WEARABLE HAND GESTURE CONTROLLER

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ABSTRACT

Wireless remote control is needed to control a robot from a distance. The purpose of this project is assigned to produce wireless remote control to control a robot using the XBee and use it as a tool to provide signal transmission medium and generating a communication protocol between the two "microcontrollers" and use the accelerometer sensor as a medium to control the robot movements. Remote control available to face problems related to the communication protocol between the two "microcontroller" and the problem of freedom to the user holds the remote control. So as a solution, wireless transmission medium "reliable" must be used and new communication protocols should be designed to suit the function of the mobile robot has been developed for the threshold values for accelerometer were identified using Arduino UNO software. XBee configuration is performed using software provided by DiGi XCTU. MPLAB has been used to create a communication protocol as required. Finally, the wireless remote control is ready to complete successfully produced as well as the new communications protocol. All objectives have been achieved.

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CHAPTER 1

INTRODUCTION

Chapter 1 covers the introduction part of this Final Year Project of Degree. . It contains the overall view of the project from its initiation, method and devices utilized in this project.

1.1 Introduction of project

With the development of science and technology, rapid development of robotic has been increasing from year to year. According to Robotic Institute of America (RIA), a robot is a re-programmable, multi-functional manipulator (or device) designed to move materials, parts, tools or specialized devices through variable programmed motion of a variety task whereas s mobile robot is an automatic machine that is capable of movement in any given environment. Mobile robots have

the capability to move around in their environment and are not fixed to one physical location and it can be found in industry, military and also in university that do research on it.

There are many types of mobile robot navigation and this report will just focusing on Manual remote or tele-operated. According to Consortium on Cognitive Science Instruction (CCSI), tele operated robots are controlled remotely by a human being. Controlling mobile robots through teleoperation is a challenging task that demands a flexible and efficient user interface as well as a reliable connection. Teleoperation requires a user interface to translate operator commands to the robot and provide feedback from the robot to the operator [1].

Controller is a device that is used to control devices from certain ranges. The remote control signals can be sent through wired or wirelessly. A There is no doubt that wired controller provide a more reliable connection and much faster compared to wireless controller but somehow it is not practical for some application especially for mobile robot application. The limitations are due to the distance constraints and the wired might get snagged or cut. Wireless controller has longer distance coverage depending on the device specifications that being used but there is a potential that the transmission speeds can suffer from outside interference. Wireless connection is also more expensive compared to wired connection.

The limitations of the existing wireless connection such as cost and power consumption can be improved by using Xbee. An Xbee module is based on 802.15.4 and operates at 2.4GHz frequency with maximum data rate of 250kbps [xbee module]. Each XBee radio (for example Series 2) has the capability to directly gather sensor data and transmit them without the use of an external micro-controller [2]. This means, the XBee offers some simple output functions so that basic actuations can also take place without an external micro-controller being present. There are a few types of XBee and this project utilizes XBee Pro Series 1 that allows coordinator, routers or end devices to communicate with the coordinator by default.

This makes point to point communication easy. Serial data is sent to the XBee router (or end device) connected to the PIC and received by coordinator.

1.2 Objective

The objectives of this project are:

1. To develop a controller that control using hand motion.
2. To use XBee device to make wireless and wearable controller.
3. To use accelerometer for find the axis of hand motion.

1.3 Problem Statement

Commonly, remote controls are Consumer IR devices used to issue commands from a distance to televisions or other consumer electronics such as stereo systems, DVD players and dimmers. Remote controls for these devices are usually small wireless handheld objects with an array of buttons for adjusting various settings such as television channel, track number, and volume. In fact, for the majority of modern devices with this kind of control, the remote control contains all the function controls while the controlled device itself has only a handful of essential primary controls. Most of these remote controls communicate to their respective devices via infrared signals and a few via radio signals. Earlier remote controls in 1973 used ultrasonic tones. The existing controller needs to be handheld but this project gives more natural feeling and less button are use. The handheld controller needs to hold and carry while using it. Sometimes this controller would slip from user hand that needs a good grip to handle it. Wearable Gesture Controller gives user more freedom because they no need to handheld the controller but just wear the glove to control. It also sticks to user hand that could solve the slippery of the controller.

