CONTROLLER REALIZATION OF AN INDUSTRIAL CASCADE LEVEL SYSTEM

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"I hereby declared that this PSM report is a result of my own work, as clearly stated in the sources of reverences and sources is explained and stated."

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ABSTRAK

Industri petrokimia, industri pembuatan kertas, dan lain-lain merupakan industri utama dimana kawalan aras cecair dan arus adalah penting. Lazimnya, cecair-cecair itu akan diproses secara rawatan kimia atau pencampuran dalam tangki tetapi selalunya aras cecair dalam tangki tersebut perlu dikawal. Nama untuk projek ini "Controller Realization an Industrial Cascade Level System". "Industrial Cascade Level System" biasanya digunakan banyak dalam kawalan proses untuk kawalan, sebagai contoh, tahap cecair dalam sebuah tangki. Sistem itu mengandungi sebuah tangki air, satu pam air, satu "ultrasonic sensor", menggunakan NI USB-6009 sebagai pengawal, dan satu injap solenoid. Objektif utama projek inimencipta sistem kawalan aras cecair menggunakan NI USB-6009 untuk mengawal sistem, juga mengenalpasti pengesan-pengesan yang sesuai dan transduser yang digunakan untuk "Industrial Cascade Level System". "Cascade Level System" uk mengawal air dalam tangki pada tahap yang diingini menggunakan NI USB 6009 kad Pemerolehan Data sebagai pengawal dan menggunakan penderia aras ultrasonik untuk mengukur air pada paras yang diingini. Sistem ini disambung dengan perisian LABVIEW. Pada Perisian LABVIEW akan muncul antara muka untuk permulaan sistem itu. Apabila sistem itu dimulakan cecair akan memasuki tangki menggunakan sebuah pam, cecair daripada tangki takungan akan menyedut oleh pam dan cecair akan memasuki untuk tangki 1. Keperluan dalam sistem ini adalah bagi mengawal kadar cecair dihantar oleh pam supaya tahap cecair dalam tangki adalah pada paras yang dingini. Satu voltan malar akan diaplikasikan pam supaya satu kadar malar cecair dapat dipam untuk tangki. Ketinggian isi cecair tangki akan kemudian akan diukur dan diplot. Selepas menggunakan suatu model ini bagi sistem, pengawal sesuai akan direka bentuk untuk mengawal isi air tangki. Untuk mengawal pam dan penderia aras kita menggunakan NI USB-6009 untuk bertindak seperti satu pengawal.

ABSTRACT

Industries such as petro-chemical industries, paper making industries, waste management and others are the vital industries where liquid level and flow control are essential. Liquids will be processed by chemical or mixing treatment in the tanks, but always the level fluid in the tanks must be controlled. The title for this project is Controller Realization of an Industrial Cascade Level System. Industrial cascade level systems are commonly used in many process control applications to control, for example, the level of liquid in a tank. The system consists of a water tank, a water pump, an ultrasonic level sensor, a controller using NI USB-6009, and valve. The main objective this project is to design liquid level control system using NI USB-6009 for control this system, also identify suitable sensors and transducers used for industrial cascade level system. The industrial cascade level system to control the water in tank at desired level using NI USB 6009 Data Acquisition card as controller and the using ultrasonic level sensor to measure level water that desired. This system is jointed with LABVIEW software. The LABVIEW software will appear the interface for the start the system. When the system is start liquid enters the tank using a pump, liquid from the reservoir tank will inhale by pump and liquid will enter to tank. The requirement in this system is to control the rate of liquid delivered by the pump so that the level of liquid within the tank is at the desired point. A constant voltage will be applied to the pump so that a constant rate of liquid can be pumped to the tank. The height of the liquid inside the tank will then be measured and plotted. A simple model of the system can then be derived from this response curve. After obtaining a model of the system, a suitable controller will be designed to control the level of the water inside the tank. To control pump and level sensor we use NI USB-6009 to act as a controller.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURE

CHAPTER 1

INTRODUCTION

1.1 Overview

Nowadays, the process industries such as petro-chemical industries, paper making and water treatment industries require liquids to be pumped, stored in tanks, and then pumped to another tank. The control of liquid in tanks and flow between tanks is a basic problem in the process industries. The above mentioned industries are the vital industries where liquid level and flow control are essential. Many times the liquids will be processed by chemical or mixing treatment in the tanks, but always the level fluid in the tanks must be controlled, and the flow between tanks must be regulated. Level and flow control in tanks are the heart of all chemical engineering systems.

