"I hereby declare that I have read this thesis and my opinion, it is suitable in terms of scope and quality for the purpose of awarding a Bachelor Degree Of Electronic Engineering (Industrial Electronic)"

Signature : .....

Supervisor : HO YIH HWA

Date : 07/04/2005

NOISE DETECTOR AND MOTION SENSOR SURVEILLANCE SYSTEM

AZHARI BIN KELIWAN

This Report Is Submitted In Partial Fulfillment Of Requirements For The Bachelor Degree Of Electronic Engineering (Industrial Electronic)

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
Kolej Universiti Teknikal Kebangsaan Malaysia

MARCH 2005

"I hereby declare that this thesis entitled

Noise Detector And Motion Sensor Surveillance System

is the result of my own research and idea except for works that I have been clearly cited in the references."

Signature : .....

Name : AZHARI BIN KELIWAN

Date : 1 APRIL 2005

For my beloved parents and family who have spent money and time to see me standing here in success.

For my humorous and brilliant supervisor who taught me a lot.

For my fellow friends who guided me when I'm lost.

ABSTRACT

Noise detector and motion sensor surveillance system has been chosen as the undergraduate project title. The project is basically to build a surveillance system that will measure the two parameters; noise and motion. Setting point to detect motion is motion that lesser than 10 meter (M). This system is applied only for housing area application. Noise detection will use a condenser microphone as the input to measure the noise of the covered area while ultrasonic transducer is used for motion detector circuit. Both detector circuits will be connected to an alarm circuit, where the siren alarm and the light emitted diode (LED) will be used in this project to report the status of the system. Alarm circuit will be triggered when both or either one of the output from the detector circuit trigger the relay that connect the detection circuit with the alarm circuit. The alarm output which is an 8Ω speaker is capable to deliver the siren alarm of 60dB. Active Ultrasonic sensing technique will be used instead of the passive technique to make sure the detection in the covered area is completely under control. First stage of the circuit operation is to detect the circuit and then the output of the circuit will turn the relay to second stage that is the alarm circuit. Alarm circuit will produce a siren and turn on the LED which is the control console inside the house.

ABSTRAK

Sistem pengawasan pengesan bunyi dan pengesan pergerakan telah dipilih sebagai tajuk projek sarjana muda. Secara umumnya, projek ini adalah untuk membina sebuah sistem pengawasan yang dapat mengesan dua jenis parameter iaitu bunyi dan pergerakan. Sistem hendaklah berupaya untuk mengesan parameter pergerakan pada jarak kurang daripada 10 meter (M). Sistem pengawasan yang direka ini adalah disasarkan untuk pengguna rumah kediaman sahaja.. Litar pengesan bunyi akan menggunakan mikrofon kondenser yang akan mengesan kadar bunyi pada kawasan yang kehendaki sementara litar pengesan pergerakan akan menggunakan transduser ultrasonik untuk mengesan pergerakan. Kedua-dua litar pengesan akan disambungkan kepada litar amaran, dimana litar amaran dalam sistem ini terdiri daripada amaran siren dan diod pemancar cahaya (LED) yang akan melaporkan status sistem. Litar amaran akan dipicu bila keluaran salah satu daripada litar pengesan atau kedua-duanya mengaktifkan geganti yang disambungkan daripada litar pengesan ke litar amaran. Keluaran litar amaran adalah pembesar suara 8Ω yang berupaya untuk mengeluarkan amaran siren pada kadar 60dB. Teknik pengesan Ultrasonik Aktif digunakan berbanding penggunaan Teknik Ultrasonik Pasif untuk memastikan kawalan maksima keatas kawasan yang dilindungi.

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURE

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Safety issue is a big issue nowadays. Many types of surveillance systems have been developed to fulfill the consumer needs. However, due to the technology used and how the system is operated, the surveillance systems are getting more expensive and could not be affordable to many people. This project will be focusing on developing a reliable and low-cost unit of surveillance system that consists of two detectors and they are; noise detector and motion detector.