1.4 Scope of Project

The Wireless Wearable Hand Motion Controller uses XBee and accelerometer. The main reasons using XBee is this device can covers range to 750m for outdoor line of sight and the frequency band of this device is 2.4 GHz. This is very suitable for outdoor usage especially for mobile robot application because it can provide a reliable connection. The accelerometer use in this project because to detect the magnitude axis and the direction of hand motion. The figure 1 shows the whole system of wearable Hand Motion controller that consist two parts, transmitter and receiver. This controller used Arduino UNO and XBee to create the communication protocol between the microcontroller of the transmitter and microcontroller of the receiver.

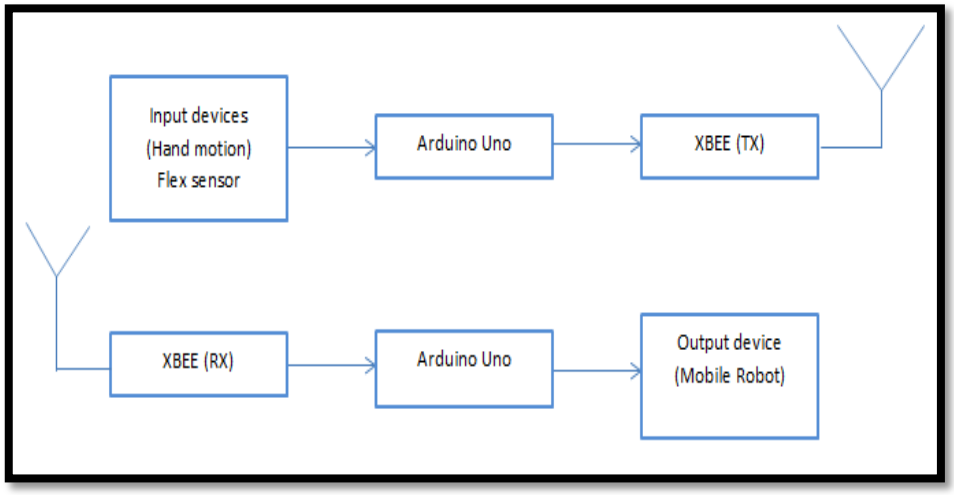

Figure 1.1: Block diagram for whole system

1.5 Thesis

In order to complete this thesis, 5 requirements are needed to be completed, which are Introduction, Literature Review, Methodology, Result and Discussion, and last but not least is Conclusion and Further Development of the project.

Chapter 1 is about introduction of the project. The basic idea about the project is being explained in this chapter including the objective and scope of this project.

Chapter 2 is about the literature review on the type of device being used for similar project. This section contains the literature review and methodologies that have been collected from different sources for the development of this circuit design.

Chapter 3 is about the design and methodology of the project.

Chapter 4 is about the analysis for all the obtained result.

Chapter 5 is about the conclusion and recommendation of the project.

CHAPTER 2

RESEARCH BACKGROUND

2.1 INTRODUCTION

In completing this project, some background researches have been done on several resources. The theory and description plus detail about the project have taken as guidance in completing this project. By this chapter, an overview of some application that similar to the project.

In this part, it will discussed more about controller technology with different type of utilization such accelerometer sensor, Bluetooth, Wi-Fi or Wireless LAN and last but not least using touch based controlled remote with temperature. It also includes the advantage/s and disadvantage/s using various type of utilization with compared to Wireless Wearable Hand Motion Controller technology.

2.2 Control of Omni-Directional robot using Accelerometer sensor on Android Smartphone [3]

By referring to this project, it using accelerometer sensor on Android smart phone with helps of Wi-Fi as medium to transmit and receive information data. The control of robot the robot movement is done by sending the accelerometer sensor value changes to the robot via a wireless network.

