SIMPLE AND SAFE
EPILEPTIC SEIZURES MONITORING SYSTEM WITH ALARM

by

MOHD HAFIFI BIN MOHD ZAIN

FINAL REPORT

Submitted to the Electrical and Electronic Engineering Program
in Partial Fulfillment of the Requirements
for the Degree
Bachelor of Engineering (Hons)
(Electrical and Electronics Engineering)

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CERTIFICATION OF APPROVAL

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Approved:

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Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

December 2010

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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Mohd Hafifi Bin Mohd Zain

ABSTRACT

The aim of this project is to develop a simple and safe epileptic seizure monitoring system with alarm. Epilepsy is a condition in which a person has recurrent seizures. A seizure is defined as an abnormal, disorderly discharging of the brain's nerve cells, resulting in a temporary disturbance of motor, sensory, or metal function. The work in this report was to create a simple monitoring alarm system for detection of epileptic seizures. This project concentrates on using vibration and movement sensor. The author comes with a system that is wormed by epileptic around the wrist or foot, and will detect vibrations that are typical in an epileptic seizure. Then, a warning will be sent to family members or medical facilities through Wi-Fi or RF devices. This report contains the research on how the epilepsy symptoms are detected and the fabrication process of the vibration and movement sensor in the system.

ACKNOWLEDGEMENTS

First of all, my utmost gratitude to Allah SWT for his uncountable graces upon me and a blessing for upon the successful of this project within the time allocate.

A special gratitude goes to my supervisor, Pn.Salina Bt Mohmad for her full support in the completion of this project. Her constant guidance, helpful comments and suggestions have helped me not only to complete the project, but also to enhance the result of the project. Her kindness, valuable advices, friendly approach and patience will always be appreciated.

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Last but not least, great appreciations to my friends, who were constantly give supports and help during my work. To all UTP lecturers, staff and to who's their names are not mentioned here but they provided help directly or indirectly.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

This is a project about building a Simple and Safe Epilepsy Seizure Monitoring System with Alarm. This system can be divided into four main parts which are sensor or detector, controller, transmitter / receiver and device to alert public. The first part of the project will be focusing on the research of the epilepsy symptoms. The second part of the project is to design and construct the monitoring system to detect the epilepsy seizure.

Epilepsy is a condition in which a person has recurrent seizures. A seizure is defined as an abnormal, disorderly discharging of the brain's nerve cells, resulting in a temporary disturbance of motor, sensory, or mental function [1].

Basically, there are many causes contribute to epilepsy which are: [1]

- Tumor
- Chemical imbalance such as low blood sugar or sodium
- Head injuries
- Certain toxic chemicals or drugs of abuse
- Alcohol withdrawal
- Stroke including hemorrhage
- Birth injuries

The main symptoms of epilepsy are: [1]

- Eyes are generally open.
- Vibration and movement occur during epilepsy attack.

1.2 Problem Statement and Solution

Many of patients with epilepsy have been exposed in the sudden unexpected death in epilepsy (SUDEP) during epilepsy attack. It is because the attack occur any time, any place without any warning.

By considering this reason, the author has come out with an idea to design and fabricate a monitoring system to alert people about the attack. Basically, there is no medicine in the market that can treat the person with epilepsy background history until date.

The most common method to help the person with epilepsy is by using the prevention device. The main function of this devise is it can detect the epilepsy and inform the public when a person gets the epilepsy attack. Normally, there are many prevention devices in the market, but most of them are very expensive and not portable.

1.3 Objectives and Scope of Study

The objectives of the project are:

- To study the symptoms of epilepsy.
- To do the research about the main causes of epilepsy.
- To find suitable sensor in the market to detect the epileptic seizures.
- To design and construct the circuit for vibration sensor.
- To do the simulation for the circuit and get the desired output waveform.
- To create a simple and safe epileptic seizures monitoring system with alarm.

The scope of study is basically to find the suitable sensor to detect the epileptic seizure. During research in the internet and study the journals, it was found that vibration detector or sensor can be used to detect the epilepsy. After choosing the suitable sensor to detect the attack, the scope of study moves to circuit construction. In this part, the circuit will be designed and constructed by using Multisim or Pspice software and from the simulation, the waveform result is analyzed. The job continues by constructing and fabricating the circuit on breadboard. Then, the circuit will be tested to see if it is functioning or not. The testing process will be conducted after the circuit is finish. Finally, the vibration sensor circuit will be transferred to real Printed Circuit Board (PCB).