Motion detector will be using ultrasonic wave as the detector that offer a wide coverage of control area and it is an effective method to detect a motion nowadays. As part of the control requirements, motion detector will detect a motion within a range of distance which is lesser than 10 Meter (M). Noise detector will use condenser microphone to detect noises. This is the basic part of the system requirements where the add-on will be available in the future depends on the consumer requirements.

1.2 PROBLEM STATEMENT

Surveillance systems offer a wide variety of parameter control to the user. However, due to the cost of the present surveillance system in the market, it is not well known by the people in the society. This project will eliminate this disadvantage of the surveillance system and the negative views by the society by offering a surveillance system that is low in cost and affordable. Without compromise the reliability aspects, the system will use the most suitable technique and concept to ensure its performance

To minimize the cost, the surveillance system will detect only two parameters that are noise and motion. Although only two parameters will be detected, the system will have a better reliability than the present surveillance system because of the components used and how the system would response in the required surrounding.

1.3 PROJECT OBJECTIVE

Project objective will guide the whole process to ensure that the project has followed all the requirements stated in the objectives. Basically, this project consists of four main objectives:

a) Surveillance system must be able to detect a motion within a range of distance which is lesser than 10 Meter and a noise.
b) Alarm circuit must be able to operate when any of the noise circuit or motion circuit is triggered or when both of them are triggered.
c) The system is portable and light so it can be relocated easily.
d) A low-cost surveillance system which is affordable for everyone.

1.4 SCOPE OF PROJECT

Scopes of the project study are:

a) Designing surveillance system that can detect noise and motion.
b) Setting point for noise detector is 70dB and higher while for motion detector is lesser than 10 M.

1.5 PROJECT BACKGROUND

Idea to develop a low-cost surveillance system that will detect a noise and motion is due to the highly crime rate in the society and expensive price of the similar system in the market. As part of the social responsibility to create a peaceful lifestyle, this project will offer an alternative to the present surveillance system in the market.

Though the term 'surveillance system' meaning is a series of monitoring devices designed to check on environmental conditions, and always related to closed-circuit television system (CCTV), this project is not using that meaning of term to describe it.

Several sources are used as the reference of this project. The first reference is the article about Guidelines for Evaluating Surveillance Systems [1]. This article explain all the aspect that should be taking into consideration when develop a surveillance system in detail. It is focused on the characteristics offered by the surveillance system, so that it could be evaluate as the reliable and perfect surveillance system. This article gives the rough idea about the characteristics of the project.

Second reference is Design and Fabrication of Non-Polymer Transducers in the Frequency Range from 30 to 80 MHz [2]. This article explained about the principle of the motion detector using ultrasonic and the tips on getting good results with the ultrasonic motion detector. In addition it also discussed about the troubleshooting techniques that related to ultrasonic motion detector. Technical side of the ultrasonic motion detector is explored in this article. This is very much appreciated in order to determine the sensing range and trouble shoot process in the project.

Perimeter Security Sensor Technologies Handbook [3] is the reference for the noise detector. It is intended to be used as a sensor selection reference during the design and planning of perimeter security systems and contains a compendium of sensor technologies that can be used to enhance perimeter security and intrusion detection in both permanent and temporary installations and facilities. From this handbook, it can be relate to the project to using the noise detector as part of the surveillance system.

Figure 1.1 show the project phase flow chart of the project. It gives the idea on how the project is carried out in general. Project phase refer to the process to each circuit when they are in term of surveillance system. During project phase, each circuit combined to get the overall expected result. Circuit is tested as a system in this process.

That means, the expected result during this process are based on the project objective. If one of the objectives cannot be achieved, the circuit that generates the problem will be taken out and will be trouble shoot. If the result same as the objective, the whole circuit will be assembly inside the casing.