The advantage of using this technology is the cost for developing the controller is more cheap compared to Wireless Wearable Hand Motion Controller because it only using accelerometer in an android smart phone. Nowadays, people can affordable to buy this Android smart phone because the price much cheaper. By using the phone that someone already has to control movement of robot can save and reduce the cost for developing the robot controller.

The disadvantages of using this technology are the accelerometer is too sensitive for controlling robot movement. It need accuracy while turning the phone left, right, backward and forward for controlling the robot. The difficulty for controlling robot increase while walking and running. This is due to that controller or the android mobile phone need to handheld while using it. Besides that, this controller technology use Wi-Fi as transmission medium between transmitter and receiver to transport signal to each other. By using Wi-Fi, the possibility of signal loss is higher compare to XBEE technology. XBEE technology can reach up to 750 meter line of sight compared to Wi-Fi technology that only can achieve about 5 meter in a closed room and 15 meter in open space. Furthermore, the further the distance between smart phones to the robot, the slower the response time of Omni-directional robot in movement.

2.3 Gesture Based Wireless Virtual Mouse Controller Using Accelerometer [4]

This paper presents a virtual mouse interface which is a gesture-based mouse interface for robust hand gesture recognition in real-time. Gesture Recognition provides an efficient human-computer interaction for interactive and intelligent computing. The gesture recognition uses a single 3-axis accelerometer for data acquisition and comprises two main stages, a training stage and a testing stage. For training, the system employs dynamic time warping as well as affinity propagation to create example for each gesture while for testing, the system projects all candidate traces and also the unknown trace onto the same lower dimensional subspace for recognition. A dictionary of gestures is defined and a database of traces is created. In this paper, it is proposed a novel approach that uses an accelerometer device to control the mouse system properly. This goal led to the project described in this paper, which monitors finger movement and contact using a small wearable and portable system composed of an accelerometer. Figure 2.1 is the final hard ware result for this project.

