UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Design and Development of Semi-Auto Point-To-Point Pneumatic Tube System for Manufacturing Applications

Thesis submitted in accordance with the partial requirements of the
Universiti Teknikal Malaysia Melaka
Bachelor of Manufacturing Engineering (Robotic and Automation)

By

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Faculty of Manufacturing Engineering
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DECLARATION

I hereby, declare this thesis entitled “Design and Develop Of Semi-Auto Point to Point Pneumatic Tube System for Manufacturing Applications” is the results of my own Project except as cited in the reference.

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ABSTRACT

The pneumatic tube system is a system that has been use in industries and to automate the document sending process to replace the manual system that had been use. Several application of Pneumatic Tube System is in Hospital, Supermarket, Pharmaceutical, Industrials, Banks, Administration and offices. In this research focus is given for Design and Development of semi-auto Point-To-Point PTS. To produce the design concept Inventor 9 Software ® is used. For the selection component to select the suitable component that had been use the two selection methods are comparison method and cost estimation method.

DEDICATION

1 dedicate this PSM thesis to my beloved father, Md Ab Rahim Harun.

My beloved brothers, Norazam and Mohd Nor Lokman, my lovely sister, Noriza.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

UTeM	-	Universiti Teknikal Malaysia Melaka
PCP	-	Pneumatic Capsule Pipeline
PTS	-	Pneumatic Tube System
PVC	-	Polyvinyl Chloride
PSM	-	Projek Sarjana Muda
FKP	-	Fakulti Kejuruteraan Pembuatan
Inc	-	Incorporation
ft	-	Feet
sec	-	Second
m	-	Meter
kg	-	Kilogram
V	-	Volt
kW	-	Kilowatt
Hz	-	hertz
max	-	maximum
US	-	United State
cm	-	centi Meter
mm	-	mili Meter
PSI	-	Pound per square inch
mbar	-	milibar

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Pneumatic Tube System (PTS), also known as Pneumatic Capsule Pipelines (PCP), is a system in which cylindrical containers are propelled through a network of tubes by compressed air or by vacuum. They are used for transporting physical objects. PTS, also known as a conveying system used for transporting material within or between buildings. It function using compressed air or by vacuum to move the material using a carrier.

Pneumatic Tube Systems are used broadly in the world especially in developed countries. The pneumatic tube systems are applied in various industries in developed countries. In Malaysia, the Pneumatic Tube System is applied in almost all general and private Hospital in several states in the country. Other application of pneumatic tube systems are in Hospital, Supermarket, Pharmaceutical, Industrials, Banks, Administration and offices.

Pneumatic Tube System consists of several main components that involve for the system. They are Station, Carrier, Carrier's basket, Carrier's Rack, Pipe, Blower, Power Pack, alarm, Control Panel and Diverter. Every component in the Pneumatic Tube System is a special component, and specification.

1.2 Objective

The objective of this project is to design and develop the PTS for manufacturing applications. This will also is to automate the document transferring process. The design process will look into reducing the cost of PTS. The design will also explore the usage of PTS by implementing at UTeM FKP laboratory.

1.3 Scope of Project

The scope of this project is to design the Semi-Auto Point-To-Point PTS. Where Inventor 9 software is use to draw this design. The selection of material and component is carried out. The control panel to control the system will also be created. The controller will have the ON/OFF switch and sensor (Optical Switch) to run or turn ON the blower and also too use a limit switch to turn OFF the blower. The prototype of the Semi-Auto Point-To-Point PTS will be developed in the process. Then the PTS and which is installed will be tested.

2.0 Problem Statement

Today, technologies in the world always develop form time to time where every second the expert person successful creates a new technology. However there are some still problems that majority of people miss look about it. Some of problem still has in organizations in Malaysia especially in manufacturing industries. In manufacturing industries there are some are still using manual system to send any documents from department to the other. In manufacturing industries the document’s management is requirements that are very important although there ICT systems existing, PTS will become a solution to transfer not just documents but object as well.

CHAPTER 2

LITERATURE REVIEW

2.1 History of PTS

The first practical implementation of PCP or PTS technology was between the Central offices of the Electric and International Telegraph Company on Telegraph Street in London, and their offices at the Stock Exchange in the City of London, in 1853. Figure 2.1 is an example of A pneumatic tube table, Central Telegraph Office, London, during the 1930s (MacGregor, J, 1930s).The system conveyed messages which had been transcribed from the telegraph. Mr. Josiah Latimer Clark installed 675ft of 1 $^{1/2}$ inch diameter tube, with messages conveyed in bags by pressure differentials generated by a single 6 (hp) engine.

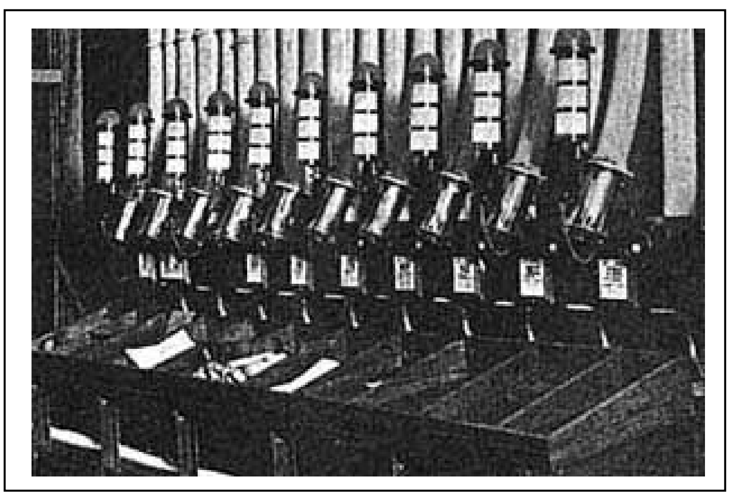

Figure 2.1: A pneumatic tube table, Central Telegraph Office, London, (MacGregor, J, 1930s)