The title for this project is **Controller Realization of an Industrial Cascade Level System**. Industrial cascade level systems are commonly used in many process control applications to control, for example, the level of liquid in a tank. The system consists of a water tank, a water pump, an ultrasonic level sensor, a controller using NI USB-6009, and valve. The main objective this project is to design liquid level control system using NI USB-6009 for control this system, also identify suitable sensors and transducers used for industrial cascade level system.

Automatic control with industrial cascade level system is a useful tool in many fields and it is also learned by the students in majors of biotechnology, industrial and chemical engineering, besides the automation related majors in some universities. Automatic control cascade level system laboratory is needed for the students to have a deeper and more complete understanding of control system design and implementation, but it will be of high cost and need more hours of course time. In order to lower the cost and save the course time, an internet based industrial cascade level system will be constructed, which will enable the students to conduct the control experiment at any time using a remote computer that is connected to the internet.

The industrial cascade level system to control the water in tank at desired level using NI USB 6009 Data Acquisition card as controller and the using ultrasonic level sensor to measure level water that desired. This system is jointed with LABVIEW software. The LABVIEW software will appear the interface for the start the system. When the system is start liquid enters the tank using a pump, liquid from the reservoir tank will inhale by pump and liquid will enter to tank. The requirement in this system is to control the rate of liquid delivered by the pump so that the level of liquid within the tank is at the desired point. A constant voltage will be applied to the pump so that a constant rate of liquid can be pumped to the tank. The height of the liquid inside the tank will then be measured and plotted. A simple model of the system can then be derived from this response curve. After obtaining a model of the system, a suitable controller will be designed to control the level of the water inside the tank. To control pump and level sensor we use NI USB-6009 to act as a controller.

1.2 Problem Statement

The problem statement on this project firstly is liquid level sensor in industries are expensive and then application and demand on the use liquid level sensor in industries now is increasing. If liquid level sensor which were relatively cheaper produce it would be able soften the blow consumer. In now hard industry to get liquid level sensor can keep tank liquid level on one level that the desired. We design liquid level control system to obtain exactly measure liquid in tank.

The foremost important step before formulating a controller, a mathematical relationship or the governing dynamics between the input and the output of the system should be known. The underlying principle and knowledge of the system should be investigated to comprehend the occurrence of nonlinearity in the system dynamics. There are wide arrays of control techniques that can be applied to meet the control objective of the system and these depend on the factors of which the proposed design objective might rely on. There are factors such as tracking, reducing the effects of adverse conditions and uncertainty, behaviors in terms of time response (e.g., stability, a certain rise-time, overshoot, and steady state tracking error) and lastly engineering goals such as cost and reliability which is vital in industrial perspective.

Sophistication of controller scheme primarily depends on the degree of how the nonlinearity can be tolerated and assumed using the linearization theory. Moreover, apart from nonlinearities, there may be a consequence of unknown parameters which hinders the objective to obtain a complete detail model of a process available for control purpose. The factors that abstained many researchers to use conventional control theory and techniques can be listed as follows:-

- Systems are nonlinear and may contain unknown parameters. That unknown parameters may not be estimated accurately if reliable experimental data is absent.
- The delays present in the process of system (cascade level system specifically) might complicate achieving high performance control.
- There are several cases such as that of liquid level digital control tank in industry where the process or disturbance characteristics are changing continuously. This requires simultaneous regulation of various variables in order to maintain the desired liquid level. Thus, a model must account for all of the most significant variables of the process.

Due to the above mentioned factors, it might be difficult to formulate a control strategy based on the analytical model because the mathematical model is usually linearised to account for complexity and nonlinearity which are inevitable in a complicated system. PID (proportional-integral-derivative) control is one of a kind of control scheme that uses the approach of linearised model. However, the PID controller might not capable to satisfy the control objectives or requirement at all times as it need to be regularly tuned due to the

varying system dynamics. Hence, it is desirable to have a robust and reliable control technique for modeling the complex and nonlinear system that prevails in all industrial process.

1.3 Objective of Project

- Fabricate Industrial Cascade Level System
- To design Industrial Cascade Level System using a NI USB-6009 as controller.
- Design Industrial Cascade Level System part using Google Sketch software, from this software we can look this project with 3D view.
- Develop control in LABVIEW software to control rate of water in the tank using the controller.
- Measure of liquid in the tank at a desired level. Ultrasonic level sensor will determine a level liquid that desired.
- Using a NI USB-6009 as controller and the LABVIEW software will related with the controller.

