EXPERT SYSTEM OF MAINTENANCE PROBLEMS FOR SQUARE FOILING MACHINE

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

by

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2015

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TAJUK: **Expert System on Maintenance Problems for Square Foiling Machine**

SESI PENGAJIAN: 2014/2015 Semester 2

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I hereby, declared this report entitled Expert System of Maintenance Problems for Square Foiling Machine is the results of my own research except as cited in references.

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APPROVAL

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 (Robotics and Automation) (Hons.). The member of the supervisory is as follow:

…………………………………

(Project Supervisor)

ABSTRAK

Projek ini adalah tentang membina sistem pakar yang bertajuk Sistem Pakar Penyelenggaraan Masalah untuk Mesin Kedap Bersaiz Empat Segi Sama. Mesin ini telah dicipta oleh Teknologi Boryung yang dibeli oleh Nulatex Sdn Bhd. Mesin ini digunakan untuk pakej kondom lateks berkualiti. Boryung Teknologi telah memberi arahan operasi yang mengandungi senarai semak kecacatan. Senarai semak kecacatan mengandungi masalah penyelenggaraan terhadap Mesin Kedap Bersaiz Empat Segi Sama. Maklumat ini digunakan untuk membina sistem pakar. Pertama, maklumat ditukarkan kepada JIKA-MAKA kaedah dan melaksanakan menggunakan kaedah rantaian kehadapan. Kemudian, maklumat telah diprogramkan menggunakan Python Bahasa Pengaturcaraan dengan aplikasi muka grafik. Sistem yang lengkap dinilai keberkesanannya dengan menggunakan satu set soal selidik. Walau bagaimanapun, ini adalah sistem tertutup yang memerlukan penambahbaikan untuk melaksanakan kepada mesin. Sebagai contoh, sistem perlu mengemaskini masalah penyelenggaraan untuk menjadi lebih cekap dan berkesan. Hasil daripada kajian ini amat berguna yang akan dilaksanakan dalam industri untuk mengurangkan masa kerosakan dan kos. Sistem ini akan digunakan dalam ramalan prestasi mesin.

ABSTRACT

This project is about developing an expert system that titled Expert System of Maintenance Problems for Square Foiling Machine. This type of machine was invented by Boryung Technology that purchased by Nulatex Sdn Bhd. The machine was used to package quality latex condoms. Boryung Technology had been provided an operating instruction that includes a defect checklist. The defect checklists contain maintenance problems of Square Foiling Machine. This information used to build the expert system. First, the information transcribed into IF-THEN rule and executed the rules using Forward Chaining method. Then, the rules programmed using Python Programming Language with Graphical User Interface application. A complete system evaluated its effectiveness using a set of questionnaire. However, this is offline system that required further improvement to implement to the machine. For example, the system need update its maintenance problems to be more efficient and effective. The result from this research is useful to be implemented in industry to reduce breakdown time and cost. The system will be used in machine performance forecasting.

DEDICATION

Very special love and appreciation for my lovely parent and family for being an internal spirit and gives continual support that effect much in developing this project. Great appreciation to my supervisor for encouraging and invaluable guidance. Thanks to Nulatex Sdn. Bhd. for permission to the project regarding to Square Foiling Machine.

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Lastly, I would like to thanks any person who contributes to my final year project directly or indirectly. I would like to acknowledge their comments and suggestions, which was crucial for the successful completion of this study.

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF ABRREVIATIONS, SYMBOLS AND NOMENCLATURES

AI	-	Artificial Intelligence
BASIC	-	Beginner's All-purpose Symbolic Instruction Code
BRT	-	Boryung Technology
C	-	C Programming
C++	-	C++ Programming
C#	-	C# Programming
CMMS	-	Computerized Maintenance Management System
FMEA	-	Failure Modes and Effects Analysis
FORTRAN	-	Formula Translating System
GUI	-	Graphical User Interface
Haskell	-	Haskell Programming
Java	-	Java Programming
LAN	-	Local area network
Lisp	-	Lisp Programming
MATLAB	-	Matrix Laboratory Programming
ML	-	Meta Language Programming
OCmal	-	Objective Caml Programming
PDCA	-	Plan, Do, Check, Act
Perl	-	Perl Programming
Prolog	-	Prolog Programming

CHAPTER 1

INTRODUCTION

This chapter is about introducing the background of this project that is related to a disposable medical device manufacturing company, Nulatex Sdn. Bhd. located in Kluang, Johor, Malaysia. This chapter is describing the problem statement, objective and scope of this project. This project is focusing on the maintenance of the Square Foiling Machine (SFM). The information in defect checklist that provided by Boryung Technology will be used to build up an expert system. In addition, a gantt chart that shows the planned activities throughout two semesters in session 2014/2015 is attached.

1.1 Background

Maintenance refers to the concern of controlling the condition of equipment. Maintenance is necessary to preserve equipment, machines, and the work environment safe and secure. Lack of maintenance can require a situation become dangerous to someone or its surroundings, accidents, and health worries.

There are five classifications of most machinery maintenance problem (Bloch & Geitner, 2004).

i.   Preventive / Periodic:
      There is a maintenance schedule that planned to carry out to the machine. This action is necessary to prevent or avoid any problem and keep them in good condition.

1

ii. Predictive / Condition Based:

Monitor the machine condition to predict proper operation and improper operation or problems. The worker will control & surveillance, inspection (on/off-line), overhaul & repair and replacement and any action that need to be taken towards the machine.

