UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM FOR ESSENCE OIL PRODUCTION PLANT

This report submitted in accordance with requirement of the UniversitiTeknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Industrial Power) with Honours

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

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ABSTRACT

Along with the advance of technology, the process for producing essential oil is growing ahead of the start of the discovery in 1987 in India and Indonesia. The two countries are major producers of sandalwood. However, the discovery of sandalwood in Australia in 1971 also made the country known as an exporter of famous nowadays. As we know, most owners still run the company sandalwood oil extracting process using traditional methods such as steam distillation. With advances in technology bucked, causing more deficiencies that occur in the process of getting the essential oil. For example, the lack of skilled workers operate the equipment in the production plant, the oil obtained may be dwindling in quality and may upon the occurrence of such a situation the sensor cannot read the actual amount of water needed for the process is also the cause of the decline of sandalwood oil. Thus, in this project will used SCADA system to develop a fully automated system for sandalwood oil process using HMI software system (INDUSOFT) and to develop the SCADA system to monitor and control the process in Sandalwood production plant.

ABSTRAK

Seiring dengan kemajuan teknologi, proses untuk menghasilkan minyak pati semakin meningkat maju dari tahun penemuannya pada tahun 1987 di India dan Indonesia. Kedua-dua negara ini merupakan negara pengeluar utama kayu cendana. Walau bagaimanapun, penemuan kayu cendana di Australia pada tahun 1971 juga menjadikan negara itu dikenali sebagai pengeksport terkenal pada masa kini. Seperti yang kita tahu, kebanyakan pemilik syarikat yang memproses kayu cendana untuk dijadikan minyak, mereka masih memilih menjalankan proses mengekstrak minyak cendana menggunakan kaedah tradisional seperti penyulingan wap. Dengan kemajuan teknologi yang menongkah arus ke hadapan, menyebabkan lebih banyak kekurangan yang berlaku dalam proses mendapatkan minyak pati. Sebagai contoh, kekurangan pekerja mahir mengendalikan peralatan ini di kilang pengeluaran, menyebabkan minyak yang diperolehi mungkin semakin berkurangan dalam segi kualitinya dan mungkin juga apabila berlakunya keadaan seperti sensor tidak boleh membaca jumlah sebenar sukatan air yang diperlukan untuk proses ini juga menjadi punca kemerosotan minyak cendana. Oleh itu, dalam projek ini akan menggunakan sistem SCADA untuk membangunkan sistem automatik sepenuhnya untuk proses minyak cendana menggunakan sistem HMI perisian (INDUSOFT) dan untuk membangunkan sistem SCADA yang mana akan diguna untuk memantau dan mengawal proses dalam kilang pengeluaran kayu cendana.

DEDICATION

In the name of Allah, Most Gracious, Most Merciful. Peace and blessings be upon Prophet Muhammad ﷺ, family members and do not forget also to his companions.

Thank God I pray gratitude to the Almighty for permission, grace, and guides the writing allows me to set up and improve the project report. During the production of this report, I've got collaboration, contribution, and assistance in terms of advice, moral and spiritual support as well as technical assistance from various parties. Appreciation and gratitude are particularly special is addressed to all members of my family especially to my father and mother, Rohaizat Bin Hassan and Aliza Bt Sam have a lot to give encouragement when I face difficulties when preparing this report. Do not forget also to my supervisor, Assoc Prof Mohd Ariff bin Mat Hanafiah who are willing to give ideas and guidance as well as to my friends who are willing to help. The final word, indeed every encouragement and assistance been given only God alone could rewards. May we always seek the blessing from Him.