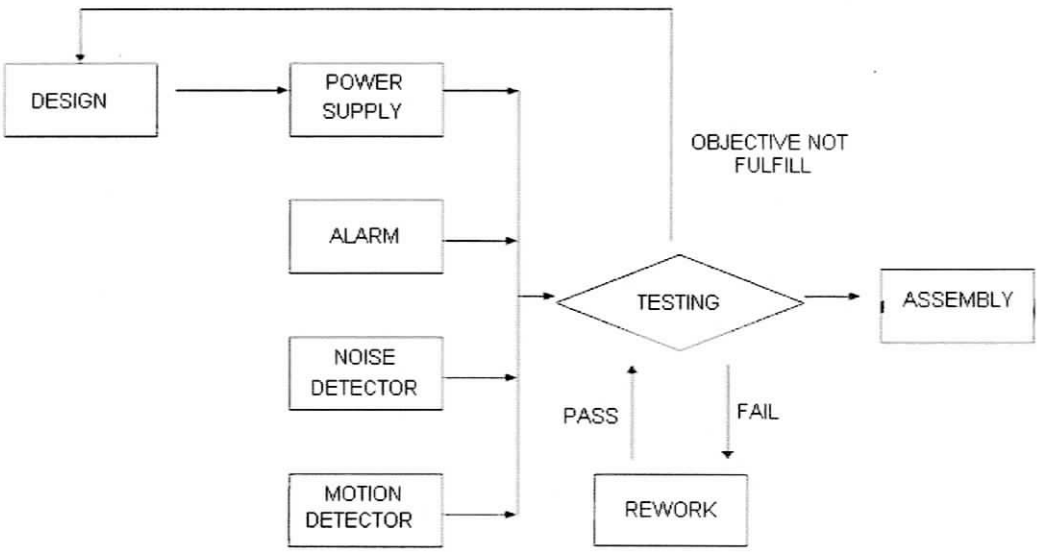

Figure 1.1 : Project phase for the surveillance system

1.6 METHODOLOGY

Methodology refer to the science that studies the methods of problem solving. Most sciences have their own specific methodology. In this project, the methodology is used to explain the progress of the project from the beginning until the end. Methodology acts to organize the project so that all phase in the project can be monitored by several way.

This project is guided with following methodology. Project methodology consists of six steps that are literature study, design, simulation, circuit transfer, testing and checking and lastly assembly.

Each step of methodology are related and represented by flow chart to make it easy to understand. Flow chart is used because it provided enough information of the whole steps in a simple way. Figure 1.2 shows the flow chart of project methodology.