In 1858 the Electric and International Telegraph Company built another tube 3,120 ft long with a diameter of 2 $^{1/4}$ inches, to an unknown location within London. Other tubes followed. By 1860 the Electric and International Telegraph Company systems had linked their central office in Lothbury with stations at the stock exchange, and at Cornhill (Anon, 1860). Systems were also installed outside of London, for example, that installed by Mr C. A. Varley in July 1864 in Liverpool (Anon, 1864). This linked the Electric Telegraph Company office in Castle Street and an office in Walter Street, a distance of 300 yards. The system was not only the first outside of London, but also the first recorded installation of a system in which messages could be sent in both directions, using the same pipe: capsules were propelled by compressed air in one direction, and a vacuum in the other. This technique became common for use on systems with relatively low throughput of capsules.

It was not until the development of the 'double valve' by Willmott, J. W. in 1870, that significant network of telegram conveying tubes developed. The double sluice valve overcame the problems associated with more than one message in a tube at one time. By 1874 an extensive system of tubes was in place, linking the Central Telegram Office at Martin's le Grand in London, with London's district post offices, distributing around 4.5 million messages annually. By 1886 London had 94 telegram tubes totaling 34 $^{1/2}$ miles, powered by four 50 hp engines.

Two types of system were eventually adopted, house and street tubes. House tubes provided for the transmission of messages between different part of the same building, street tubes provided for transmission of telegram forms from branch offices to the head office (from whence they were telegraphed). By the 1930s, 67 branch offices were connected to the head office by a series of radial tubes. Most tubes conveyed messages in one direction only, some in both directions. At its peak, the London network made use of 57 miles of pipeline (Aldhous, P, 1995). The system was used because it allowed quicker handling of messages than would be the case if messages were telegraphed from local offices to head office. There was also no error in translation. The PCP or PTS system also is automatically system. Figure 2.2 is an example of the automatic switch room for the London Street Tube System (MacGregor, J, 1930s).

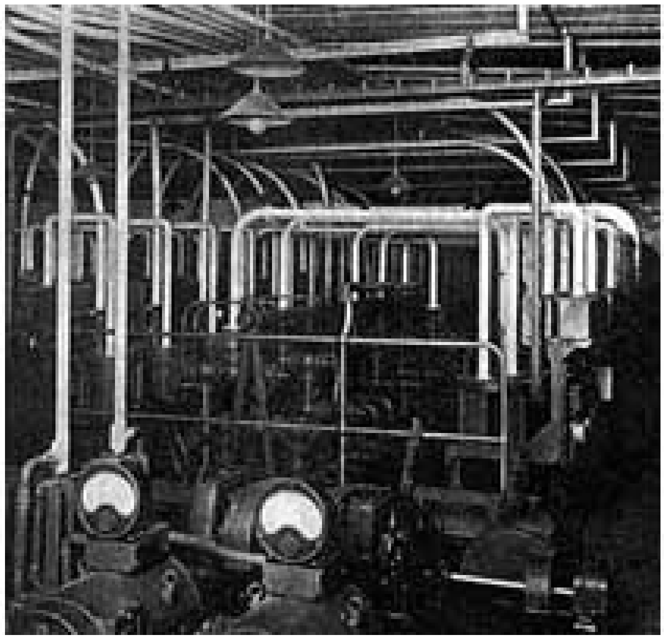

Figure 2.2: The automatic switch room for the London Street Tube System (MacGregor, J, 1930s)

Street tube pipes were made of lead, laid 30cm under the street within iron ducts, which provided mechanical protection (McGregor, J, 1957). Tubes were laid using mandrel plumbers joints, which reduced the chance of leakage occurring. Many tubes lasted more than fifty years, the main requirement for replacement being as a result of damage inflicted by repairs to the road above. Most tubes were 2 $^{1/2}$ inches in diameter, with 3 inch diameter tubes being used where traffic was particularly heavy. Messages were placed in carriers, each carrier holding between 20 and 30 messages. Carriers consisted of a cylinder, covered with sleeves which acted as skirts within the tube. A thick felt pad was fitted to front of the carrier to act as a buffer on arrival. The carrier was then placed into the tube either by inserting it through a funnel shaped end piece or by lifting a small flap door. Carriers could be dispatched every few seconds (in long tubes multiple carriers were allowed, although they had to be dispatched at regular intervals. The carrier was then drawn along the tube at an average speed of 30 feet per second, or 20 mph. Street tubes, which varied in length from a few hundred feet to over three miles, required pressures of up to 12 lbs per sq inch above atmosphere in order to achieve these speeds. This pressure is created by supplying compressed air at one end of the tube, and leaving the other open to the atmosphere; or alternatively leaving one end open to the atmosphere and exhausting the air at the other by means of a suction pump which maintains partial vacuum in the tube. Initially air differentials were created by steam driven beam engines. By the 1930s, two electrically driven compressors operate all street tubes in London. (http//www.capsu.org // Pneumatic Capsule Pipelines // History)

2.2 Profitability

2.2.1 Why PTS?

Because PTS can solves internal transport problems with a speed of 20-25 ft /sec. That can save time, energy and allows your staff to concentrate on more important matters instead of running errands.

The profitability of PTS could be calculated as follows:

R x T / 60 (http//www.aerocom-usa.com/**)**
where:
R = Route (how often)
T = Time spent per route in minutes
60 = Conversion factor from minutes to hours