



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DESIGN AND SIMULATION OF WATER LEVEL AND FLOW
CONTROL SYSTEM USING ANDROID**

This report submitted in accordance with requirement of the Universiti Teknikal
Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering
(Robotics & Automation) (Hons.)

by

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FACULTY OF MANUFACTURING ENGINEERING

2014

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2014

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Design and Simulation of Water Level and Flow Control System Using Android

SESI PENGAJIAN: 2013/2014 Semester 2

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This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotic & Automation) (Hons.). The member of the supervisory is as follow:

.....

Project Supervisor

(Mr. Mohd Nazmin Bin Maslan)

ABSTRAK

Laporan ini mengenai projek simulasi sistem aliran bendalir dan sistem kawalan paras air. Fokus utama projek adalah untuk mewujudkan Antara Muka Pengguna (GUI) secara grafik dengan simulasi interaktif antara pengguna sebagai aplikasi mudah alih pada platform Android. Simulasi GUI direka dan dibangunkan untuk aliran bendalir dan sistem kawalan aliran air yang mesra pengguna dan mudah untuk digunakan. Aplikasi telefon pintar ini dibangunkan menggunakan perisian Eclipse dengan Kit Pembangunan Android (SDK). Kajian dan penyelidikan mendalam telah dilakukan berkaitan dengan sistem bendalir aliran, konsep asas sistem kawalan, sistem paras air, sistem operasi Android di mana aplikasi tersebut akan dibangunkan, dan mempelajari asas dalam pembangunan aplikasi mudah alih pada perisian Eclipse IDE dengan Android SDK. Simulasi ini mempunyai dua seksyen; simulasi sistem aliran bendalir dan sistem paras air. Sistem paras air seterusnya direka dengan sistem kawalan terbuka dan sistem kawalan tertutup. Setelah aplikasi tersebut dibangunkan, ia diuji oleh 50 orang pelajar FKP yang dipilih secara rawak sebelum mereka diminta untuk menjawab kaji selidik dalam talian. Data yang diperolehi daripada kajian menunjukkan bahawa aplikasi simulasi ini mesra pengguna dan mudah digunakan. Aplikasi simulasi telefon bimbit pintar ini membuktikan ia membantu pelajar dalam pemahaman konsep asas sistem kawalan terbuka, sistem kawalan tertutup dan sistem bendalir aliran, sekaligus mencapai objektif projek.

ABSTRACT

This report is about a simulation project on fluid flow and water level control system. The objective is to create a Graphical User Interface (GUI) with user interactive simulation as a mobile application on Android platform. The GUI simulation was designed and developed for fluid flow and water level control system that is user-friendly and easy to be used. The mobile application is developed using Eclipse software with Android Software Development Kit (SDK). Research was done on the fluid flow system, basic concept of control system, water level system, android operating system where the application will be developed based on, and learning the basic of developing mobile application on Eclipse IDE with Android SDK. The simulation was carried out in two sections; simulation on fluid flow system and water level system. The water level system is further designed with open loop system and closed loop system. The application was developed and was tested by 50 FKP respondents that are randomly selected and they were asked to answer an online survey. The data obtained from survey was analyzed where the student's response reveals the application is user friendly and easy to be used. The simulation mobile application managed was proven helpful in understanding the basic concept of open loop control system, closed loop control system and fluid flow system, successfully achieving the objective of the project.

DEDICATION

I would like to dedicate this project and my degree to my mother, Kanagasabai Malarvizhi, without whom I would not have reached this stage of life.

ACKNOWLEDGEMENT

I would like to take this opportunity to thank Mr Mohd Nazmin bin Maslan for being an excellent supervisor who gave his time and moral support for me to complete this project. His style of giving me the freedom to complete the project at my own pace without pressuring me but at the same time guiding me when it necessary is well appreciated by me. It was a pleasure to have such a supervisor to complete this project

Other than that, thousands of gratitude dedicated to the technicians, friends and everyone that had given help and support the in the process of completing the project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMECLATURE

SDK	-	Software Development Kit
PLC	-	Programmable Logic Controller
GUI	-	Graphical User Interface
IDE	-	Integrated Development Environment
OS	-	Operating System
PID	-	Proportional, Integral, Derivative
API	-	Application Programming Interface
AVD	-	Android Virtual Device Manager
UI	-	User Interface
XML	-	Extensible Markup Language

CHAPTER 1

INTRODUCTION

This chapter covers on the background, problem statement, objective and scope of the research study. The project background discusses the overview about the project that will be conducted. The problems that might arise before starting the project are identified in the problem statement section. Lastly, the objective is about the target to be achieved with this project meanwhile the scope is the limitation of the project.

1.1 Background

At the university, the application of the water flow control system is usually used in water flow and level control system. It is can be used in learning the basic control system so that students are able to understand about the connection between water flow control in process control system. This project is an extension of learning kit simulation using Eclipse Android SDK tools software about the simulation design on water flow control system. It uses Android platform that are used in touch screen enabled smart phones and tablets that are increasingly popular to show the water movement and the Graphical User Interface (GUI) as the monitoring system interface using the Eclipse software.

In fluid flow and water level control, it has the process control that is the operational control in the internal characteristic. It is usually in the fluid process as a component device to control the fluid flows and need to control the continuous flow of fluid through a large set of following operations. The process is defined as a set of operation that perform physical or a series transformation in which fluid is converted into a more useful state. A process forms part of a set of production or processing functions complete in and by means of process hardware such as tanks, pipes, fittings, measuring device and others. The performance of an industrial process is influenced by internal and external condition called process variables such as flow, level, temperature, dimension, speed, volume and others. The control of the process variable is archived by the control equipment and the controlling them to the desire level called set points. Figure 1.1 shows the process control variables where the manipulated variables determine the control that state of the system the examples flow rate. The flow rates entering or leaving the process so the control will be changed. The controlled variable there is an associated manipulated variable; it is maintained despite any disturbance.