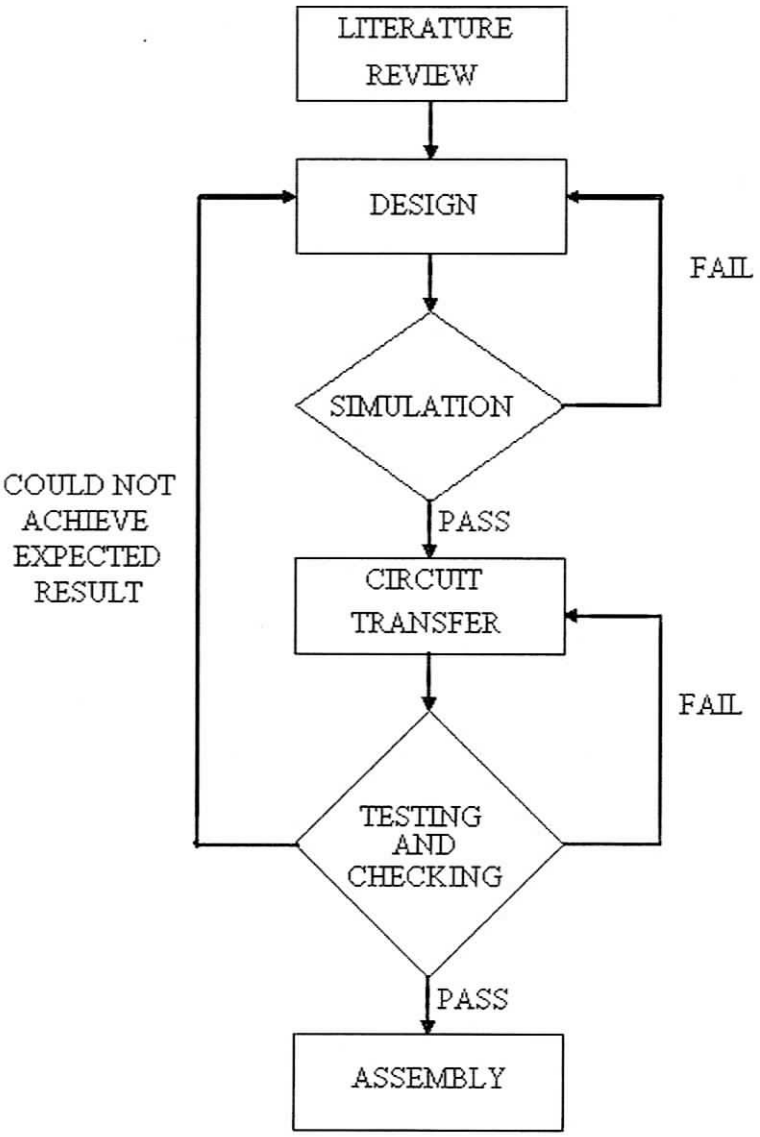

Figure 1.2 : Flow chart of project methodology.

Project methodology phase guided the student how each process in project phase should be carried out to prevent time losses and to guarantee each project phase have a standard procedure.

After literature study, the circuit that will be used determined and altered to suits the project. Design and simulation step done using several engineering software as MULTISIM and Mathlab. Based on the choosen circuit and the component, circuit drawn and simulate to study the result of the design circuit. If the result did not come out as expected, modification made.

If the result are as expected, then the step will proceed to circuit transfer step. During this step, the component are assembly on strip board following the design. After that the real circuit will be tested using electronic equipments such as function generator, oscilloscope and digital multimeter. During this step, result from real circuit analysis will be compared to the result from the simulation.

It is important to make sure that the circuit have the same characteristics as the circuit in the simulation. If it is not same after troubleshoot process, then circuit transfer step will be repeated again. After that it will be tested again.

If the result still cannot match the expected result, then the circuit have to be design again to ensure that the expected result can be gain from the real circuit. After the real circuit pass the testing and checking step, it will then proceed to assembly step. Assembly step refer to combined all circuit and placed it inside the housing.

1.7 OVERVIEW REPORT STRUCTURE

This report consists of six chapters. Chapter 1 is the introduction of this project. It discuss about the objective, background of the project and methodology that will be implemented in the project.

Chapter 2 describes the motion detector circuit. It will cover the type of motion detector used and the differences between ultrasonic transducer. In addition it will elaborate about the methods and concept of the ultrasonic transducer.

Noise detector and its characteristic is discusses in Chapter 3. It explains about the microphone that is used as a noise detector. Also, the factors of choosing the right microphones is discussed using microphones technology and microphones pickup-pattern that will determine the reliability of the microphone in the circuit.

System design about the circuit in the surveillance system is covered in Chapter 4. This chapter shows how the circuit is design using the information gathered in the previous chapter. Flow chart and block diagram used to explain the operation of all circuit.

Chapter 5 is the project result. It contains project result of two main circuits that is noise and motion detector. The data then analyze to make sure the result is same as required. The end of this report is a Chapter 6, project conclusion and discussion. This chapter will review the project. Some additional idea will be discuss on this chapter to make the project better than other or to implement the project in the actual field.

