WIRELESS MULTIPOINT NETWORK PRODUCTION MONITORING SYSTEM

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Tajuk Projek	:	WIRELESS MULTIPOINT NETWORK PRODUCTION MONITORING SYSTEM
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To my beloved mother and father

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ABSTRACT

A production line requires a monitoring system that is automated, accurate and reliable, as well as low cost and easy to maintain to help companies to achieve a better yield. A production line usually consists of several sub-processes which makes it very time consuming to troubleshoot whenever failure occurs. Wireless multipoint network production monitoring system (PMS) aims to solve this problem. The objective of this project is to design and develop a wireless multipoint PMS using PIC, IR sensors, and ZigBee technology, as well as to simulate and analyse the performance of the system in terms of data accuracy and real time. In this project, the system is designed for only two sub-processes in one production line and concentrated on collecting the information: total input, rejected product, and downtime counter. The design involved designing an initial circuit, followed by software design and hardware circuit constructions. The hardware and software will be combined and their compatibility will be tested to make sure it is functioning as desired. Finally, the output data is gathered and analysed. This system aims to be used in the production floor to monitor each sub-process and helps to reduce the troubleshooting time, while improves the production performance and yield.

ABSTRAK

Satu barisan pengeluaran memerlukan satu sistem pemantauan yang automatik, tepat dan boleh dipercayai, serta kos yang rendah dan mudah untuk mengekalkan and membantu syarikat-syarikat untuk mencapai hasil yang lebih baik. Satu barisan pengeluaran biasanya terdiri daripada beberapa sub-proses yang menjadikannya sangat memakan masa untuk menyelesaikan masalah apabila berlaku kegagalan. Sistem pemantauan pengeluaran (PMS) berbilang rangkaian wayarles bertujuan untuk menyelesaikan masalah ini. Objektif projek ini adalah untuk merekabentuk dan membina satu PMS yang berbilang rangkaian wayarles menggunakan PIC, IR sensor, dan teknologi ZigBee, serta membuat simulasi dan menganalisiskan prestasi sistem dari segi ketepatan data dan masa nyata. Dalam projek ini, sistem ini direkabentuk hanya untuk dua sub-proses dalam satu baris pengeluaran dan memberi tumpuan kepada pengumpulan maklumat: jumlah input, jumlah produk yang ditolak dan masa kerosakan di produksi. Rekabentuk yang terlibat dalam projek ini ialah merekabentuk litar awal, diikuti dengan rekabentuk perisian dan pembinaan litar perkakasan. Perkakasan dan perisian akan digabungkan dan kompatibiliti akan diuji untuk memastikan system ini berfungsi seperti yang dikehendaki. Akhirnya, data output akan dikumpul dan dianalisis. Sistem ini bertujuan untuk digunakan di lantai pengeluaran untuk mengawasi setiap sub-proses dan membantu mengurangkan masa penyelesaian masalah, manakala meningkatkan prestasi dan hasil pengeluaran.

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LIST OF ABBREVIATION

PMS	–	Production Monitoring System
PIC	–	Programmable Interface Controller
IR	–	Infrared
LCD	–	Liquid Crystal Display
LED	–	Light-Emitting Diode
I/O	–	Input Output
GSM	–	Global System for Mobile Communication
GPRS	–	General Packet Radio Service
RX	–	Receiver
TX	–	Transmitter
PCB	–	Printed Circuit Board
SMT	–	Surface-Mount Technology
ICT	–	In-Circuit Test
DC	–	Direct Current
GND	–	Ground
IC	–	Integrated Circuit
ADC	–	Analog To Digital Converter
USB	–	Universal Serial Bus
COM	–	Communication Port
EUSART	–	Enhanced Universal Synchronous Asynchronous Receiver Transmitter

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CHAPTER I

INTRODUCTION

This Chapter will provide an overview of this project regarding wireless multipoint network production monitoring system. It discuss about problem statement, objectives, scope of work, and a brief description of methodology of this project. The structure of this report will be listed in the end of this chapter.

