"I/we acknowledge that I already gone through this report and I/we are in the opinion that this report covers the scope and quality for the purpose of graduation in Bachelor of Engineering in Electric (Power Industry)."

PROF. MADYA DR. MOHAMMAD ROHMANUDDIN
Pensyarah
Fakulti Kejuruteraan Elektrik
Kolej Universiti Teknikal Kebangsaan Malaysia

Lecturer I :

Date : 09/03/05

Sign :

DEVELOPMENT OF SEMI – AUTO FILLING MACHINE

CHAKRAVARTHY GOPALA KRISHNA

This Report Is Submitted In Partial Fulfillment of Requirements For
The Degree of Bachelor in Electrical Engineering (Industry Power)

Fakulti Kejuruteraan Elektrik
Kolej Universiti Teknikal Kebangsaan Malaysia

March 2005

I hereby verify that this paper work is done on my own except for the references I made which I have stated the sources clearly on the specified section.

Sign : ____________________

Name : CHAKRAVARTHY GOPALA KRISHNA

Date : 9 MARCH 2005

AKNOWLEDGEMENT

I would like to take this opportunity to thank my project supervisor, Prof.Dr. Rohmanuddin, who had provide me support and editorial advise in preparation of this report. A very sincere thanks is forwarded to the Electrical Faculty which plays a major role preparing students with handful knowledge and skills.

Also not forgetting, my grateful thanks is extended to my beloved parents, course mates and other friends for providing me support, advice, love and affection in preparation of this project.

ABSTRACT

The whole concept of this project is to build a semi automated filling machine. The construction would be based on the adapting idea from the similar system with fully automated machine which are used in mass production industries. This filling system will be targeted for the small and medium industries while marketing it with cheaper cost. Basically, the proposed system will be integrated with mechanical part, pneumatic units and electrical unit to make it as one filling system. The inclusive of the software program to control the performance of the filling machine is also taken into account. As a result the system would be complex free as the PLC replaces the necessary sequential relay circuit for the machine control

ABSTRAK

Konsep utama projek PSM adalah cadangan untuk pembuatan "Semi-Auto Filling Machine". Pembuatan ini dikendalikan dengan memperolehi idea daripada sistem automatik penuh yang sedia ada di pasaran. Sistem ini disarankan untuk kegunaan industri ringan dan sederhana serta ditawarkan dengan harga yang berpatutan. Secara keseluruhannya, sistem ini merangkumi bahagian mekanikal, unit pneumatic dan juga bahagian electrical. Kemasukan perisian dalam sistem ini dapat mengawal proses yang hendak dilakukan. Di samping itu juga kompleksity dapat dikurangkan dari segi pembinaan.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLE

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

A "system" comprises a complex combination of resources (in the form of human beings, materials, equipment, software, facilities, data, information, services, etc.) integrated in such manner to fulfill a designated need. A system is developed to accomplish a specific function, or a series of functions, and maybe classified as a natural system, human-made system, physical system, conceptual system, closed loop system, static system, and dynamic system and so on.

The" system" in general addresses to identify the need for and the basic requirements for initially bringing systems into being and for later evaluating systems in terms of their effectiveness in a user's environment. In fact in recent years and for many systems, there has been an imbalance between the cost side of the spectrum and the effectiveness side as illustrated in figure 1.1. Many systems have grown in complexity, and although there has been an increase in emphasis in some performance factors, the resultant reliability and quality have been decreasing. At the same time, the overall long time cost has been increasing. Thus, there is a need to provide a proper balance in the development of system in the future, as any specific design decision will have an impact on both sides of the balance and the interaction effect can significant.

