

AUTOVOLUME AND HANDCLAP CHANNEL SCAN FM RADIO WITH
AUXILIARY AUDIO INPUT

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This thesis was done in completion of my final year project, which is my brainchild. The idea of creating an automated volume control came through my head when I was passing across an electronic appliances shop. The shop was playing a song on its Hi-Fi too loud and I was feeling irritated. The invention of this project is hope to overcome such problem to human being.

There are several people that I would like to acknowledge for their assistance and support over the course of this project. Firstly, I would like to sincerely thank Mr. Zulhairi B. Othman for his continuous supervision and care. It would be difficult for to gain some knowledge on industry without such experienced person.

Along the implementation of the project, I have also gained much experience on countless field of engineering along with my friends. Therefore I would like to thank them, the BENE students for organizing the group discussion.

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ABSTRACT

This project is an integration of a power amplifier with many other added function. The amplifier will have the ability to sense a person passing in front of it, and reduces its audio level (volume) to a certain level.

To make the amplifier more convenient to people, a handclap function is also added, so that when a clap is detected, the radio switches to another broadcasting channel without having that person to get close to the amplifier. However, channel switching button is also built since both autovolume and handclap function can be turn on and off depending on the user.

To expand the function of the amplifier in the future with its integration with DSP, a source selector is built so that there are multiple audio source can be received, but only one is projected as output at a time.

Besides making people more free to remote control device, this project is also hoped to give a new idea to the control system and audio technology.

ABSTRAK

Projek ini adalah satu integrasi antara penguatkuasa (power amplifier) dengan beberapa fungsi tambahan. Ia membuatkan penguatkuasa ini mampu mengesan kehadiran seseorang yang berhampiran, serta menurunkan takat nadanya kepada takat yang tertentu.

Untuk memudahkan lagi kehidupan manusia, fungsi pengesan tepukan tangan juga ditambahkan, untuk menjadikan ia mampu untuk mengesan tepukan tangan dan mengubah siaran radio yang sedang didengari tanpa perlu seseorang pengguna menghampirinya. Bagaimanapun, penukaran siaran secara manual juga dibina memandangkan fungsi takat nada automatik dan penukaran siaran secara tepukan boleh diaktifkan atau dimatikan mengikut keselesaan pengguna.

Untuk meningkatkan lagi kebolehan sistem ini untuk berintegrasi dengan sistem-sistem lain pada masa akan datang, terutamanya dengan Pemproses Data Digital (*Digital Signal Processor -DSP*), satu fungsi pemilihan sumber audio secara digital telah dimuatkan. Ia membolehkan penguatkuasa ini menerima beberapa masukan audio, tetapi hanya satu sahaja yang dikeluarkan sebagai keluaran pada satu masa.

Selain daripada menjadikan kehidupan ini lebih mudah, projek ini juga diharapkan akan memberikan satu idea baru kepada teknologi audio dan sistem kawalan.

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LIST OF ABBREVIATIONS

PIR	Pyro-electric Infrared
EORD	End-of-Range Detector
CPU	Central Processing Unit
ASM	Assembly Language
BASIC	Beginner's All-purpose Symbolic Instruction Code)
ADC	Analog-to-Digital Converter
PWM	Pulse Width Modulation
DSP	Digital Signal Processor

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CHAPTER I

INTRODUCTION

1.1 Project Overview

Nowadays amplifiers with many rating and quality have been invented and sold in the worldwide market. The amplification factor ranged from the least amplification such as the mini speakers, to the great amplification such as the concert speakers. Sometimes in some conditions, loud volume can be very irritating. What's more, it needs some effort for the person to turn the volume down, hence lead to the autovolume concept. From the name, it has given a brief impression of the true operation. Basically it is an upgrade of the conventional power amplifier, which FM radio feature is added, and the volume control can be hands free. The volume will be adjusted accordingly to distance of a person standing in the sensitive area. The additional of the autovolume function makes the user less dependent on the remote control deice. To enhance this ease, a handclapping channel scan is also. With a handclap, the FM receiver will lock on the other broadcasting frequency.

The human detection technique has been applied in many applications. This project also will be applying human detection technique to give a new impression in control system and audio technology.

