**DESIGN AND DEVELOPMENT OF PLC-BASED TRAINING KIT SYSTEM.**

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**NOVEMBER 2009**

"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrumentation and Automation)"

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*"Design and Development of PLC-Based Training Kit System"*

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"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references."

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Date : **NOVEMBER 2009**

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## ABSTRACT

This project is designed based on the training kit system. The applications are to detect, sort, stamp and storage. For the future, it cans adobe monitoring system. The training concepts are mechanical, electropneumatics, electrical, sensors, PLC, faulting, and troubleshooting.

This project explores an alternate approach which employs simulation to real-life industrial production equipment in learning automation technology. The rationale for this project as a means of enabling concurrent product and production system design is put forward. The long-term implications and work required to establish the concept are discussed. Experience learned from this project can be applied to industrial practice without any training gap learned versus practical.

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## NOMENCLATURE

| | |
|---|---|
| UTeM | Universiti Teknikal Malaysia Melaka. |
| PLC | Programmable Logic Control. |
| DAQ | Data Acquisition Card. |
| D.O.F | Degree of Freedom. |
| DCV | Directional Control Valve. |
| DSP | Digital Signal Processing. |
| CPU | Central Processing Unit. |
| LED | Light Emitting Diode. |
| I/O | Input and Output. |
| AC | Alternating Current. |
| DC | Direct Current. |
| SAC | Single Acting Cylinder. |
| DAC | Double Acting Cylinder. |
| PB | Push Button. |
| Cy | Compact Cylinder. |
| RM | Ringgit Malaysia. |
| MEMS | Micro Electro Mechanical System |

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction to the project.

This project is titled "Design and Development of PLC-Based Training Kit System". This project is designed based on training kit system to overcome and to meet industrial requirement.

The ideas and techniques developed during an interdisciplinary process provide the conditions to raise synergy and provide a catalytic effect to find new and simpler solutions to traditionally complex problems. There are a projects which integrate the mechanical, electrical, and computer systems (Program) with information systems for the design and manufacture of products and processes.

The project can be generated by the right combination of parameters, which will produce a better final product. This project is a result of applying information technology to physical system. The physical system consists of mechanical, electrical, electronic and computer systems as well as actuators, sensors, and real time interfacing. This training kit system brings industrial realism to the classroom by allowing trainees to program it and to assemble a minimum of four different variations of the valve.

Sensors and actuators are used to detect energy between high power, usually the mechanical side, and low power, the electrical and computer or electronic side. The automation systems frequently consists of more than just mechanical components and

may include fluid, pneumatic, thermal, acoustic, chemical, and other disciplines as well.

Besides the education and training of engineers for design and manufacturing of automation devices, technicians and skilled workers are to be trained for implementation and service. New job profiles are created as a mix of mechanical, electrical and IT knowledge called automation engineer.

## 1.2. Problem Statement

There is advanced toward the on universities and vocational training institutes with their links to industry to expose students and apprentices to real working environments in education and training of multi-skilled engineer. This led to a new type of job profile which contains a mix of electrical, mechanical and automation (mechatronics).

During the class, student and teachers make use of the simulation Computer Module. The majority of institute control languages are based on MATLAB and BASIC. Although they are useful for developing mathematical concepts and teaching accepted programming techniques, their applications for real-time processing is limited. The very nature of these languages restricts them to sequential rather than multi-tasking events.

This project contributes to these target demands with the development and evaluation of a new invention of multi perspective learning environment for vocational education and training of engineer and skilled workers in the field of automation and control engineering.

## 1.3 Objective.

The main objective of this project is to design an innovation technical education training system that will produce competence technician and engineer to meet industrial challenges. This training kit system will be implementing in technical education institute. There are the objectives of this project:-

i. To design and develop the prototype of automation based PLC programming to create real-time processing.
ii. To give understanding on the principles of automation and PLC system.
iii. To give understanding on the function of automations components.
iv. To analyze and trouble shoot the functional of each components of mechanical, electro-pneumatics, electrical, sensors, and PLC hardware.

## 1.4 Project Scope

In engineering, the transition from idea to product requires that the engineer produce clear proposals demonstrating the idea's practicality and economic feasibility. Design and Development PLC-Based Training Kit system is advanced and innovative training equipment developed to meet the requirements of automations, mechatronics and production system for engineering institutes. This project is combination of pneumatic, electro pneumatic and PLC technologies. It enables the skills demanded by industry to be developed by combining the varied technologies related to the Automation field.

