ACCELEROMETER 3D BASED MOTION COMPUTER CONTROL

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This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Industrial Electronic) With Honours

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka

June 2012

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : **ACCELEROMETER 3D BASED MOTION COMPUTER CONTROL**

Sesi Pengajian : 1 1 / 1 2

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Name : DR. KOK SWEE LEONG
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Dedicated to my father, LEE CHEOW SIN and my mother, TAN KHAI SUN.

ACKNOWLEDGEMENT

Here, I would like to take the opportunity to express my gratitude towards all the people who have been involved in successful completion of this project. Without whom this project would have never reached the epic where it is right now.

With sincere respect, I would like to thank my project supervisor and co-supervisor Dr.Kok Swee Leong for his valuable time, efforts, guidance and moral support. Their continuous guidance and support led this project to a successful completion. By providing an opportunity to work on this project, it offers me a chance to gain knowledge of wireless zigbee transceiver fundamentals and sensor technology.

Finally, I would like to thank my peers, my friends and my family especially my parents for providing me constant inspiration and support during the different phases of the project.

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ABSTRACT

This project presents a creation effort of a computer controller based on 3D motion utilizing the MEMs IC on a computer control medium or interface to give commands to the computer, in order to perform simple computer instructions; constructing an accelerometer 3D based computer control, which will add an extra option for future wireless control. A MEMs IC based accelerometer will be linked with the microcontroller. The study and design of the microcontroller is out of the scope of this project, instead the application of MEMs accelerometer and the transmission and conversion of MEMs data to the computer will be the focus of the project. The major aim for this project will be combining the 3D motion accelerator onto a microcontroller; making it feasible in showing the data changes on the screen by the movement of human hand. The MEMs IC will then sense motion changes on the IC's circuit board, hence, send data to the receiver planted on the computer it and will be process by computer.

ABSTRAK

Projek ini membentangkan usaha mewujudkan pengawal komputer berdasarkan gerakan 3D menggunakan IC MEMs pada medium kawalan komputer untuk memberi arahan kepada komputer, untuk melaksanakan arahan-arahan komputer yang mudah; membina komputer accelerometer kawalan berasaskan 3D, yang akan menambah satu pilihan tambahan untuk kawalan wayarles pada masa hadapan. Accelerometer MEMs berasaskan IC akan dihubungkan dengan mikropengawal. Kajian dan reka bentuk mikropengawal dari skop projek ini tidak diberi perhatian, sebaliknya penggunaan accelerometer MEMs dan penghantaran dan penukaran data MEM ke komputer akan menjadi tumpuan projek. Tujuan utama untuk projek ini akan menggabungkan gerakan accelerometer 3D ke mikropengawal; menjadikan ia dilaksanakan dalam menunjukkan perubahan data pada skrin oleh pergerakan tangan manusia. IC MEMs kemudiannya akan mengesan perubahan gerakan pada papan litar IC, dengan itu, menghantar data ke penerima yang ditanam pada komputer itu dan akan diproses oleh komputer.

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LIST OF ABBREVIATIONS

MEMs	-	Micro-electromechanical Systems
AC	-	Alternating Current
DC	-	Direct Current
IC	-	Integrated Circuit
PC	-	Personal Computer
EEPROM	-	Erasable Programmable Read Only Memory
UART	-	Universal Asynchronous Receiver Transmitter
CTS	-	Clear to Send
RTS	-	Request to Send
RISC	-	Reduced Instruction Set Computing
TQFP	-	Thin Quad Flat-pack
QFN	-	Quad-flat no-leads
MLF	-	Micro Lead Frame
PWM	-	Pulse-width Modulation
MIPS	-	Microprocessor without Interlocked Pipeline Stages
USB	-	Universal Serial Bus
TTL	-	Transistor–Transistor Logic

CHAPTER I

INTRODUCTION

1.1 Background

An accelerometer based 3D motion computer control is a computer control device embedded with an accelerometer to measure accelerations, converting it in to digital data to manipulate or operate the computer. There are various kinds of computer control in the market nowadays such as, mouse and keyboard, joystick, gamepad and many more. One of them is the Human Computer Interaction Technology which is applied in one of the famous gaming gadget nowadays which will be the Nintendo Wii's gaming console.