1.2 Objectives

Some people like to hear music with very high volume without taking note the people around them might be irritated. When passing across a high power speaker, the sound may hurt our hearing system, moreover hurts our feelings. Things get worse when the remote control device is missing when we want to turn the volume down. It should be any easier ways to overcome this problem, or at least reducing it. One of the ideas is through this autovolume system. The target of this project is to:

- i. Adjust the volume according to the distance of a person standing in the sensitive area so that it will not irritate the passer by.
- ii. Build a handclap channel scan for channel toggling.
- iii. make people more independent to remote control
- iv. Apply a new idea, the 'distance control' which soon might be replacing the infra-red remote control.
- v. Set up new ideas in control system and audio technology.

1.3 Scope of Project

This project involves an integration of many ready-made circuits and self designed circuits. The primary target is to add an autovolume function to the amplifier. The next step will be integrating the FM radio onto the ready made power amplifier. The other things that need to be worked on are the source selector, handclap detector, peak detector and the power supply.

After designing the circuits, they will be tested on the breadboard, and then constructed on the PCB. The PCB construction includes from exposing to the stripping. The circuit schematic and PCB design layout was done using ISIS 6 professional application software.

The final step is the most difficult part, that is to integrate all the portions and troubleshooting them for any problems occurred. The expected data from the design has been be the reference to the obtained data from the test. Troubleshooting is done, and some changes have been made to give the best performance to this project.

CHAPTER II

LITERATURE REVIEW

Nowadays, distance sensing method has been used widely in our daily lives, only if we notice it. One of the examples is automatic door at the shopping complex, shops etc. We usually see on TV how control system is applied on entertainment purposes such as switching on or off a TV by using handclap, but until now I have not seen it is applied on a radio. This is how the invention contributing new ideas to audio technology.

Basically, the sensing device produces analog voltage. The voltage can be used as the 'distance' reference of the people standing in its sensing area. The system estimated the range when the person is standing in a distance from the sensor base on the voltage produced, which is by referring to a preset voltage. After doing some research, the project system is designed as expressed in diagram 2.1. Diagram 2.2 shows the hardware brief connection.

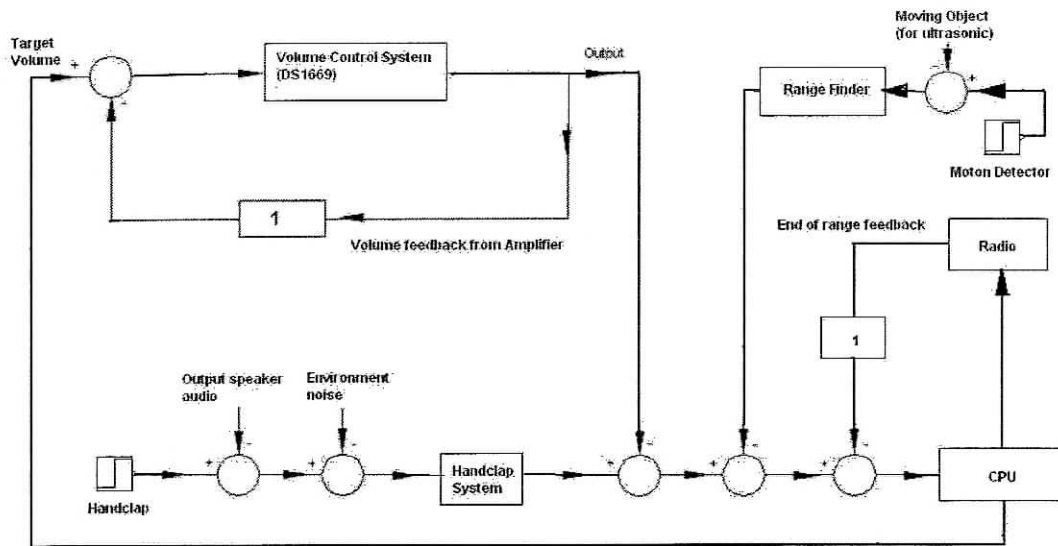


Diagram 2.1: Developed project block diagram.