1.4 Scope of Project

The purpose of this project is measure liquid in the tank a desired level, along with develop and validate a mathematical dynamic model that represents the cascade level system apparatus. This project use NI USB-6009 to control pump and also controls ultrasonic level sensor to gauge liquid in tank at a desired level.

Then, after the models are approved of its validity, simulation will be performed using engineering simulation software like LABVIEW to simulate its dynamic characteristic using the actual plant parameters obtained from laboratory. A test was performed on the nonlinear model of the cascade tank system by simulation to observe various important dynamic characteristics at different operating conditions (water level). This is to investigate the behavior of the system at certain range of operating conditions and thus, will give a guideline in the development of a reference model for the system to track.

For first operation on this project, enter the value that desired at interface of LABVIEW software and the valve manual will a little open, when controller get signal from the LABVIEW software has been programmed it will get directive and pump will operate with inhaled water inside reservoir tank. Water would pass pipe channeled and would enter inside tank 1.

Operation further, water going to go inside tank 1 and when deep water tank 1 until achieve level desired. Further ultrasonic level sensor 1 will detect level desirable and it sends signal to controller. When sensor detects level that desired, controller would give output to solenoid valve. Solenoid valve will open valve and further water going to go inside tank 2. Pump further will get signal from controller to stop an operation. When water which entered into tank 2 achieve level desirableness When water which entered into tank 2 it will achieve desired level, ultrasonic level sensor 2 will detect water level further send signal to controller and controller will sends signals solenoid valve to stop and pump to is start again an operating. Water-from tank will be pumped got back into tank1, this process wills recur up to operation in interface LABVIEW software is stopping. When to halt a moment these operation buttons pause in interface LABVIEW would be impressed.