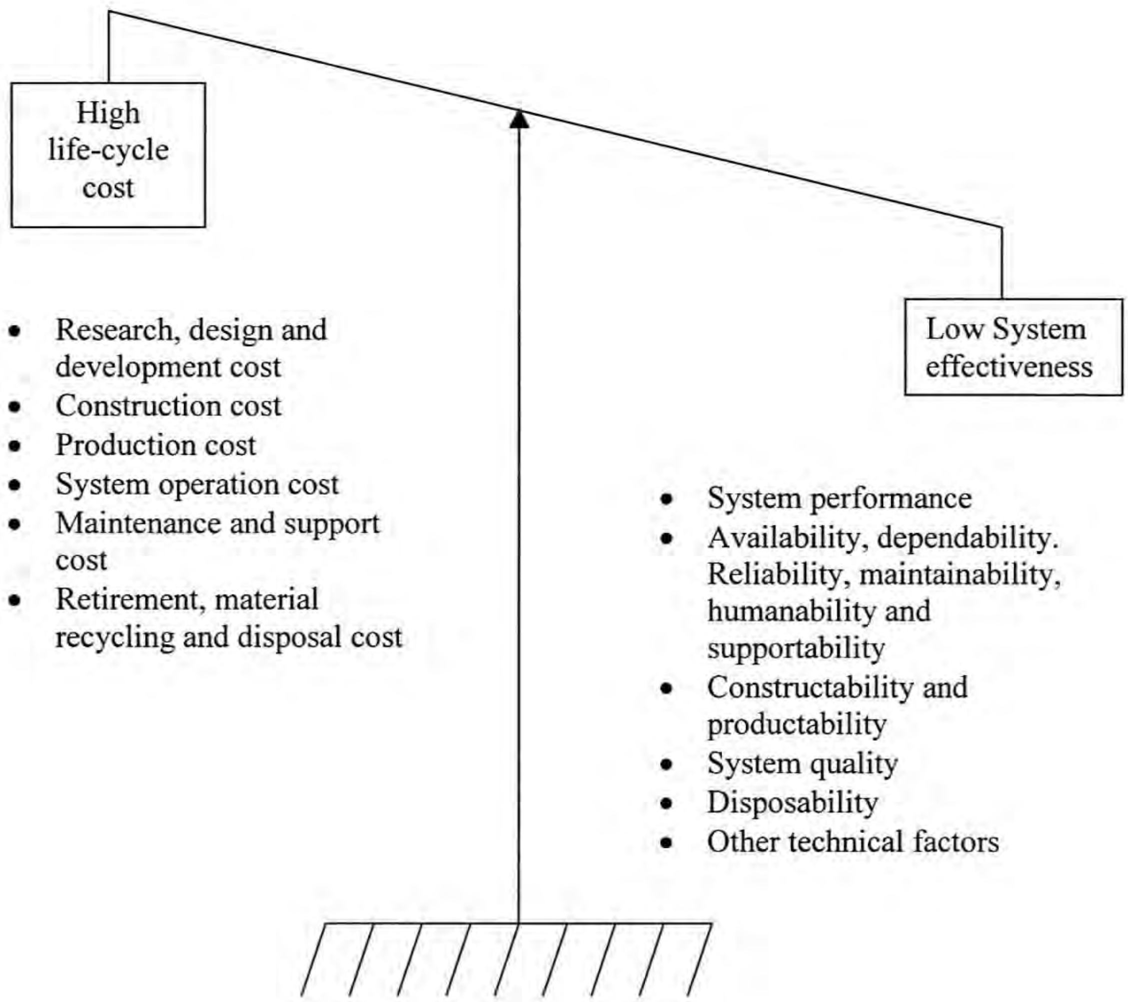

Figure 1.1: The imbalance between system cost and effectiveness factors

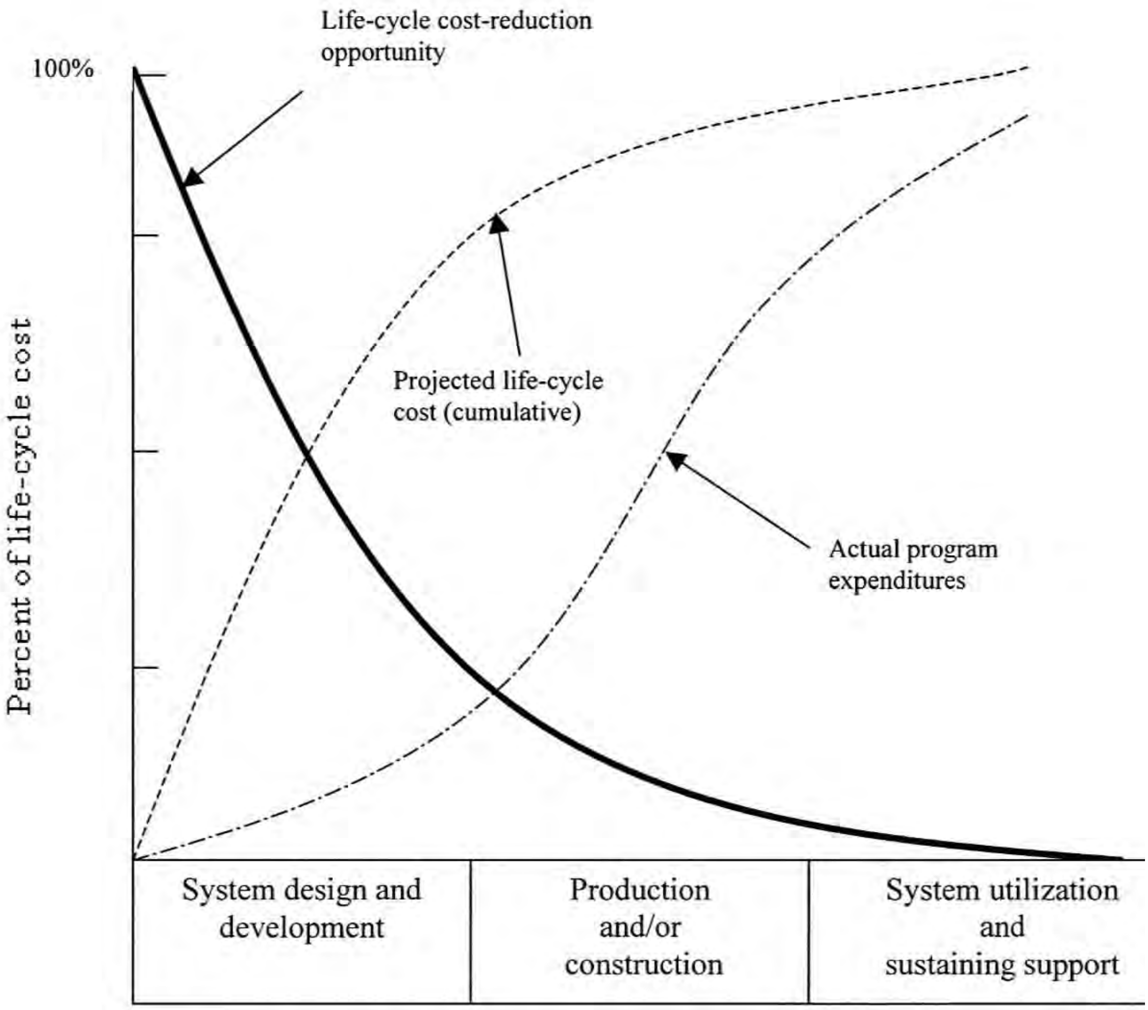

Figure 1.2: Commitment of life-cycle cost

A highly disciplined approach must be pursued in the design and the development of new system, with the objective providing the customer (user) with a quality system that is cost-effective, considering the proper balance among the factors identified in Figure 1a.In addition, there must be more emphasis on systems from a life cycle perspective, which must be established from the beginning, as illustrated in Figure 1.2 above [1]

CHAPTER 2

THEORICAL BACKGROUND

There are many types of filling machines available on the world market. One type of filling method may fit certain applications better than others. Conversely, some filling methods are not suited for some applications at all and will result in wasted investment. It is therefore important that your filling machine supplier can offer you a wide range of filler types with the greatest amount of flexibility to meet your specific product filling needs.

Likewise the Crandall International, Inc produces various types of filling machine to market it according the users environment. The types of filling machine available are for Food & Beverages, Cosmetic & Personal care, Chemical, Pharmaceutical and some solid products. To be specific for the review we will take note some of the filling machine for liquid products.

Crandall International can provide gravimetric filling machines to fill liquid and semi-liquid products into containers from 500 ml to 10 liters (pint to 2.5 gallons).The 10 Liter/2.5 gallon capacity "KN" model filling machines are available with from 1 to 4 filling nozzles, and are capable of speeds to 1800 containers per hour. These machines use simple weight tripping devices for weight sensing and provide accurate filling. The 10 Liter/2.5 gallon capacity "DN" model filling machines are available with from 1 to 4 filling nozzles, and are capable of speeds to 1400 containers per hour. These machines use digital scales for weight sensing and provide highly accurate filling. Machines from Crandall International are available with contact parts in stainless steel, sanitary stainless steel, or titanium to meet the requirements of the food, chemical and petroleum industries.