1.1 Overview

In the global landscape, manufacturers have more competition, more product variables, and more cost pressures in this present climate. To ultimate the victory on the competitive landscape, manufacturers must minimise waste and maximise productivity without sacrificing product's quality. It requires access to the production information for measurement, tracking the production flow, and analyse the production processes.

Nowadays, manual data collection is still very common for many production floor processes. Manual method of data collection is a time-consuming and labour intensive process. Generally, it is done with pen and paper by human operators. When manual data collection is carried out, it is usually followed by a step of manually compiling the data collected and keying in to spreadsheets. Manual data compilation leaves room for both inconsistencies and inaccuracies (Giese, 2007). The data

collected can be inaccurate due to some errors such as human errors and data modifications. The truthfulness of the collected information is no longer reliable due to human intervention. Thus, an automated data capture and display system is required to improve the data accuracy and reliability.

A real time production monitoring system (PMS) is a production tool that is used to provide information on the status of a production floor process or working line (Imran, 2012). It collects the production information, such as the total amount of goods produced, amount of reject pieces produced and machine breakdown or downtime occurrences, and displayed them on the display panel units. The information obtained can help the management team and responsible personnel to benchmark the latest production floor performance, as well as to let the operators know whether they are on schedule. This can improved the production line efficiency towards achieving the realistic production goals at reduced downtime, resulting in improvement of the productivity (Siva, 2009).

Studies have found many problems related to hard wire connection. If the monitoring system is in the form of wire connection, the transmission range will be reduced due to the physical limitations of cable. In addition, wired monitoring systems are less adaptable to expansion, making it more difficult to add or modify in the future. Since it requires a lot of wiring, it is very difficult to install, maintain and troubleshoot the system (Muhammad Azlan, 2014). Besides that, hard wired connection is more expensive than wireless as the number of wire cables and the complexity of the circuit are cost expensive compared to a pair of wireless transmitter and receiver. Hence, a cost effective wireless production monitoring system is needed to ease the responsible personnel to do maintenance and troubleshooting the system.

The production process is a process whereby a range of inputs is transformed into those end products that are required by the customer or market. A production flow consists of a continuous operations of parts and sub-processes passing through a moving platform or conveyor from one work station to another until the product is completely assembled. For example, a PCB assembly production consists of a large number of process steps, such as SMT lines, wave soldering, ICT test, calibration, checking and packing. A production flow involves the use of production lines. A

production line with several sub-processes makes it very time consuming to troubleshoot. Therefore, a multipoint network is needed to monitor a complete assembly process which involves more than one sub-processes in a production line, to help expedite the troubleshooting and fault finding whenever failure occurs.

1.2 Problem Statement

Nowadays, manual data collection is still common for many production floor processes. The data collected can be inaccurate and the truthfulness is no longer reliable due to human intervention. Besides, if the monitoring system is in the form of wire connection, it is very difficult to install, maintain and troubleshoot as it requires a lot of wiring and circuit connections, depending on the circuit complexity. A production flow consists of a continuous operations of parts and sub-assemblies passing through from one work station to another until finished. A production line with several sub-processes makes it very time consuming to troubleshoot whenever failure occurs.

A wireless multipoint network production monitoring system (PMS) aims to monitor each sub-process of a production line and helps to reduce the troubleshooting time, while improves the production performance. This cost effective automated PMS helps to improve the accuracy of the data reported and is considered as a reliable system for management without human intervention. The wireless technique is required to make the system easier to maintain, cost effective and robust for any future expansion.

1.3 Objectives

There are three objectives that need to be achieved in this project. These objectives are:

1. To design an automated multipoint network production monitoring system using PIC microcontroller, IR sensors and LCD display.
2. To develop a wireless multipoint network production monitoring system using ZigBee technology.

3. To simulate and analyse the performance of the whole system in terms of data accuracy and real time.

1.4 Scope of Work

This project mainly focuses on the hardware and software design to develop a wireless multipoint network production monitoring system. In this project, the system is designed for only two sub-processes in one production line, named as Process 1 and Process 2. The system should be able to perform automated data collection for each sub-process and display the information collected on a display board. Figure 1.1 illustrates the suggested system to be designed.