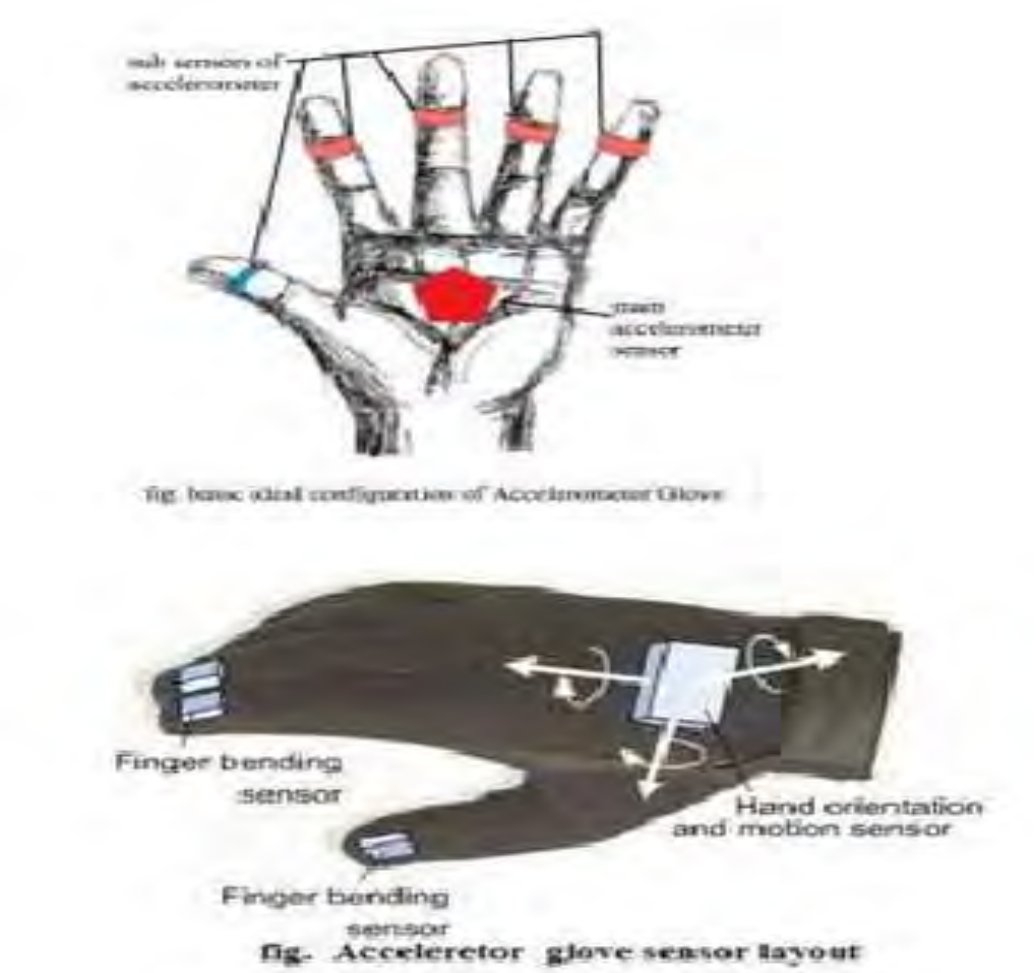

fig. Acceleretor glove sensor layout

Figure 2.1: Accelerometer glove sensor

2.4 Hand gestures controlled speed and direction of mobile robot [5]

In this paper, the main goal of this project is to control the speed and direction of robot using different hand gesture by using accelerometer. In this project, it uses XBEE as utilization for communication between robot and accelerometer that placed at human hand or medium to transmit data signal between transmitter and receiver. In this project also, camera to recognize the gesture is used to provide geometrical information to the robot.

The similarity between this project which is Hand gestures controller speed and direction of mobile robot to my project is using XBEE technology. This is due to a

lot of benefit of using this technology compared to other technology such as high in range that can be cover up, the network can be secure from hijacking of an authorized person and this technology is low in cost but the technology that they provide is great. In this project, the gesture that going to use must be capture and save first before start controlling the robot. The weakness of this technology is the gestures that already save and input gesture must match to control mobile robot. If not, the robot will not moving at all. Besides that, it is hard to coding the programming and does the image processing compare when using only XBEE technology and PIC18f4550 that are going to use in my project.

2.5 SKPS in PS2 Controller Starter Kit [6]

In this paper present about Play Station 2 offer a good human manual gesture as an input for control system. This kit can easily found at a play store. There is some issue that rising. The major issue is that the new protocol to connect with PS2 socket is needed as PS2 socket is very unique and hard to find in a market place. Cytron Technologies has designed and invented PS2 controller Starter Kit called SKPS. This inventory is developing to overcome the problem.

SKPS is a device from Cytron Technologies that has low current consumptions which is less than 150mA. This device communicates with its microcontroller through 5V TTL UART and need simple inquiry command and button status feedback for host to process. This device (SKPS) fully compatible either with wired or wireless.

In generally, there are two methods of using SKPS. The method is designed for interface to embedded system with 5V TTL (microcontroller) or connection to computer (normally for functionality test).

The SKPS is PS2 Starter Kit that uses Bluetooth connection between transmitter and receiver as its transmission medium. According to Michigan State University, Bluetooth's discovery protocol lets devices automatically find and start interacting with each other. This unintentionally exposes access and data to unauthorized users, will lead to a risk for potential hijacking incidents and identity theft. This theory is supported by the George Mason University; Bluetooth technology is Omni-directional, meaning that their signals cover all directions. When other devices are present in the same space, signals from Bluetooth can get distorted in the direction of its intended recipient.

Connection between a Bluetooth device and its recipient device is not perfect. If an object is placed between the devices, transmission could easily be cut off and signal loss might occur. This can cause the loss control of a particular system. There are many types of PS controller in the market and the sensitivity for each type also different.