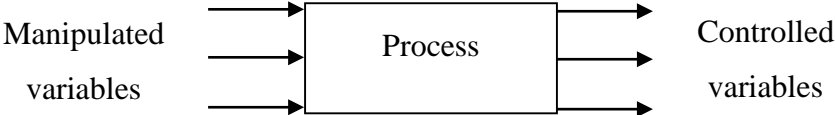


Figure 1.1: Process control variable (Singh, S.K, 2012)

Eclipse is a multi-language Integrated development environment (IDE) comprising a base workspace and an extensible plug-in system for customizing the environment. It is written mostly in Java. Released under the terms of the Eclipse Public License, Eclipse SDK is free and open source software. This software is the basic tools used in creating application for the Android platform that are available freely in the market. An Android application developer, is a person with the training and skills necessary to design, create, and test application for Android platform.(Tigrek & Ph, 2012)

1.2 Problem Statement

The problem statement of the project needs to be identified in order to perform the project. Through meticulous observation, it is found out that engineering student lack of a learning kit that can aid them to understand the basic process control system. This simulation is developed as a supplementary guidance on how to manipulate the process control system using the water level and fluid flow control system. This is an extension project improving an existing Windows-based GUI using Visio Basic. Since Android devices becoming popular and accessible to most students, Android based mobile and tablets are being explored as an option to further improve the existing project. This creates an opportunity to utilize the need for an application based on Android for the water level and fluid flow control system.

1.3 Objectives

1. To design and develop a GUI simulation for fluid flow and water level control system that is user-friendly and easy to be used by students, by using the Eclipse and Android SDK tools software.
2. To demonstrate the water level system; open-loop control system and closed-loop control system and demonstrate the fluid flow system.
3. To analyze the fluid flow and water level GUI based on students' understanding from the application.

1.4 Scope

The scope of this project is to design a basic simulation for water flow control system and Graphical User Interface (GUI). The simulation is to control the water flow simulation moving created in Eclipse. This simulation system allows student to understand about how to control the water flow control system.

1.5 Summary

This chapter briefly explains about the project that will be conducted. The problem that resulted in the project execution is discussed and the objectives that to be achieved at the end this project is listed and the scope within which the project will be done is identified.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review is done to gain the information on the project that is being carried. This project focuses on the concept experimental rig as a simulation platform using water flow and water level control system. This can be used in the university to show and aid the student to understand more in the basic control system. Firstly the explanation of water flow control system is presented followed by water level control fundamental, components related to flow control of water, water level system and GUI monitoring system that allows controlling the tank.

2.2 Fluid Control System

2.2.1 Fluid Flow Control System

Fluid level and flow control system is usually found in the chemical engineering sector. Flow control in particular "denotes a collection of methods to manipulate a water flow into a state with desired properties"(Research in Water Dynamics: Meeting National Needs,2006: 6). A water flow system consists of three main components that:

- i. Process: mixing or blending processes, liquid-holding tanks
- ii. Actuators: valves, pumps
- iii. Measured values: level, flow, composition.

The process will be the change in liquid level, where the input signal will be the flow into the tank where else the output signal will be the height of liquid in the tank. The transducers will function as pressure gauge which will be used to calculate the level. Then the actuation system uses the current signal through a current to control process valve. [Modeling for control engineering [Online], Available:http://www.palgrave.com/science/engineering/wilkie/sample/0333_77129Xcha 05sample.pdf]

It is important to them to know and understand how to control flow of fluid in the container or tanks. The process in industry usually uses rotating equipment such as pump, centrifugal compressor and blower to move fluid. Prime mover such as electric motors commonly used in many industrial processes. Fluid flow and level control system is to control fluid in the tank with several process control algorithms. A typical fluid flow system consists of a mechanical system and a process system. A good design of mechanical and process system, together with the load and hours of operation will affect the energy consumption. A good fluid flow system is expected to control fluid flow

continuously and accurately during processes. Various methods of fluid flow control can be used (Parekh P. S., 1999).

Valves are an important component of the mechanical system where valves can be set to allow specific flows of fluid through a treatment plant either an inlet or the outlet. These valves "manipulates a flowing water to compensate for the load disturbance and keep the regulated process variable as close as possible to the desired set point"(Prasad M.H 2010, p. 52). Three operating conditions are considered when designing a fluid flow control; the normal flow, the maximum flow and the turndown flow. For maximum flow and turndown flow, the pipe, fittings and pumps are used, but the control valve are sized to operate under all three flow condition (Parekh P. S.,1999).If the regulating valve is fitted, it will require regular adjustment to ensure that constant flow maintains.

Flow measurement gives an indication of the efficiency of a process. Fluid flow rate is the important measurement in water flow. Flux is often detected in industrial production and accuracy in flow measurement is very important. The fluid flow is the amount of water passing through a pipe within a given period of time. The flow in pipes under pressure or in open channels under the force of gravity, the volume of fluid flowing past any given point in the pipe or channel per unit time is called the flow rate or discharge (Q). The fluid flow rate can calculate using equation velocity multiply cross section vector area to get the volume of water passing given station per unit time (Esposito, A , 2009).

$$Q = v \cdot A$$