Breakdown / Demand Based:

Resolving problems that appeared, a decision must be brought to replace with new single.

iii. Bad Actor Management:

A problem caused by humans in direct or indirect actions. For instance, problems occur during inspection & failure analysis, weak spot identification, modification in operating procedures, maintenance, and design process.

iv. Organizational Concern:

It is about the interest of management and technician to the machine condition for some other use.

All the information related to the maintenance should be kept properly for future purpose. Same problems may occur and needed the same solution. Thus, the information, experience, and justification must be stored in a base so that it used as a problem solver.

There is a defect checklist in the instruction operated manual provided by Boryung technology. This a defect checklist shows the problem, its causes and remedy of SFM maintenance problems (Boryung Technology, 2013).

Maintenance problems are related to the SFM. This machine is a sealing machine that will foil every single of condoms. The sealing process is a process that some heat is supplied to mold to enclose a product to keep the hygiene product in clean and safe condition. It will prevent the content from coming out or other foreign particle moving into the product.

Figure 1.1: Square Foiling Machine (Boryung Technology, 2013)

This machine is used for foiling purpose and the model type is BRT-5000SA. It was invented by Boryung Technology (BRT) Company. BRT-5000SA is designed to seal condoms in a square shape by manual loading with four side seals. The packaging material should be plastic. It was to prevent the stain on the foils. Therefore, the silicone oils will keep in the foil with the condoms (Boryung Technology, 2013).

Table 1.1: Specifications of Square Foiling Machine (Boryung Technology, 2013)

No	Specifications	Details
1	Model no.	BRT-5000SA
2	Dimension	2200L x 1000W x 1650H mm
3	Power supply	240V. Single-Phase
4	Package size	55 x 57 mm
5	Production rate	About 70 to 100 pcs per minutes
6	Electric power consumption	2~3.0 Kwh
7	Automatic Grade	Semi-automated

This machine consists of several important parts. There are loads parts, oil insertion, heating the part, perforated and trimmed cutter. Loading part is a space provided for operators to place clean and rolled condoms on that specific fixture provided. Oil insertion is a component of silicone pump to pump the silicone oil on that condom. Furthermore, for the heating part is the primary part of this machine. There is a heated mold used for the sealing process. While for the perforated and trimmed cutter used to cut the foiled condoms in square form.

1.2 Machine operation

A batch of condom that have been tested using a dry electronic testing machine, passed and got confirmation from the quality department will be sealed and foil based on type and customer requirement. Start the machine by press green button. Temperature switch will be set to the optimum and accurate temperature and reserved for some minute to obtain an exact temperature.

The operator will place the condoms into the special fixtures called hopper feeder manually. Once put the condom on that particular fixture that also a special conveyor that functions to place the condom on the foil. The conveyor is rotated vertically.

Figure 1.2: The rolled condoms on the special fixtures (Mohamad, 2014)

The condom will be along the bottom foil. Afterward that, there will be a drop of silicone oil that used to lubricate and keep the condom in good condition. A type of silicone used depends on the job order to be unflavoured or flavoured. There are many type flavours are available like vanilla, strawberry, tutti-fruity, lemon, orange, banana, cherry and green apple.

Figure 1.3: Silicone oil being pump on the condom (Mohamad, 2014)

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There will be upper foil that flow together with the bottom foil. They will undergo a heating process to ensure the foil stick together at an absolute temperature. A mold will be heated so that the foil melt and stick together.

Figure 1.4: Heated mold (Mohamad, 2014)

The completion of foiling and sealing process the condoms need to perforate and trimmed to separate them each.

Figure 1.5: Perforated and trimmed equipment (Mohamad, 2014)

This machine is operated manually without programmed with specific software. The adjusted button will ensure this machine work smoothly and run according to the spec. There are buttons to control the temperature, speed and the flow according to the silicone oil pumping so that the movement of condom will be simultaneous to silicone oil pumping.

1.3 Problem Statement

Maintenance of a machine is a concept that maintains the machine performances in good condition. Maintenance is the necessary, a basic support of machines includes tasks such as lubricating, adjusting, and replacing parts of the SFM. From the defect checklist, there are seven maintenance problems provided in operating instructions. Man must know solutions or remedies to solve maintenance problems so that

5

breakdown time can be reduced. The expert system will use information provided that consists of symptoms complete with the causes and remedies. Therefore, the expert system will detect the maintenance problems based on certain causes and provide the remedies automatically if implemented to the SFM. Thus, breakdown time will reduce because all the causes of the maintenance problems complete with the remedies.

1.4 Objectives

The objectives of this project are to:

i. Identify maintenance problem related to SFM,

ii. Suggest a solution for maintenance of SFM using an expert system,

iii. Develop an expert system for the maintenance problem of SFM, and

iv. Evaluate the effectiveness of an expert system towards the maintenance problem.

1.5 Scope

This project is to develop an expert system of maintenance problems for BRT-5000SA SFM. This machine was used to foil pharmaceutical product which are male latex condoms. The system will use preliminary information in operating instructions from Broyung Technology that contain defect checklist. There are seven symptoms of maintenance problem. Every symptom has its causes and its causes have own remedies. An expert system is an intelligent computer program that simulates any practical or theory knowledge in any domain of human. Maintenance problems related to the will be utilized to build up an expert system. The expert system will be developed by using the Python Programming Language with Graphical User Interface, GUI. However, the expert system will be not implemented to the SFM due to some limitations. The expert system is an offline system that stands alone without connecting to the machine.