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Thank you.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

SCADA - Supervisory Control and Data Acquisition

CO_2 - Carbon dioxide

LAN - Local Area Network

WAN - Wide Area Network

WPAN - Wireless Personal Area Network

WLAN - Wireless Local Area Network

WMAN - Wireless Metropolitan Area Network

WWAN - Wireless Wide Area Network

HMI - Human Machine Interface

RTU - Remote Terminal Unit

PLC - Programmable Logic Controller

PLC - Power Line Carrier

IWS - Indusoft Web Studio

DNP3 - Distributed Network Protocol version 3

IED - Intelligent Electronic Devices

OSI - Open System Interconnection

ISO - International Standard Organisation

TCP/IP - Transmission Control Protocol/Internet Protocol

ARPANET - Advanced Research Project Agency Network

DARPA - Defense Advanced Research Project Agency

DNS	-	Domain Name Server
FTP	-	File Transfer Protocol
SMTP	-	Simple Mail Transfer Protocol
HTTP	-	Hyper Text Transfer Protocol
URL	-	Uniform Resource Locator
CPU	-	Central Processing Unit
LD	-	Ladder Diagram
FB	-	Function Block
SFC	-	Sequential Function Chart
IL	-	Instruction List
ST	-	Structure Text
DM	-	Data Memory
PID	-	Proportional-Integral Derivative

CHAPTER 1

INTRODUCTION

1.0 Introduction

Essence oils known as one of consumers goods used in the world such as cosmetics, perfumes, detergent, soaps and toilet products. The traditional technologies pertaining to essential oil processing are still being used. There are several methods that still be used like water distillation, steam distillation, maceration and etc. This project is about to develop a fully automated system for sandalwood oil process using HMI software system (INDUSOFT) and to develop the SCADA system to monitor and control the process in Sandalwood production plant.

1.1 Background

SCADA system stands for supervisory control and data acquisition system. Data acquisition refers to the method used for accessing and collecting the data from the devices being controlled and monitored and to be forwarded to a telemetry system ready for transfer to the various sites. The data may be analogue or digital gathered by sensors such as ammeters, voltmeters, and flowmeter. It can also be data to control equipment such as actuator, relays, valves and motors. Telemetry is the initial step in applying SCADA by defining the technique used for measuring the data from different location in the real time process and transferring it to the RTU in another location through a communication circuit.

This task proposes to simplify the task of control and monitor the production plant for Sandalwood oil. SCADA system are employed throughout industry and are used to centrally monitor and control processes equipment such as valves, pumps, relays, sensors and motors. It is a system as a combination of protocols, software and special hardware. SCADA can be used to gathers information (such as where a leak on a pipeline has occurs), transfer the info back to a central site, alerts the home station that a leak and carrying out necessary analysis and control (determine if the leak is critical and display the info in a logical). Thus, with this system, control and monitor production plant will be easy and quick. This system also use to make sure that in order to control and monitor the production, the data being record can be more accurate, and suitable with the production plant.

1.2 Problem Statement

At present, the traditional technologies pertaining to essential oil processing are still being used widely. Water distillation, water and steam distillation, direct steam distillation, maceration, cohobation and enfleurage are the most traditional and commonly used methods.

When using the traditional methods, all the process control like water level, temperature, flow control and pressure need to be monitored by person in charged at the section. If valve that pump water damaged or sensor cannot detect the suitable temperature for heating, it will effects the whole production. Thus, by creating the HMI and interfacing in the production plants, the abnormal condition in producing essential oils can be done easily control and monitor by SCADA system. Therefore, production plant can enhance a good result in making the essential oils.

1.3 Objective Study

The objectives of this project are:

i. To control and monitor the sandalwood oil production process using SCADA

ii. To automate the equipment and components used for the sandalwood oil production

iii. To develop a Human Machine Interface (HMI) and SCADA system by using INDUSOFT SCADA software

1.4 Scopes of Study

There are a few scopes and guidelines listed to ensure the project is conducted within its intended boundary. This is to ensure the project is heading in the right direction to achieve its intended objectives.

Scopes of this project are focus on:

i. To study the implementation of INDUSOFT SCADA software.

ii. To study other instruments or protocols that contributed to the development of fully automated process control such as RTU, Modbus and etc.

1.5 Summary

This chapter is about the background and the problem statement of the project which encouraged this project to be conducted. The objectives of this assessment also discussed in this chapter. In addition, scope also has been discussed in order to ensure that the assessment was conducted systematically according to its objectives.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter will describe all the related research as the studies of this subject. Research and references is used from various source of book published, journal, internet and others previous projects to accomplished this project. All the theory related to process of getting essence and SCADA system will be explain in Section 2.1, Section 2.2, Section 2.3, Section 2.4, Section 2.5, Section 2.6, Section 2.7, Section 2.8, Section 2.9 , Section 2.10 , Section 2.11 , section 2.12,section 2.13, section 2.14 and Section 2.15. The previous research and article or journal related to this project will be discussed in Section 2.16. Basic knowledge of PLC and software been used as to conduct a ladder diagram will be discussed in Section 2.17 till Section 2.19.