1.1.1 Human Computer Interaction Technology

Human–computer Interaction (HCI) includes study, planning, and design of the interaction between users and computers. Their interaction interfaces includes both software and hardware. For example, characters or graphical objects displayed by software on a personal computer's monitor, input received from users via hardware peripherals such as keyboards and mouse or other large-scale computerized systems such as industrial machines or aircrafts. Association for Computing Machinery defines human-computer interaction as "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."[1].

The common aspect sought for HCI is the user satisfaction, although user satisfaction is different with user performance by terms of metrics, this mainly is because human–computer interaction studies a human and a machine; its basic goal is to improve the interactions between users and computers by making computers more usable and receptive to the user's needs. It draws knowledge from both machine and the human action. For machines, techniques in computer graphics, operating systems, programming languages, and development environments are essential. While for human action, communication theory, graphic and industrial design disciplines, linguistics, social sciences, cognitive psychology, and human factors such as user satisfaction are relevant. Engineering and design methods are profoundly important.

Several issues concerning HCI are such as:

- interfaces designing methodologies and processes
- interfaces implementing methods
- evaluating and comparing interfaces techniques
- new interfaces and interaction techniques development
- descriptive, predictive models and theories of interaction development

1.1.2 Plug and Play Devices

When data processing technology started to bloom, the hardware was consisted by collection of modules, and the modules functions had to be linked to suit different calculating operations. This linking was usually done by some wires connection between modules and disconnection from others. For many mechanical data processing machines at that time has their calculating operations directed by the use of a quick-swap control panel wired to route signals between module sockets.

As general purpose computing devices rises, these connections and disconnections were used to specify system address space locations where expansion device appears, in order for the device to be accessible by the central processing unit. If more than two of the same type of device were installed in one computer, it would be necessary to assign the second device to a non-overlapping region of the system address space to enable both to be accessible at the same time.

Nevertheless, some early micro-computing devices sometimes required the end-user to physically cut and solder wires, making configuration changes were intended to be largely permanent for the life of the hardware. As computers became more accessible to the general public, configuration accomplished by jumpers or DIP switches were developed.

However, the process of configuring devices manually using jumpers or DIP switches could be quite arduous. Plus, incorrect settings could render the system completely or partially inoperable. Some settings required knowledge of configurations had been previously manually assigned to other devices, as well as the settings the main system are using. The system might still seem to work properly with an incorrect setting, until the entire system suddenly freezes and must be reboot.[2]

In an attempt to resolve this ongoing problem, the Plug and Play (PnP) specification was developed by Microsoft with cooperation from Intel and other hardware manufacturers. The goal of Plug and Play is to create a computer whose hardware and software work together to automatically configure devices and assign

resources, to allow for hardware changes and additions without the need for large-scale resource assignment tweaking. In other words, the goal is to be able to just plug in a new device and immediately be able to use it, without complicated setup maneuvers. For example, if we connect a Plug-and-Play mouse to the USB port on computer, it will begin to work within a few seconds after being plugged-in; while, a non plug-and-play device would require us to go through several steps of installing and setting up before it could work.

1.2 Project Objectives

1. To assemble the design of the ADXL 335 Accelerometer based microcontroller with Zigbee technology which detects human hand movements.
2. To develop algorithm of the Accelerometer 3D based computer control microcontroller.
3. To analyse the output data of the system.

1.3 Problem Statement

1. There are limitations on human-computer interaction. For instance, interfacing using mouse is limited to flat surface (x and y-axis), this resulted in a very limited and non-flexible human controlled applications.
2. The requirement of long contact hours using x and y-axis controlled devices like the mouse produce side effects in terms of health problems (headache, fatigue eye, joint pain, and stiff at shoulder, and etc).
3. Limited freedom (move around) on current wireless devices control on computer.
4. Commercialized wireless human controlled console is not easy to customize, therefore a new console was needed for easy and globalize usage configuration.