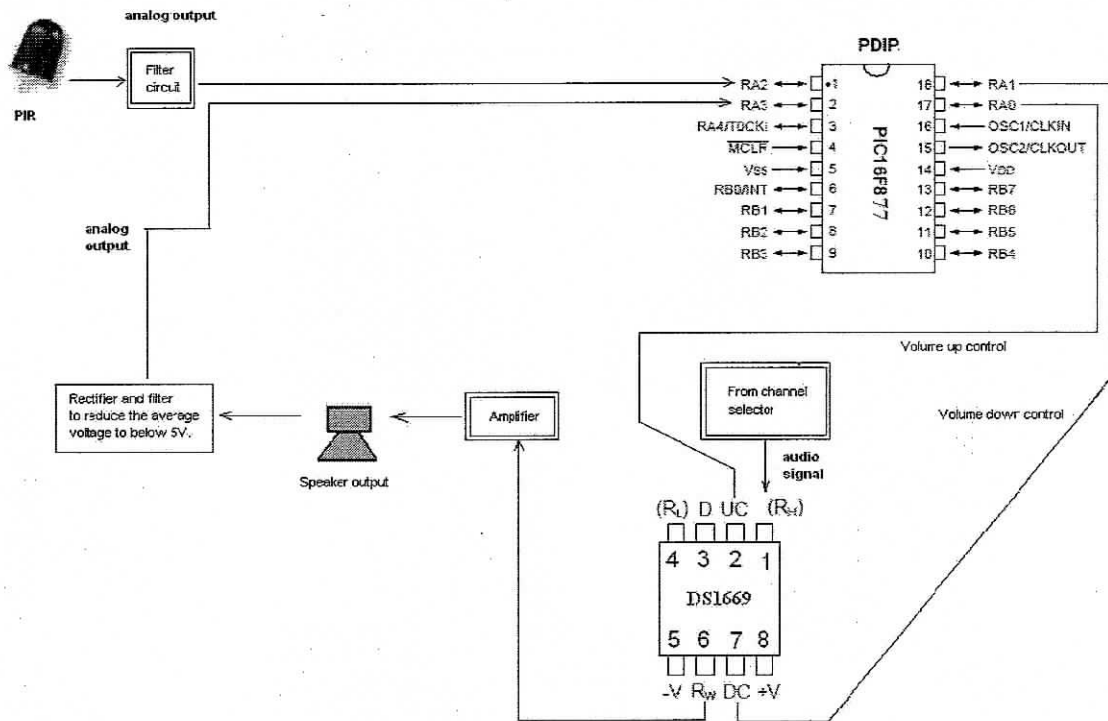


Diagram 2.2: System hardware connection.

2.1 Motion Detection

Since this project needs to identify the range of a person standing in the sensitive area, it needs the sensor which can identify human, movement and having the ability to calculate one's distance. The most common motion detection method is the infrared and the ultrasonic [1].

2.1.1 Heat Sensing by Infra-red Sensor

This project is proposed to use a pyro-electric infra-red (PIR). Easily said, it has the ability to convert thermal energy into electrical form. Infrared radiation exists in the electromagnetic spectrum at a wavelength that is longer than visible light. Infrared radiation cannot be seen but it can be detected. Objects that generate heat also generate infrared radiation and those objects include animals and the human body whose radiation is strongest at a wavelength of $9.4\mu\text{m}$ (PIR sensing range is 8 to $14\mu\text{m}$).

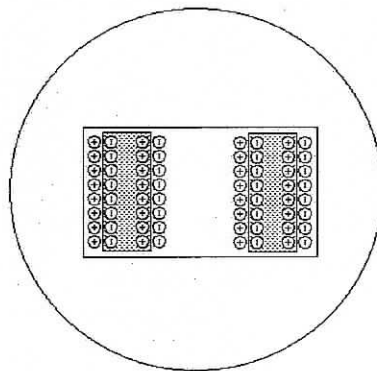


Diagram 2.3: Undisrupted charge distribution.

