WIRELESS ROBOTIC ARM

SHAZA FAZIRA EDORA BINTI SHARUIDDIN

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Special thanks to my family, project supervisor and friends

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ABSTRACT

In recent year, with the increase usage of wireless application, the demand for a system that could easily connect devices for transfer of data over a long distance without cables grew stronger. This paper presents the development of a wireless robotic arm. A wireless robot that functional to do pick and place operation and be controlled by Personal Computer. Visual Basic programming as an interface between robot and computer and Arduino UNO as a microcontroller of the robot that consist of 4 Degree of Freedom (D.O.F). For the wireless part, Zigbee modules will be used for transmitter part and receiver part. All the movements will calibrate to ensure that the transmission of data is correct. Two Zigbee modules are connected to single node using star topology. After Zigbee module received the data from transmitter, the signal will send to the Arduino microcontroller. This microcontroller will be stimulated the signal and send to the robot. Finally, robot will be doing the desired task according to input instructions. These robots can used in many fields of applications including office, military tasks, hospital operations, dangerous environment and agriculture.

ABSTRAK

Pada tahun kebelakangan ini, dengan meningkatnya penggunaan aplikasi wayarles, permintaan untuk sistem yang mudah boleh menyambung peranti untuk pemindahan data melalui jarak jauh tanpa kabel bertambah kuat. Kertas kerja ini membentangkan pembangunan lengan robot tanpa wayar. A robot tanpa wayar yang berfungsi untuk tidak memilih dan operasi tempat dan dikawal oleh komputer peribadi. Pengaturcaraan Visual Basic sebagai antara muka di antara robot dan komputer dan Arduino UNO sebagai pengawal mikro robot yang terdiri daripada 4 Ijazah Kebebasan (DOF). Untuk sebahagian wayarles, modul ZigBee akan digunakan untuk bahagian pemancar dan bahagian penerima. Semua pergerakan akan menentukurkan untuk memastikan bahawa penghantaran data adalah betul. Dua modul ZigBee disambungkan kepada nod tunggal menggunakan topologi bintang. Selepas modul ZigBee menerima data dari pemancar, isyarat akan dihantar ke mikropengawal Arduino. Pengawal mikro ini akan merangsang isyarat dan hantar ke robot. Akhir sekali, robot akan melakukan tugas yang dikehendaki mengikut arahan input. Robot ini boleh digunakan dalam banyak bidang aplikasi termasuk pejabat, tugas ketenteraan, operasi hospital, persekitaran berbahaya dan pertanian.

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURE

LIST OF APPENDIX

LIST OF ABBREVIATIONS

PC	-	Personal Computer
CLK	-	Clock
UART	-	Universal Asynchronous Receiver/Transmitter
USB	-	Universal Serial Bus
EEPROM	-	Electricity Erasable Programmable Read-Only Memory
DC	-	Direct Current
MHz	-	Mega hertz
CPU	-	Central Processing Unit
PWM	-	Pulse Width Modulation
PCB	-	Printed Circuit Board
I/O	-	Input / Output
IDE	-	Integrated Development Environment
WLAN	-	Wireless Local Area Network
ADC	-	Analog Digital Converter
GUI	-	Graphical User Interface
COM	-	Component Object Model
RAM	-	Random Access Memory
ROM	-	Read Only Memory
RF	-	Radio Frequency
VB	-	Visual Basic
IFR	-	International Federal of Robotics
DOF	-	Degree of Freedom
CTU	-	Configuration &Test Utility Software
UHF	-	Ultra High Frequency

EPROM	-	Erasable Programmable Read-Only Memory
PROM	-	Programmable Read-Only Memory
SRAM	-	Static Random Access Memory
AVR	-	Atmel Voltage Regulator
TCP/IP	-	Transmission Control Protocol/Internet Protocol
LED	-	Light Emitting Diodes
PAN	-	Personal Area Network
SKXBee	-	Starter Kit XBee
TTL	-	Transistor–transistor logic
GND	-	Ground
RX	-	Receive Signal
TX	-	Transmit Signal
RST	-	Reset Pin XBee
COM	-	Component Object Model
AT	-	Command Mode
WR	-	Write
CT	-	Command Mode Timeout
RSSI	-	Received Signal Strength Indicator
ICSP	-	In-Circuit Serial Programming
VIN	-	Voltage input
FDTI	-	Future Technology Devices International

CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, robots are increasingly being integrated into working tasks to replace humans especially to perform the repetitive task. A robotic arm is a robot manipulator, usually programmable, with similar functions to a human arm. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement [1]. The links of the manipulator can be considered to form a kinematic chain. The business end of the kinematic chain of the manipulator is called the end effectors and it is analogous to the human hand [1].