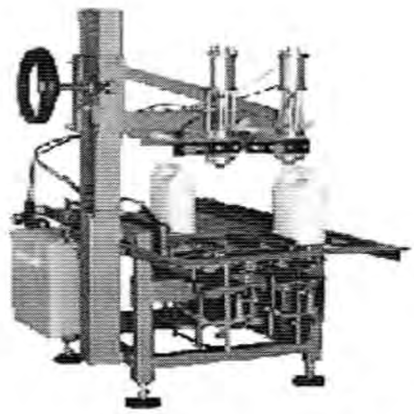

Figure 2.1: Gravimetric Fill

Piston fillers from Crandall International can fill liquids, semi-liquids, and viscous products into containers from 10 ml to 4000 ml (1/2 Oz to Gallon).Piston fillers are able to efficiently fill small volumes of flow able products, including viscous products with soft solids. The Piston fillers are available with electric and pneumatic operation to meet a wide range of requirements.[2]

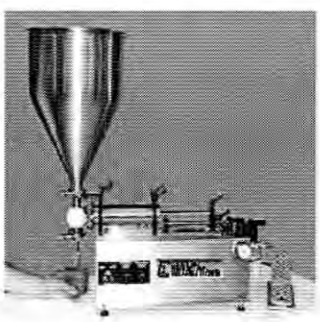

Figure 2.2: Volumetric Filling

The second manufacturer to be name for the review is the SVF Inc cooperation. The SVF series filling machines are based on the VOLUMETRIC FILLING PRINCIPLE. Volumetric fillers deliver a pre measured volume of product to each container, and the volume of product in each container is held constant. The advantages of the volumetric fillers include accuracy, flexibility, and reliability in addition to being relatively easy to clean. Accurately delivering a pre measured volume of product to each container also produces cost savings by reducing the amount of product that is used in overfill in some operations to assure that each container receives at least the minimum desired amount of product.

The flexibility of volumetric filling systems allows them to be adapted to fill a wide variety of products ranging from thin alcohol to thick caulking compounds. They can be used to fill rigid containers or light weight containers that may be distorted by the forces of vacuum or pressure used in some filling operations. These systems are reliable and easy to maintain, because they are constructed from relatively simple design. Volumetric filling systems are relatively easy to clean by flushing techniques since they normally do not have small hoses, tight passageways, or delicate sensing mechanisms that can be clogged or damaged by water or air pressure. No tools are required.

Piston filler measures and delivers the product to the container by the action of a single piston for each filler head. On the intake stroke, the piston draws the product from the supply tank or hopper, through the upper check-valve, and into the cylinder of the piston chamber or product cylinder. On the down stroke, the product flows through the lower check-valve, and the product is forced from the chamber through the valve and into the container. The volume of the filling chamber in which the piston is operating determines the volume of product delivered into the container. The larger the product cylinder, the more available volume for filling. Adjusting the length of the piston's stroke can change this volume. As the stroke is lengthened, the volume of the chamber is increased, and as the stroke is shortened, the volume of the chamber is decreased.

Accuracy is dependent on what percentage of the overall volume of the product cylinder is used. The greater the volume, the more accurate. The SVF series filling machines are accurate to +/- .5% when used in the recommended fill volume ranges for each specific size cylinder. In some applications, double filling is used to deliver two discharges from the filler into each container. This technique works effectively, but it is considerably slower and is generally used for short runs. The filling speed is dependent on four factors [2]

- The piston draw speed based on product viscosity and draw length
- The piston stroke speed based on nozzle pressure, foaminess
- The size of the container, or dose size
- The operators experience

2.1 Different Technique and Comparison Between the Project

Basically, there are different kinds of technique used to construct the filling system mechanism. In the vast changing technology, each manufacturer complete in making a system which compromise latest equipment.

This equipment which has its own configures reliability and functions advantages actually increased the system complexity. The system life cycle will be a question mark as the constantly changing requirement because of the dynamic condition worldwide.

Expertise assistance is needed to handle the systems with care and also a frequent service is required to maintain the system function reliability

2.2 History of PLC

In the late 1960's PLCs were first introduced. The primary reason for designing such a device was eliminating the large cost involved in replacing the complicated relay based machine control systems. Bedford Associates (Bedford, MA) proposed something called a Modular Digital Controller (MODICON) to a major US car manufacturer. Other companies at the time proposed computer based schemes, one of which was based upon the PDP-8. The MODICON 084 brought the world's first PLC into commercial production.

When production requirements changed so did the control system. This becomes very expensive when the change is frequent. Since relays are mechanical devices they also have a limited lifetime which required strict adhesion to maintenance schedules. Troubleshooting was also quite tedious when so many relays are involved. Now picture a machine control panel that included many, possibly hundreds or thousands, of individual relays. The size could be mind boggling and the complicated initial wiring of so many individual devices is a difficult task. These relays would be individually wired together in a manner that would yield the desired outcome.

These "new controllers" also had to be easily programmed by maintenance and plant engineers. The lifetime had to be long and programming changes easily performed. They also had to survive the harsh industrial environment. Thus, a programming technique most people were already familiar with was used to replace mechanical parts with solid-state ones.