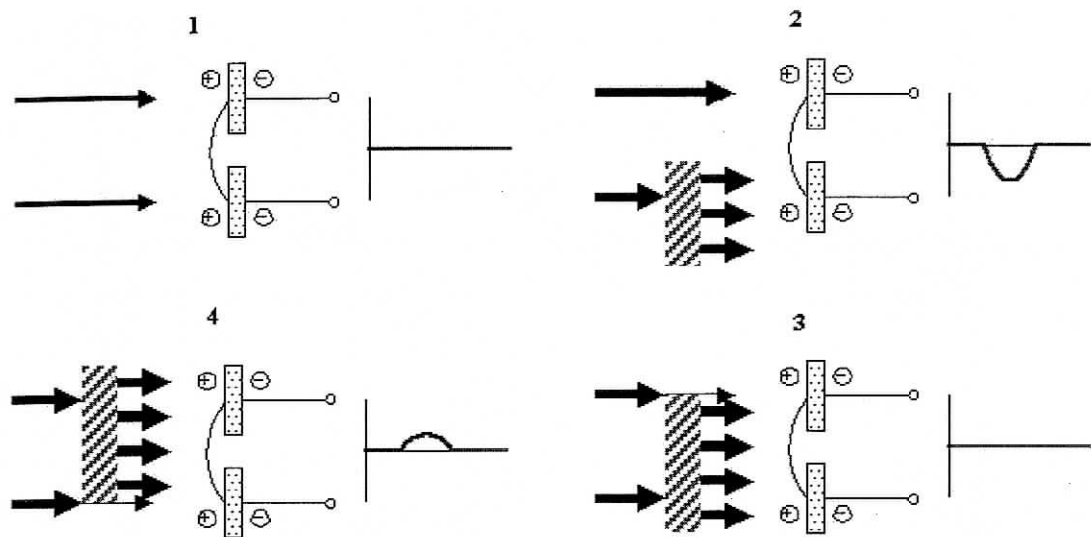


Diagram 2.4: PIR motion detection technique.

The PIR has two sensing elements connected in a voltage bucking configuration. In the initial condition, the charge on the element is equally distributed (see diagram 2.3), in consequence to the blocking of the infra-red source, the distribution is disrupted thus producing the voltage. Diagram 2.4 shows the clear operation description of the PIR. A body passing in front of the sensor will activate first one and then the other element whereas other sources will affect both elements simultaneously and be cancelled. The radiation source must pass across the sensor in a horizontal direction. The movement in vertical direction still can be detected, but less sensitive.

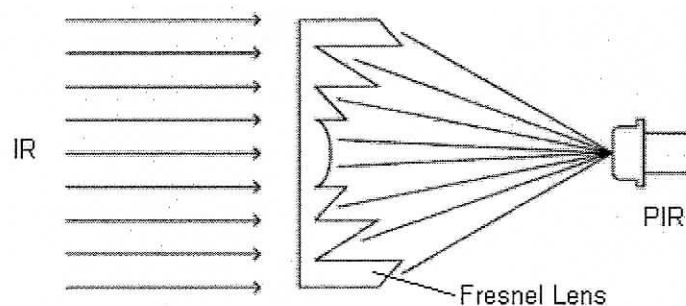


Diagram 2.5: Fresnel Lens function description.

Since PIR contains only two sensing element, a projection method is needed so that in can detect infra-red radiation in various direction. The method that is discussing about is the use of Fresnel lens. It is designed to have its grooves facing the IR sensing element so that a smooth surface is presented to the subject side of the lens which is usually the outside of an enclosure that houses the sensor lens as described in diagram 2.5. Fresnel lens will projects light source from various direction onto the PIR.

However, the use of infrared is dependent on the interrupting characteristic such as the environment light intensity. High light intensity definitely will be the noise to the sensor. This type of noise can be reduced through a band pass filter, but it cannot be totally demolish. When the environment condition changed from time to time, the system must have the ability to recognize the new reference condition. The PIR needs some support from other sensor to have better verdict. The most possible sensor is the ultrasonic.

2.1.2 Ultrasonic Motion Detection

The integration of PIR and ultrasonic is not a new insight. Although human detection is done with PIR sensor, commercial motion detector such that installed in a briefing room usually having an additional ultrasonic feature, of course, for a better identification. The explanation is simple: ultrasonic sensor converts energy into ultrasound, or sound waves above the normal range of human hearing. Technically an ultrasonic transducer converts mechanical energy in the form of air pressure into ultrasonic sound waves, which means it sense all kinds of motion. PIR detects human movement but it is less sensitive. The two method need to be integrated to achieve the best performance.

In this project, ultrasonic is necessary for distance calculating purpose. Ultrasonic will calculate the range just as it does in sonar technique, which used by the ships to perceive the deep of the ocean. However, ultrasound application needs great