mile drive. (The exact day of the 100 mile drive will be determined by one of our sponsors.)

The second period of your project will involve the creation of a hybrid system. This hybrid system should be able to power the wheel chair while taking additional energy from the Li-Ion batteries when required. Various design and safety issues must be addressed before this system will be ready to use; this is the main goal of our IPRO.

2. Background

In the world today oil is becoming scarcer and greenhouse gases are an important factor towards the global warming that is being seen today. There is a limited amount of oil available to mankind before all the natural reserves will be used up. It is therefore becoming more and more important to find alternative energy resources that will be used once oil is not an affordable option anymore. Hydrogen is one energy resource that is rather easily obtained. Hydrogen can be used with fuel cells to create electricity which on the other hand can run motors. The particles that get create by the reactions in the hydrogen PEM fuel cell are only water. Therefore not only is an alternative energy source found but the greenhouse gases problems has also been elegantly solved. The problem nowadays is creating an affordable, safe and efficient system that will be usable for machines in every day life. One such solution is being investigated by this IPRO team.

3. Research Methodology

As our IPRO team is rather big (currently there are ~17 members) we decided to create 6 groups who will be responsible for their specific tasks and for their component that they will design. This approach was chosen as it would be unpractical to approach our project from a sequential point of view that would be normally used for a project like this. Using 6 teams that are working in parallel on various issues maximizes the potential efficiency as all the members will have some task to work on. The major disadvantage to this approach is that communication between the teams is essential. This is required because all the various components have to be compatible with each other and some components depend to some extent on other components. For this reason a Yahoo! Group has been created where it is possible to post documents and information so that it is available to all the groups. Further a team meeting will be held every Monday. During this team meeting every team will make a short presentation of their accomplishments in their team, where they are having difficulties and where they need some input from a different team. Utilizing these instruments and the various classical communication methods (phone, email ...) it is hoped that major incompatibility issues will not arise and the project will flow smoothly towards the ultimate goal – the creation of a hybrid system.

In the following the 6 teams will be shortly introduced and their tasks that they will complete:

Battery Team:

The battery team will be responsible for the Li-Ion batteries off which the wheelchair will run for the 100 mile drive. In a first step they will test to see that all batteries passed on from the previous IPRO are working properly. Then they will try to find to improve the passive cooling system and thermally analyze the batteries. Further they will possibly investigate new designs and improve the wiring of the batteries.

Fuel Cell Team:

The fuel cell team is responsible for proper charging of the batteries. The main component this team will work on is a DC/DC converter due to compatibility issues between the fuel cell output and the required input of the Li-Ion batteries. Further they analyze the hydrogen consumption and create a process flow chart.

Hybridization Team:

The hybridization team is responsible for coming up with the necessary circuitry and design to create a functional hybrid system.

Vehicle Design Team:

The vehicle design team is responsible that all components will be safely attached to the wheel chair. Various safety issues concerning the handling of hydrogen will be

considered and implemented. Further they will develop a convenient arrangement for all components (batteries, wiring, fuel cell, hydrogen tanks ...) so that they are easily accessible but there will still be a maximum on comfort for the driver.

Website Team:

The website team is responsible for creating a website that represents our team. Various important reports and information should be posted and there should be an intuitive design to it.

Route Planning / Business Team:

This team has two major duties. In a first step a route has to be determined for the 100mile drive. They will be responsible for finding an appropriate and safe route for the driver. The second major duty of this team is to analyze the application for any Real-World applications for marketability and usability and further perform a cost analyzes of the product.

4. Expected Results

For this project the result will be a wheel chair that, in a first step, will be able to complete a 100 mile drive in roughly a week's time and in a second step will use a hybrid system to power the wheelchair under all conditions. To design a successful hybrid system a major team effort is required as this task could potentially have a few pitfalls. Other results that will also be created on the way will be the improvement of the passive cooling system and the design of the Li-Ion battery pack. Further various safety issues concerning the handling and usage of hydrogen will be analyzed. As a result a safety manual will be created addressing various important safety issues. As a last result this project will provide a cost analysis of this system and a future Real-World application of this model that will show its marketability, usability and possible projections.