There are different modules in this training kit system and these modules are assembled on an aluminum profile (base). These modules are:

i. Transfer
ii. Detection/Classified
iii. Handling by using conveyor or suction cup (vacuum)
iv. Storage
v. Controller - PLC.
vi. For advance / future – Monitoring system

These modules, when operated together form the training kit system. The modules can also be operated individually as a separate automation module. Programmable Logic Controller (PLC) controls the modules. This gives the advantage that each module can be operated independently. This project is a training model that shows an overall view of the automation systems.

The objectives supported by the system are:

a. Mechanical:

- Station Mechanical set-up.
- Selection and application of various electrical drives

b. Pneumatics:

- Installation of tubing for pneumatic components

c. Electrical:

- Correct wiring of electrical components

d. Sensors:

- Correct application of limit switches
- Mode of operation and applications of optical and inductive sensors

e. PLC:

- Programming and application of a PLC
- Programming of alternative (OR) branches

f. Commissioning:

- Commissioning of the entire sequence

# CHAPTER II

## LITERATURE REVIEW

### 2.1 Introduction.

Conducting literature review is very important to study any information, general view of the project and the ways to solve the problem regarding the project. Reference books, journals and website are the sources to gains the information. This chapter review about the study of the basic ideas of picks and place operation in training education system and the technical specification element that related in components will be used and some analysis of the performance. These literatures review as a guideline to develop the project without any mistake.

### 2.2 Pick and Place.

Pick and place systems are designed to perform repetitive picking and placing tasks in production or laboratory facilities, and are usually employed for their precision and cost effectiveness. Pick and place machines designed are distinguished by their exceptional efficiency and precision, resulting in an increase in output as well as long-term savings for Customers. Each pick and place design typically requires custom grip tooling and/or vacuum suction for controlling the part, and a calculated motion envelope.

Factors of pick and place are determined by speeds, accelerations, and degrees of rotation required optimizing cycle time. Pick-and-place system is a good example of how we can gently handle parts. An improved pick and place machine works together with a part holding device to pick and lift a part out of a first station, shift to a second station, descend and release the part.

A unique linkage system converts simple reciprocating motion from a fluid cylinder or the like into an inverted U-shape motion, providing a smooth, controlled acceleration, deceleration motion for the holding device. The machine has a carriage which is held upright by a sliding lever and which having a box shape, rum outside of a body enabling the part holding device to be mounted on the carriage. [4]

2.2.1. AP-360 Models

The Pick and Place AP-360 Models (figure 1.0) can achieve placement rates as high as 82 cycles per minute. Cycle rates however, are affected by payload weights. The placing head has a unique drive mechanism that is actuated by an air cylinder. A precision cam guides the motion linkage that supports the mounting plate and placement jaws. The cam controls the pickup and placing motions. The AP-360 Models are available in two horizontal stroke lengths.

The vertical strokes of each model can be adjusted to meet variable pickup and placement heights. An optional support column allows the placing head to be adjusted over a 10.25-inch (260mm) work area. The Model AP-360 Pick and Place Head can be used in confined work areas due to the compact design. The Head can also be used as an excellent means in removing completed assemblies from a work holding fixture in an automatic process.[3].

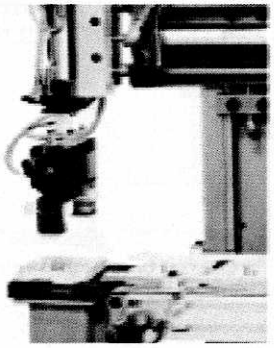

Figure 1.0: Pick and Place AP-360 Models

2.2..2. R14 Miniature Cartesian robotic positioning system.

The R14 is a two or three axis Cartesian positioning system designed for highly accurate, repeatable positioning of product under some process. The R14 is, in fact, just a mechanism which may be optionally fitted in any enclosure to suit the application. The figure 1.1 shows two-axis R14 positioner manufactured for Process Analysis Automation as their StorStar product. It positions a titer plate or tube holder under an aperture. All you do is send it a well number and the medium is positioned accordingly. This ensures that sample is entered or taken from the correct well or tube under computer control, eliminating human error or for positioning under a fixed pipette. R14 is small and compact and uses small but powerful stepping motors with lead screw drives. It has a single card controller developed by ST Robotics which uses exactly the same ROBOFORTH commands as it's big brothers R15/17/19. [7].