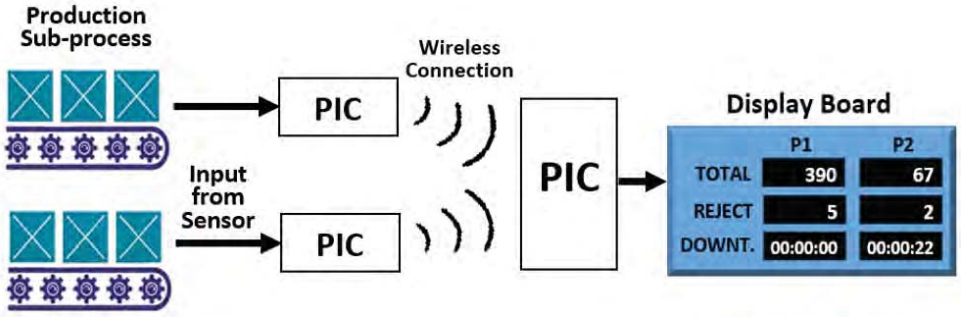

Figure 1.1: Suggested System to be Designed

This project concentrates on the following areas:

1. Design and develop electronic circuitries to capture the production line information such as the total production input, reject pieces produced, and the machine downtime.
2. Design wireless connection circuits that is capable of transmitting the data collected from each sub-process to the master PIC board.
3. The circuits are designed by using Proteus Design Suite Version 8.0.
4. The system circuits are using PIC 18F4550 microcontroller, which is programmed in C programming language using CCS PCWH V4.038 Compiler. There are 3 units of PIC microcontrollers, 2 units are used to control the sensors

and timer in each sub-process and another 1 unit, known as master PIC, is used to control the display board.

5. In each sub-process, the circuit includes 2 pairs of IR sensors. IR sensor 1 is used to detect the total production input and IR sensor 2 is used to detect the amount of reject pieces produced.
6. A switch is used for a machine downtime timer for each sub-process.
7. The wireless technology used is the XBee Series 1 module by ZigBee technology. There are 2 units of ZigBee transmitter and 1 unit of receiver, used for transmitting information from two sub-processes in a production line to the master PIC.
8. The transmission distances range in this system is roughly 1 – 100m surround in free space.
9. The output unit consists of a 4×20 characters LCD display board, which is used to display all the information received from each sub-process.

1.5 Project Methodology

Methodology covers the methods and processes that are being used to complete this project and functioning well. Before the project starts, all the necessary procedures have been taking into consideration to minimize any unwanted or difficulties from occur. The first thing is about the circuit and system design. Some researches are done to obtain information about the design of production monitoring system, familiarize with the features of the system, and comprehend about the appropriate components used. Then followed by conceptualizing an initial circuit and system design. Later, the program for PIC is designed by using C programming language. The entire program is simulated by using Proteus 8.0 software. The project then proceed by constructing the hardware circuit and test for its functionality. Troubleshooting are needed whenever error occurs. Finally, the whole system performance is analysed.

1.6 Report Structure

This report is divided into five chapters which cover all the matters in developing this project.

Chapter 1 – "Introduction"

This chapter will include an overview of the project, problem statement, project objectives, scope of work and a brief description of methodology. The structure of this report will be listed in the end of this chapter.

Chapter 2 – "Literature Review"

This chapter will highlight past studies related to the subject of this project. Background theory will also be included in this chapter. It provides review from previous research, books, articles and also journals regarding wireless technology, production line, multipoint, and production monitoring system.

Chapter 3 – "Methodology"

This chapter will describe about the methods and approaches that are being used to complete this project. Both flow chart and block diagram with clear explanation are used to present the project methodology. This chapter includes the details of the project development, system operation, implementation of the components used, and also the circuit and system design.

Chapter 4 – "Results and Discussion"

This chapter shows the simulation and results obtained from the system designed. The analysis of the whole system performance in terms of data accuracy and real time is also included in this chapter. This chapter combines both visual and textual representation of the project findings.

Chapter 5 – "Conclusion and Recommendation"

This chapter contains a brief outline of the entire work, including methods, results and major conclusions arising from completing this project. Some recommendations for future work will also be included in this chapter together with the contributions of the project.