Chapter 6

CONCLUSIONS

6.1 Summary of Results

In this research, we have developed an application to conduct a remote control experiment via internet, called E-laboratory. Three plants, namely rotary flexible link, belt conveyor and rotary inverted pendulum, are used as the experiment platform. The experiments consist of simulations which is developed using SIMULINK and real experiment which is based its development using MATLAB Real Time Window Target and Wincon QUANSER software and devices. As it completed, we claim that E-laboratory is simple and straightforward. The simplicity is covering the field of the development and the usage.

In chapter 2, we have clearly explained about the architecture of E- laboratory, hardware and software subsequently. The detail of clarification take the plant experiments and the computer network into account as well. Each plant of experiments platform were analysed.

Chapter 3 discusses about basic knowledge that used in the procedure of experiments. The mathematical model of each plant were presented. Two representations that used are state space and transfer function. Sort and procedures of system identification also brought to give ideas on identification experiments that conducted via E-laboratory. Two famous control design were offered in the application. Clasical but familiar PID controller and modern LQR based controller were used in system analysis and controller design experiments for their respective plants.

In chapter 4 we described about what and how the experiments were conducted. Three types of experiments can be held are system identification, system analysis and controller design. They are provided in simulation and real experiment. In system analysis, user can explore the plants to understand the behavior of the them more deep. Identification experiments provide a tool for the user to conduct a process of system identification. Different input were provided for different methods of identification. Furthermore, controller design experiment was brought to enable user attempts their controller after they observed the behavior of the plants and understand it. Comparisons between what are presented in the web page and off line analysis using MATLAB are used as theme of discussions.

In chapter 5 we specially discuss the experiment on the real hardware. Flexible link plant is employed in this experiment. Problems and obstacles that arose also presented to bring more information on the future works.

6.2 Recommendation for Future Works

To make experiments increase in number and better presented for the existing plant, certaintly we need improvement. Some idea that can be applied to our system for examples

- To integrate this web-based laboratory with subject based e-learning.
  The integration will, in turn, create a combination of web-based learning which consists of theoretical and practical instances. We believe that when it is reached, the advantages will not only enjoyed by the students but also by all components of academic in general. This thougt surely will be a nice future work to be done.

- To set a visualization media for the plant.
  By doing this, user can see what is happening when their controller applied and being run. This surely will bring better perspective from user about the controler, control experiments as well as the plant. This idea is applicable since right now we have better technology to apply. We can just use web camera that is attached somewhere near the plants and broadcasts the result so that can grab more idea. Web camera does not need to much internet bandwidth so will not load the internet conection.

- To increase the security aspects of the plant.
  The first priority of an internet application is actually the security aspect. Although nobody expect for intruder, there could be anybody "visit" and change our setting. The security aspects include the safety of the plant, the safety of computers connected and the data of experiments as well as user data.

- To make more efficient pogramming cod.e
  There are many aspects that can be patched up in our application. The utilization of MATLABis one of them. In our application, mangement of files is conducted based on directory. It means that for every experiment, we create a directory to contain all of the files related. This management certainly can be renovated by using better programming so that there will not exist troublesome once number of files are getting large when a lot of user are connected.

- To develop a special graphical interface to create MATLAB Application.
  This GUI is directed for the teacher that want to upload their M-files, to be read by the students. The interface consists of forms that ready to be filled. This GUI will generate an M-files that can be executed by client browser to generate graphical or text files automaticaly.

- To reconfigure the hardware architechture.
  The inability of the connection between host computer and server brings some point

of thought. To solve the problem that arose as stated in 5.4, we can take some way out such as reinstallation of the plant or upgrading the software application. Anotther solution that also reasonable is to renew the license so there will be more support on hardware to be able to work in newer operating system which supports sharing equipment well.