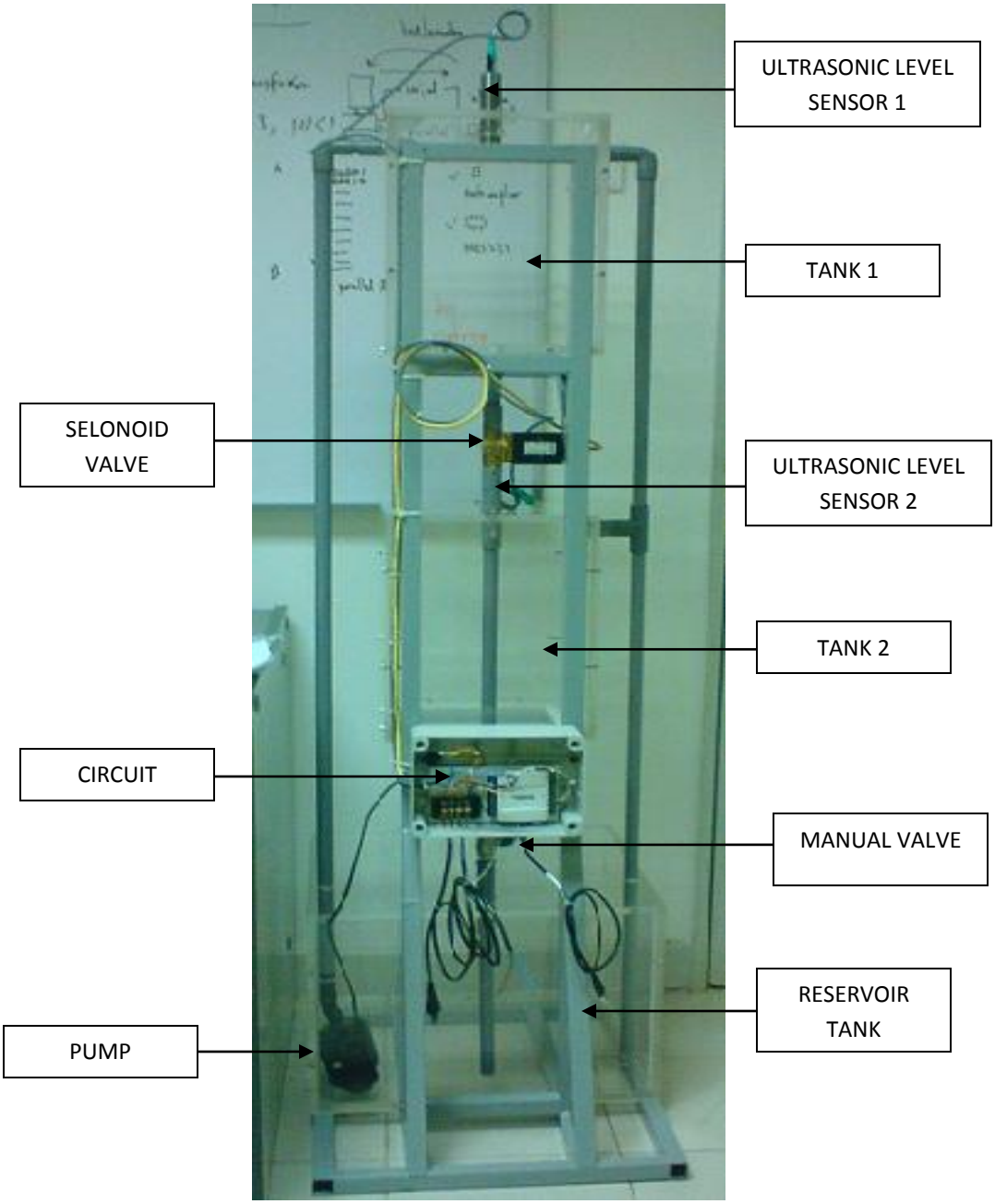

Figure 1.1: Industrial Cascade Level System

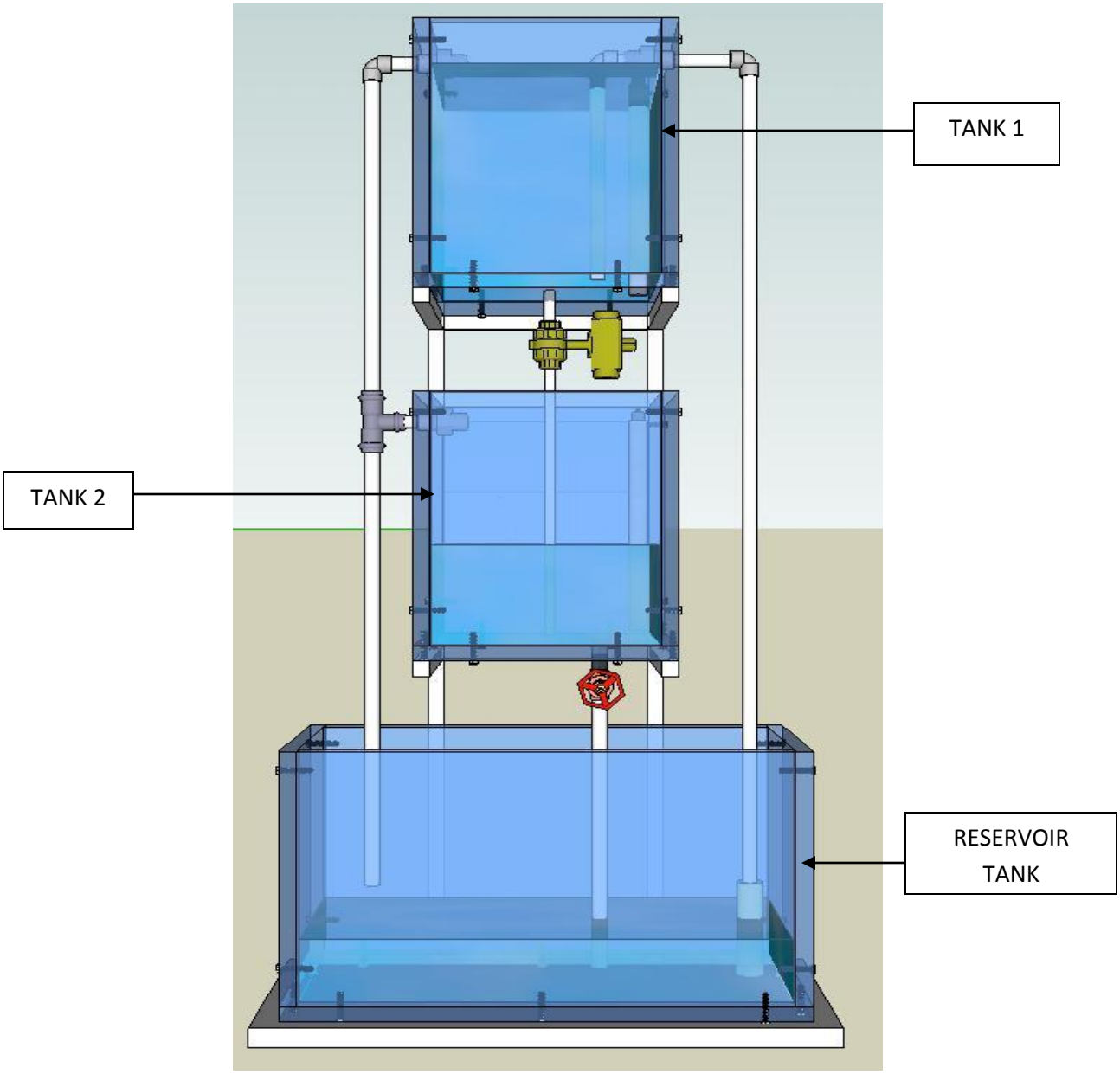

Figure 1.2: Design of Liquid Level Digital Control System