CHAPTER 2

MOTION DETECTION

2.1 INTRODUCTION

Motion detection is one of the parameter that detected in the surveillance system. The term "Motion Detection" describes the process of analyzing motion to determine activity or movement of objects. A motion detector is a type of electronic security device that senses movement and usually triggers an alarm. Many types of motion detectors can sense motion in total darkness, without an intruder becoming aware that an alarm has been triggered. A motion detector will detect the movements as soon there is a movement within the area protected by the detector. Motion detector systems use a variety of methods to detect movement. Each method has advantages and disadvantages.

Ultrasonic motion detection is using an ultrasonic transducer to detect a motion in the covered area. Ultrasonic pulses are emitted by the transmitter, reflected from a target, and then detected by the receiver. The time it takes for the reflected pulses to return is used to calculate position, velocity, and acceleration.

2.2 ULTRASONIC

Ultrasonic is the study and application of high-frequency sound waves, usually in excess of 20 Kilo Hertz (KHz) that equal to 20,000 cycles per second. Modern ultrasonic generators can produce frequencies of as high as several gigahertz (several billion cycles per second) by transforming alternating electric currents into mechanical oscillations, and scientists have produced ultrasound with frequencies up to about10GHz (ten billion vibrations per second). There may be an upper limit to the frequency of usable ultrasound, but it is not yet known.

Higher frequencies have a shorter wavelength, which allows them to reflect from objects more readily and to provide better information about those objects. However, extremely high frequencies are difficult to generate and to measure.

Ultrasonic ranging and detecting devices use high-frequency sound waves to detect the presence of an object and its range. The systems either measure the echo reflection of the sound from objects or detect the interruption of the sound beam as the objects pass between the transmitter and receiver.

Detection and measurement of ultrasonic waves is accomplished mainly through the use of piezoelectric receivers or by optical means. The latter is possible because ultrasonic waves are rendered visible by the diffraction of light.

Ultrasonic sonar sensors actively transmit acoustic waves and receive them later. This is done by ultrasonic transducers, which transform an electrical signal into an ultrasonic wave and vice versa. Often it is possible to use the same transducer for both transmitting and receiving.

Ultrasonic sensors emit and receive sound energy at frequencies above the range of human hearing that is above about 20 KHz. Ultrasonic sensing depends upon an object's density ability to reflect sound.

There is widespread agreement among researchers and scientists that ultrasonics is still in its infancy. This is evidenced by the fact that there is a great deal which is still not known about the field and the continued rapid rate of progress on nearly all aspects of it.

Among the keys to further progress will be advances in materials (particularly piezoelectric materials for the transducers), in electronics and in computers (for interpreting and enhancing the results). Improvements in performance will be accompanied by further reductions in cost and increased diversity in the applications, likely including the development of some completely new uses.

"Ultrasonics" should not be confused with the term "supersonics," which was formerly applied to this field. Supersonics now refers to the study of phenomena arising when the velocity of a solid body exceeds the speed of sound.

2.3 TYPES OF ULTRASONIC

Ultrasonic sensors are categorized by transducer type either electrostatic or piezoelectric. Electrostatic types can sense objects up to several feet away by reflection of ultrasound waves from the object's surface. Piezoelectric types are generally used for sensing at shorter ranges.

2.3.1 Piezo Ultrasonic Sensors

Piezo transducers are constructed using a ceramic piezo element that has been cut and tuned to a specific frequency range. Two electrodes are then bonded to the crystal, and the crystal is then adhered inside closed-face housing and sealed from the rear. Figure 2.1 below show the cross-screen of piezo ultrasonic transducer.

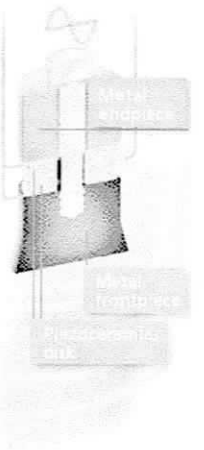

Figure 2.1 : Cross-screen of piezo ultrasonic transducer.