In the mid70's the dominant PLC technologies were sequencer state-machines and the bit-slice based CPU. The AMD 2901 and 2903 were quite popular in Modicon and A-B PLCs. Conventional microprocessors lacked the power to quickly solve PLC logic in all but the smallest PLCs. As conventional microprocessors evolved, larger and larger PLCs were being based upon them.

Communications abilities began to appear in approximately 1973. The first such system was Modicon's Modbus. The PLC could now talk to other PLCs and they could be far away from the actual machine they were controlling. They could also now be used to send and receive varying voltages to allow them to enter the analog world. Unfortunately, the lack of standardization coupled with continually changing technology has made PLC communications a nightmare of incompatible protocols and physical networks.

The 80's saw an attempt to standardize communications with General Motor's manufacturing automation protocol (MAP). It was also a time for reducing the size of the PLC and making them software programmable through symbolic programming on personal computers instead of dedicated programming terminals or handheld programmers. Today the world's smallest PLC is about the size of a single control relay.

The 90's have seen a gradual reduction in the introduction of new protocols, and the modernization of the physical layers of some of the more popular protocols that survived the 1980's. The latest standard (IEC 1131-3) has tried to merge plc programming languages under one international standard. We now have PLCs that are programmable in function block diagrams, instruction lists, C and structured text all at the same time. PC's are also being used to replace PLCs in some applications. The original company who commissioned the MODICON 084 has actually switched to a PC based control system. [3]

2.2.1 About PLC

A PLC (i.e. Programmable Logic Controller) is a device that was invented to replace the necessary sequential relay circuits for machine control. The PLC works by looking at its inputs and depending upon their state, turning on/off its outputs. The user enters a program, usually via software, that gives the desired results.

PLCs are used in many "real world" applications. If there is industry present, chances are good that there is a PLC present. Industries such as machining, packaging, material handling, automated assembly or countless other industries are probably already using them. If these industries do not use the PLC software, they are indeed wasting money and time. Almost any application that needs some type of electrical control has a need for a PLC. For example, let's assume that when a switch turns on we want to turn a solenoid on for 5 seconds and then turn it off regardless of how long the switch is on for. This can be done by using simple external timer.

As the bigger the process the more a need for a PLC is needed. We can simply program the PLC to count its inputs and turn the solenoids on for the specified time wanted. [3]

2.2.2 The Guts Inside

The PLC mainly consists of a CPU, memory areas, and appropriate circuits to receive input/output data. We can actually consider the PLC to be a box full of hundreds or thousands of separate relays, counters, timers and data storage locations. These counters, timers, don't really exist physically but rather they are simulated and can be considered software counters, timers, etc. These internal relays are simulated through bit locations in registers. [4]

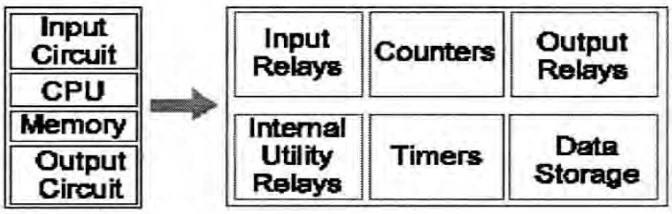

Figure 2.3: Internal Of PLC

- **Input Relays-**(contacts) these are connected to the outside world. They physically exist and receive signals from switches, sensors, etc. Typically they are not relays but rather they are transistors.

- **Internal Utility Relays-**(contacts) these do not receive signals from the outside world nor do they physically exist. They are simulated relays and are what enables a PLC to eliminate external relays. There are also some special relays that are dedicated to performing only one task. Some are always on while some are always off. Some are on only once during power-on and are typically used for initializing data that was stored.

- **Counters**-These again do not physically exist. They are simulated counters and they can be programmed to count pulses. Typically these counters can count up, down or both up and down. Since they are simulated they are limited in their counting speed. Some manufacturers also include high-speed counters that are hardware based. We can think of these as physically existing. Most times these counters can count up, down or up and down.

- **Timers**-These also do not physically exist. They come in many varieties and increments. The most common type is an on-delay type. Others include off-delay and both retentive and non-retentive types. Increments vary from 1ms through 1s.

- **Output Relays**-(coils) these are connected to the outside world. They physically exist and send on/off signals to solenoids, lights, etc. They can be transistors, relays, or triads depending upon the model chosen.

- **Data Storage**-Typically there are registers assigned to simply store data. They are usually used as temporary storage for math or data manipulation. They can also typically be used to store data when power is removed from the PLC. Upon power-up they will still have the same contents as before power was removed.