Using Google Sketch Software (FRONT VIEW)

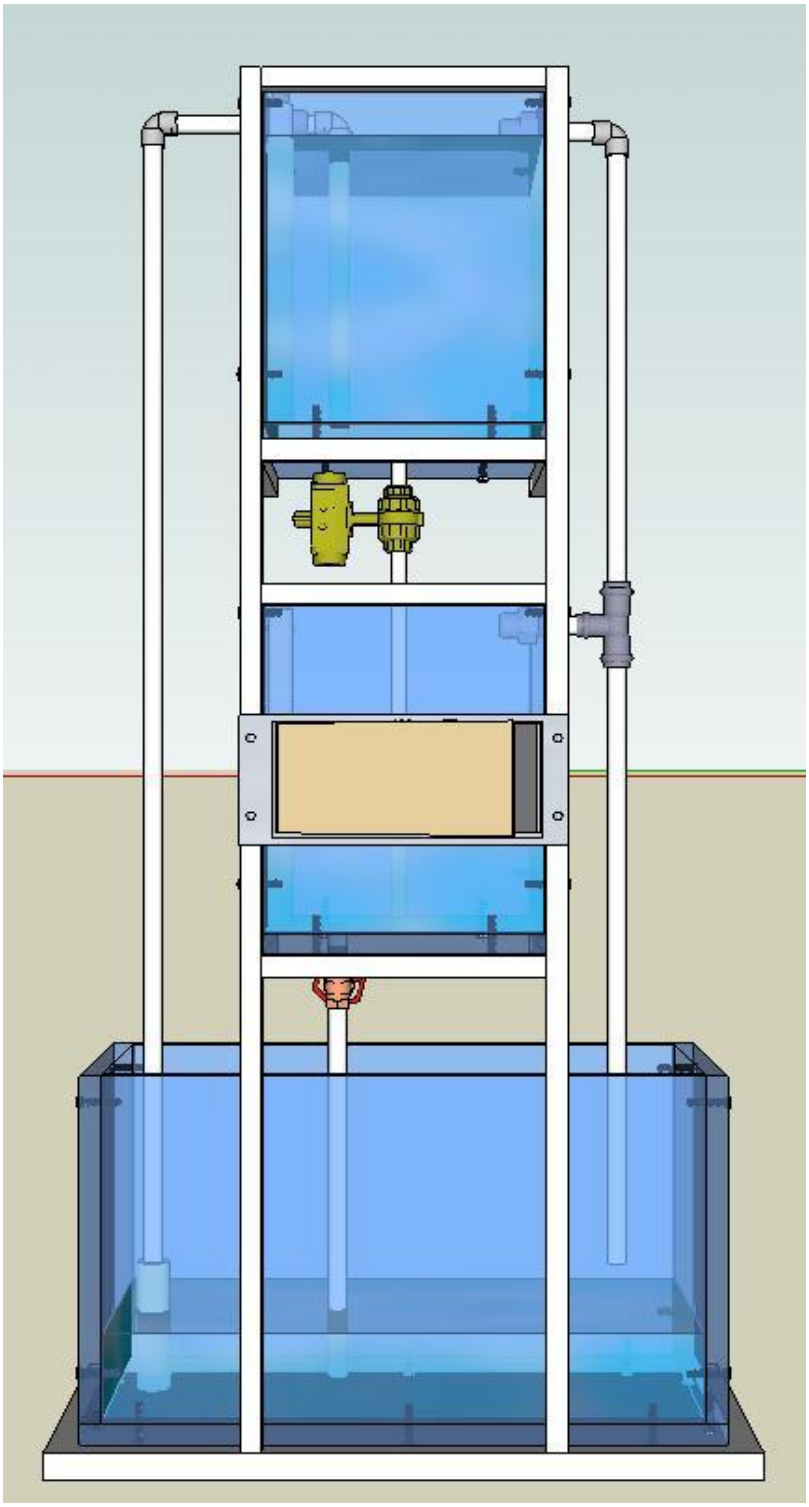

Figure 1.3: Design of Liquid Level Digital Control System Using Google Sketch Software (BACK VIEW)