In general, robotics can be divided into two areas, industrial and service robotics. International Federation of Robotics (IFR) defines a service robot as a robot which operates semi- or fully autonomously to perform services useful to the well-being of humans and equipment, excluding manufacturing operations [2]. The end effectors can be designed to perform any desired task such as welding, gripping, spinning etc., depending on the application. The robot arms can be autonomous or controlled manually and can be used to perform a variety of tasks with great accuracy. The robotic arm can be fixed or mobile (i.e. wheeled) and can be designed for industrial or home applications. These robots also used in many fields of applications including office [2], military tasks, hospital operations, dangerous environment and agriculture. Besides, it might be difficulties to the worker whose must pick and place something that can affect itself. For example, things like chemistry that cannot be picked by human and for the military such as defuse bomb that needed robot to pick and place the bomb to somewhere and for user that needed robot to do pick and place item while sitting and much more. Therefore a locomotion robot can be replaced human to do work.

In addition, wireless communications are now growing very rapidly because it is very efficient to use. Wireless technology that is widely used at close range is a device that can interface the other devices. Communication between robots is the process of delivering information to do something [1]. Communication between robots is an important component in the interaction of the multiple robots and their environment. In multiple robot systems, robot leader delivering orders to the follower robot to complete a task that occur coordination between the robot form of communication between the robots wirelessly. This form of communication is in the form of a command to the robot follower robot to follow the movement of the robot leader. Advantages of communication between the robots are efficient in completing the task. With time quickly orders can be delivered in a broadcast to the follower so that the job can be completed simultaneously. The robot is wireless controlled to ensure it can journey a long way from the user [3].

1.2 Problem Statement

Nowadays, most of industries use wired system between the robots setup in their industrial. The problem will be occurs when to setup the new robots, this is because the wired or cable is heavy to handle, consequently it will take times and constraints in setting the setup of the robots. In fact, it will take a lot of space to place it when we use the wired system in industries [1]. Labors can't move around the robot freely because disrupting with cable connectivity of robots. Furthermore, the robots is not portable devices means robot is difficult to move another places when we want changes the place this is because robot are involving assembly of wired [2]. On the other hand, in the information technology systems moving forwards globalization nowadays, an old system is improved for looking to automate their production with using new approaches that is wireless system. This system will bring benefits in most industries such manufacturing, electronics and health are now reaching a point where almost every field is now automated [4].

1.3 Objective

Generally, the objectives of this project are:

1) To design and develop a wireless robotic arm using wireless system.
2) To utilize the most suitable wireless technology to implement at arm robot.

1.4 Scope

The scope of this project basically divided into two parts which is hardware and software. For the hardware section, this project will use an Arduino UNO and Zigbee modules. The Arduino hardware platform already has the power and reset circuitry setup as well as circuitry to program and communicate with the microcontroller over Universal Serial Bus. In addition, the Input Output pins of the microcontroller are typically already fed out to sockets for easy access. ZigBee is low power consumption, low cost and moderate range. This range is suitable for our application where we want to wirelessly transmit data from Personal Computer to the robot. Another most important reason for using ZigBee module is that these modules come with serial interface therefore it will be easier for us to use these modules.

As for the software development, the programming for Arduino is using Arduino IDE and Visual Basic Programming 2010. Arduino provides a number of libraries to make programming the microcontroller easier. The simplest of these are functions to control and read the I/O pins rather than having to fiddle with the bus/bit masks normally used to interface with the Atmega I/O. More useful are things such as being able to set I/O pins to Pulse Width Modulation (PWM) at a certain duty cycle using a single command or doing Serial communication. For Visual Basic this paper is to describe a new approach from wired to wireless technology added with Graphical user Interface (GUI) application to make it more user-friendly. The transmitter will be connected to the computer whereas the receiver will be connected to the robotic arm interface. In the GUI, the robotic arm is modeled Visual Basic 2010. As a result, real-time and simultaneous movements from simulation to actual environment will be performed. All the movement will be calibrate to ensure that the transmission of data is correct.

1.5 Thesis Structure

There are 5 chapters in this final year project thesis. In Chapter 1, there is introduction about the project in general. Here will be well explanation about main idea and objective. Problem involves in the topic and what is affected was discussed. There are also the scopes and outlines of the report can be referring in this chapter.

In Chapter 2, reader can find some information about the project. This chapter is called literature review. Some basic theory and background of study are explained here. In this chapter, the definition, the operation of wireless technology system, and basic theory are well explained so that reader will be able to understand about the devices used in this project.

Chapter 3 discusses about methodology of project. In this chapter, how the project is developed is explained stage by stage. Each part of project development is shown in this chapter. More interesting, the case study that has been conducted from previous studies also has been discussed here. There is also a flow chart of this project development for reference.

The result and analysis of the project are explained in Chapter 4. In this chapter, result with the images will be inserted. All the details about the results will be explained here.

Chapter 5 will discuss and conclude the overall o the project. In this chapter, the future recommendations also will be included which can help for future development. References and appendixes are listed at the end of the thesis report.