5. Schedule / Milestones

As the various tasks for each team have already been stated in a previous section and the teams will independently decide when and in which order to perform the tasks, the following table will indicate all important events that include the submitting of deliverables to the IPRO Office or the submitting of reports team internally.

Our team has one milestone. This is a very important event for our IPRO team as on this day the wheelchair will have to be operational for a 100mile drive. The exact date hasn't been set yet but it rough time period is known.

Week Nr.	Day	Event / Deliverable
1. / 2.	Weeks of Aug 30 and Sep 6	IPRO Team Briefing
2.	September 10	Project Plan
2.	September 13	Weekly Report
3.	September 17	Weekly Report
3.	Unknown (16th Sep?)	100 mile Drive for Wheelchair
4.	September 24	Weekly Report
5.	October 1	Weekly Report
6.	October 8	Weekly Report
7.	October 15	Weekly Report
8.	October 22	Weekly Report
8.	October 22	Mid-Term Progress Report
8.	Week of Oct 18	Mid-Term Reviews
9.	October 29	Weekly Report
10.	November 5	Weekly Report
11.	November 12	Weekly Report
12.	November 19	Weekly Report
13.	November 26	Weekly Report
14.	November 29	Exhibit Poster
14.	November 29	Abstract
14.	December 1	Web Site Done
14.	December 1	Final Oral Presentation
14.	December 3	Final Report
14.	December 3	Team Information
14.	December 3	Comprehensive Deliverables CD
14.	Friday, Dec 3, HUB	IPRO Projects Day Conference
15. / 16.	Weeks of Dec 6 and 13	IPRO Team Debriefings

Table 5.1: Events and Deliverables for IPRO Team

Apart from the events and deliverables described above the general group work schedule will look like the following:

Week(s)	Tasks:
1	Create teams and discuss what has to be done.
2 – 3	Teams work on their short term tasks. Essentially make sure the wheelchair will be functional for the 100 mile drive and that all preparations have been finished.
3 – 11	Teams work on their long term tasks and try their best to get their components working by week 11 if not earlier.
11 – 13	The components will now be tested on the wheel chair. Various improvements will be made as the product is closer to its final stage and the problems can be identified. The wheel chair should be operational by week 12.
14	The Project must be completed by this time.

Table 5.2: General Group Schedule

6. Individual Assignments

As the project has been split into 6 teams and as the tasks for each team have already been described in detail in a previous section the following will show who the members of the various teams are. It is therefore implicitly implied that the group members are responsible for completing the tasks listed for that specific group. Ultimately the team leader will be responsible that the team completes its assigned tasks. Team leaders are listed first and their name is bold in Table 6.1 shown below.

A group leader was assigned. He will be responsible for the success of the IPRO group. His duties are to coordinate and review individual team members. Further he is responsible for keeping the Yahoo! Group up-to-date with the most recent administrative information submitting all deliverables to the IPRO Office through PRS. The group leader is in bold and is listed with an asterisk (*) in front of his name.

Currently 2 team members have not been assigned to any team. They just joined the team and were therefore not present at any of the meetings yet. They will be assigned in the next meeting.

<i>Battery Team</i>	<i>Fuel Cell Team</i>	<i>Hybridization</i>
Steve Langel Alison Smith	Chrissy Lefief Matt Moy Olatunde Omolaoye Matt Ayersman	Mike Prince Matt Bachmann David Eisenberg
<i>Vehicle Design</i>	<i>Website</i>	<i>Route Planning / Business</i>
Ken Weber Dong Chul Lim Rick Kraft	Vince Aderangi	David Eisenberg Rita Buresh (* Siddha Pimputkar)

Table 6.1: Groups and their Members

Currently unassigned new members:

Steven Johnson

Tanim Taher