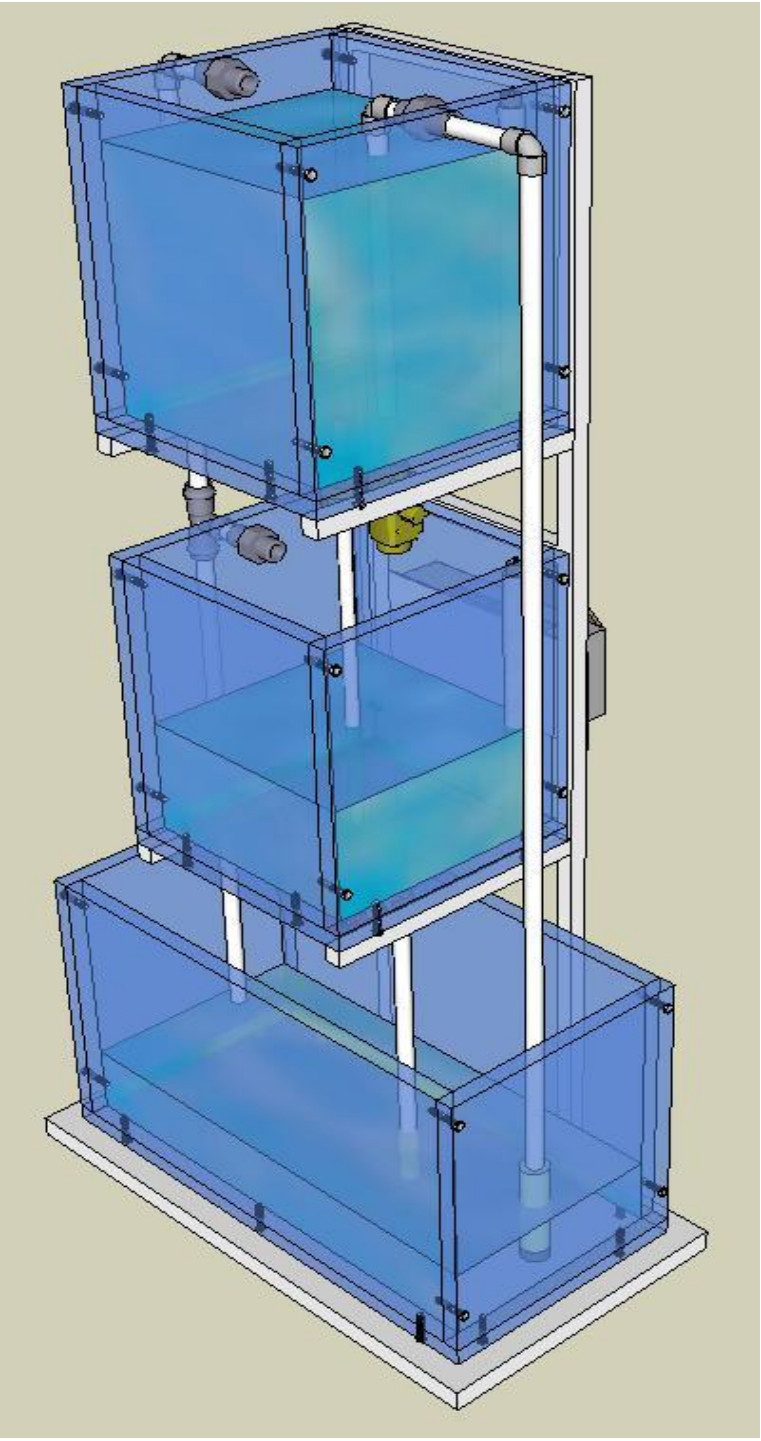

Figure 1.4: Design of Liquid Level Digital Control System Using Google Sketch Software (PERSPECTIVE VIEW)