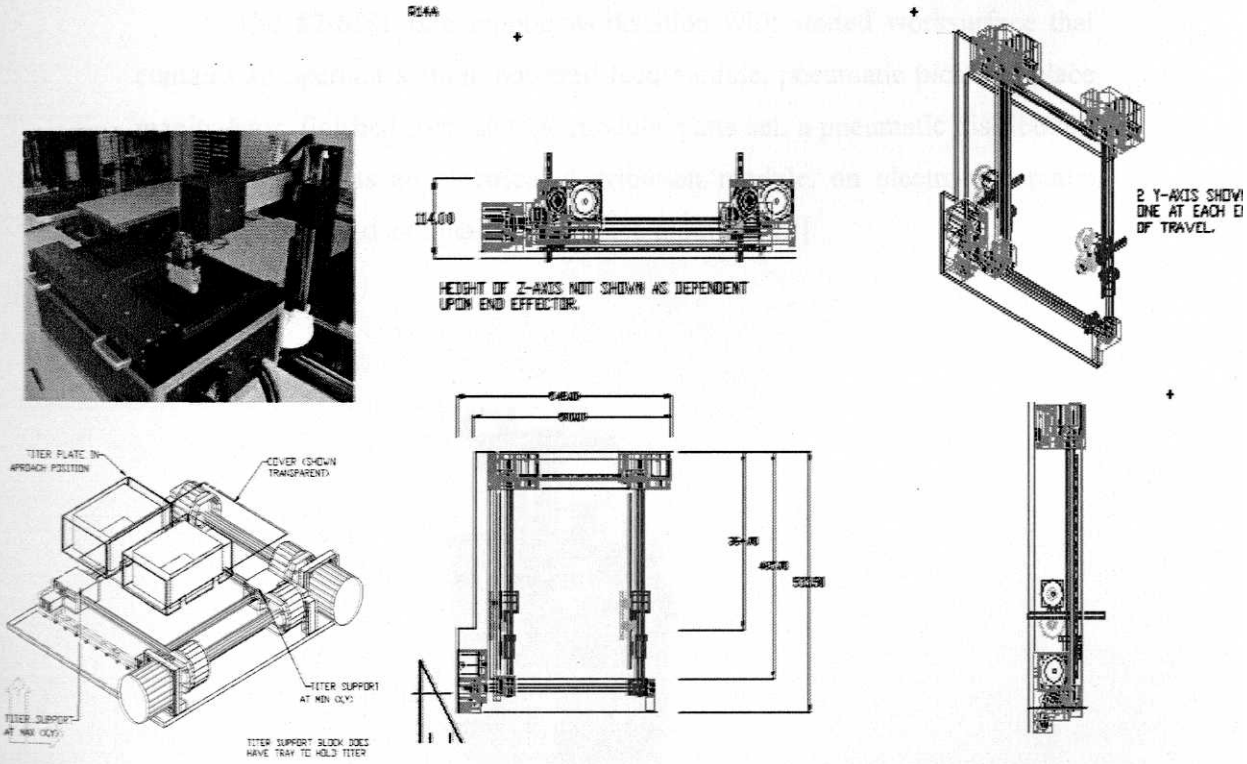


Figure 1.1: R14 Miniature Cartesian robotic positioning system

2.2.3 87-MS1 Mechatronics Pick and Place Feeding Station

Amatrol's 87-MS1, Pick and Place Feeding in figure 1.2 shows, is station 1 of the 870 Mechatronics Learning System. The 87-MS1 station is a small mechatronics system in itself with multiple, integrated technologies that can be used stand-alone or in combination with other stations. Industrial safety and operation are emphasized on all Amatrol mechatronic stations. The Pick and Place Feeding station teaches interfacing, problems solving, programming, sequencing and operation for pneumatic robots, material feeding systems, powered parts feeders, vacuum grippers, hall-effect sensors, and magnetic sensors. This station starts the process of assembling a working industrial directional control valve.

The 87-MS1 is a mobile workstation with slotted worksurface that contains an operator station, powered feed module, pneumatic pick and place manipulator, finished parts storage module, parts set, a pneumatic distribution module as well as an electrical distribution module, an electro-pneumatic valve manifold, and a digital I/O interface module. [12]

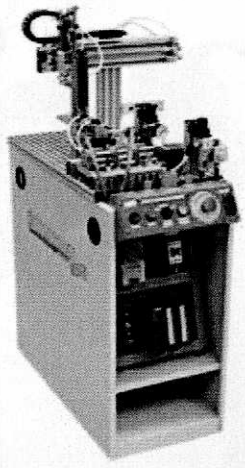

Figure 1.2: 87-MS1 Mechatronics Pick and Place Feeding Station