2.1 *Santalum Album* (Sandalwood oil)

Sandalwood, of the genus *Santalum*, is a genus of woody flowering trees and plants. Most species are semi-parasitic and several produce a highly aromatic wood. The most common species are Indian sandalwood (*Santalum album*) and Australian sandalwood (*Santalum spicatum*). Different sandalwood species are indigenous to several Pacific Islands such as Hawaii (*S.ellipticum*), Fiji (*S. yasi*), Papua New Guinea (*S.macgregorii*) Vanuatu (*S.austrocaledonicum*) and French Polynesia (*S.insulare*). The essential oil produced by sandalwood is obtained through steam distillation of the chipped heartwood because it highly valued for their fragrant heartwood oils. The oil is a clear with a yellow tinge viscous liquid that is insoluble

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in water. The oils have been used for centuries for religious (related with Indian culture - an ancient Hindu medicine, Ayurveda used plant extracts and essential oils in their healing potions (spiritual enhancement abilities)) and customary purposes and are used internationally for aromatherapy (release stress, anxiety and insomnia), cosmetic, medicines (cancer), perfumery and scenting of soaps.

Figure 2.1: Sandalwood oil

2.2 Methods of Producing Essential Oils

Traditionally, sandalwood is wild- harvested, since cultivation is difficult. Regarding hydro distillation, the essential oils industry has develop terminology to distinguish three types: water distillation, water and steam distillation and direct steam distillation. Originally introduced by Von Renchenberg, all three methods are subject to the same theoretical considerations which deal with distillation of two phase systems. The differences lie in the methods of handling the material. In order to isolate essential oils, the aromatic plant material is packed in a still and a sufficient quantity of water is added and brought to a boil. Alternatively, live steam is injected into the plant charge. Due to the influence of hot water and steam, the essential oil is

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freed from the oil glands in the plant tissue. The vapour mixture of water and oil is condensed by indirect cooling with water. From the condenser, distillate flows into a separator, where oil separates automatically from the distillate water.

2.2.1 Mechanism of Distillation

Hydro distillation of plant material involves the following main physicochemical processes:

     i.   Hydro diffusion

    ii.   Hydolysis

   iii.   Decomposition by heat

Hydro diffussion (percolation)

Define as diffusion of essential oils and hot water through plant membranes. Membranes of plant cells are almost impermeable to volatile oils. Therefore, in actual process at the temperature of boiling water, a part of volatile oil dissolves in the water present within the glands and this oil water solution permeates by osmosis the swollen membranes and finally reaches the outer surface where the oil is vaporized by passing steam. The speed of oil vaporization is not influenced by the volatility of the oil components but by their degree of solubility in water is one of the aspects of hydro diffusion.

<u>Hydrolysis</u>

In the present context is defined as a chemical reaction between water and certain constituents of essential oils.

<u>Effect of heat</u>

To obtain the best quality oil, distillation must be done at a low temperature. It is possible to obtain better yield and quality of oils by:

a) Maintain the temperature as low as possible

b) Using a little water (for steam distillation)

c) Packing it uniformly before distillation

2.2.2 Traditional and modern methods

A. Water (hydro) Distillation

Using this method, material used is completely immersed in water to soak. The water is then boiled, often heated over an open fire. The essential oils will eventually floats to the surface, above the hydrosol, where it can be collected. During process, all parts of the plant charge must be kept in motion by boiling water.

There are several advantages and disadvantages when using this method. The advantages are it permits processing of finely powdered material by contact with live steam, the stills are inexpensive, easy to construct and suitable for field operation. The disadvantages are complete extraction is not possible. It requires a greater number of stills, more space, and fuel. It also requires heating a large quantity of water which increases the cost and time needed for sandalwood distillation. It demands considerable experience and familiarity with the method. It is also a slower processes, it takes a long time to accumulate much oil, as good oil is often mixed with bad quality oil.