1.4 Project Scope

In this project, ADXL 335, ADXL 345 and ADXL 346. Due to the low sensitivity of ADXL 345 and ADXL 346 compared to ADXL 335 for approximately same measurement operation range compared to ADXL 335, ADXL 335 will be the best choice. This is because it not only has the most optimum acquires, it is also easy to get in the market nowadays.

For the data processing part of this project, Arduino Duemilanove is being used. This motherboard is integrated with ATmega 328 microprocessor. For tranciever module, Zigbee techonology is chosen over other RF technologies such as Bluetooth, mainly due to its cost-effectiveness and easy to be implemented. XBee Pro from Digi International Inc. is chosen due to its long range and low power requirement capabilities. The X-CTU software is compatible with the ZIgBee module, which is used to program and control the data communication between modules.

The 3D accelerometer based motion detector will be interfacing with the ATmega 328 microprocessor

1.5 Project Importance

1. Improvement of design flexibility of plug-and-play devices and provide an alternative to computer gaming market as a easy to customize human-computer controller.
2. As an alternative controller in various industries (Example: Manufacturing, Archeology, aerospace and etc).
3. Convenient electronic applications for disabled and senior citizen.
4. Simplicity whilst using machine arm control. Hence creating an inexpensive hand-like device that is as adaptable as a human appendage.

1.6 Methodology

Initially, a progress plan will be made by plotting a flow chart of how the work should be carry out in the whole progress. Then the plan execution period and milestone will be stated in the plan. Subsequently, a Gantt were plotted in order to give a clear picture of how and on what time the related works should start and end on-time, possibly before the dead-line.

Based on the process planned, methods and approaches are taken to find out the knowledge and needed data and sufficient information to help and support the whole progress. Initially, will be the gather up of information as in literature products or books of previous findings or any related materials regarding the project. Information and data sheets of components on the internet were also collected in order to make comparisons between materials to enable selection to be made.

Next will be the study on the concept and functions on the related information materials. Understand how the material will function and the existing risk in the progress.

After this would be the concept of the project and design the project. In this context, the interface between the MEMs IC with the computer control module will be studied. Next will be the building up of the solid project.

Subsequently after the successful construction of the whole circuit board, a test and evaluation will be done on the control gadget using a computer to test its feasibility. In addition to any problem arising from the project piece will be troubleshoot of trouble, if possible some alteration or maintenance could be applied.

If the accelerometer 3D motion based computer control has successfully produced, the process flow will proceed to the last of the progress that is the production of report and thesis for this project

1.7 Report Structure

Chapter 1: Introduction

Introduction will be the first part of this project report will be the introductory part of the project which contains the introduction on the technology used in this project. It will start with the explanations of the importance and the perspective of the previous findings.

Next will be the Objective of this project to be carry out following with the problem statement occurred which causes this idea to arise. Then will be the scope in this project and lastly on this chapter will be the methodology briefing.

Chapter 2: Literature Review

Literature review will consist of several aspects such as explanation of methods and perspectives which is used in the research and the relations with the project done, theories and concept used in solving the problem. Last but not least, stating the hypothesis of the project.

Chapter 3: Project Methodology

In the third part of the project report which is methodology, it will be showing the methods and approach in collecting, processing and analyzing the data. Next will be the factors taken count in considering the methods and approach to be executed. Lastly will be the strength of the methods compared to others.

Chapter 4: Results and Discussions

The fourth part will be the results obtain throughout the process and analysis of the data will be done and presented. The findings will be viewed in the angle of objective perspective and also based on the problem statement.

Chapter 5: Conclusion and Recommendation

This will be the ending of decision of findings which concludes all the analysis and observations done. It will include the conclusion of project finding analysis and recommendation that could be applied on the project or research done for future improvements.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

2.1.1 Applications of MEMs Accelerometer

Accelerometers are vastly used nowadays. Various technology and industries depends on it to carry out specific task which could never be so precisely done by any other devices or gadgets. The area of its coverage consists from personal tools, engineering, industry, biology, or even medical uses. In engineering, accelerometers are used to measure vehicle acceleration. Specifically used in the performance evaluation of both engine and braking systems. Moreover, accelerometers can be used to measure vibration on cars, machines, buildings, process control systems, safety installations, measure seismic activity, inclination, machine vibration, measure gravity, and etc.[4]