CHAPTER 2

LITERATURE REVIEW

2.1 Electroencephalogram (EEG)

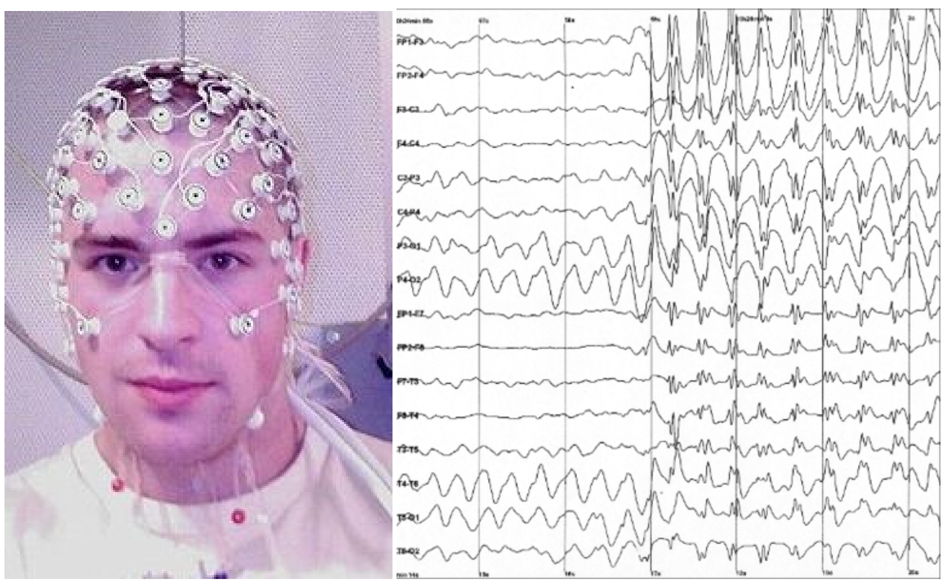


Figure 1: Epileptic Spike and Wave Discharges Monitored with EEG [2]

The Electroencephalogram (EEG) is a measure of brain waves. It is a readily test that provides evidence on how the brain functions over time.

The EEG is used in the evaluation of brain disorders. Most commonly it is used to show the type and location of the activity in the brain during a seizure. It is also use to evaluate people who are having problems associated with brain function. These problems might include confusion, coma, and tumors, long- term difficulties with thinking or memory, or weakening of specific parts of the body.

Based on the research from the internet, the author found that there are some risks associated with an EEG. Through this method, special sensors (electrodes) will be attached to our head and hooked by wires to a computer [3]. Then, the computer will record the brain's electrical activity on the screen or on the paper as wavy lines. During an EEG, doctor may encourage the things that stimulate the seizures, such as deep breathing on flashing light, so that he or she can see what happens in the brain during the seizures.

By considering a few factors, the author takes the decision not to use the EEG method in the monitoring system. It is due to certain aspects.

- **Safety**

  The author found that this method is not suitable to use for the Final Year Project since it is harmful to human health. It is because most part of the test involves the area around human's brain. Sometime, it is need to implant some device into the human brain to see the reaction occurred in the brain during epilepsy attack. Besides, it takes a long time to do the EEG analysis.

- **Cost**

  The author also found that the cost to do the EEG test is very high since it requires a high technology. Basically, the EEG method already use in the foreign and develop country like Japan to detect the epilepsy. Besides, it also uses the modern technology to run the analysis.

2.2 Bed Sensor

Figure 2: Bed Sensor [4]

The epileptic seizure or Bed Sensor alarm is a sensor that monitors a person with epilepsy while they sleep. Patented sensor technology detects all of the person's movement in bed and is able to differentiate the normal movement from epileptic seizures.

Basically, this system consists of a sensor, a control unit and a Tunstall radio transmitter. The bed sensor is extremely thin and contains no embedded wires or switches [4].

The sensor detects hyperventilation and partial convulsions as seizures. The alarm triggers if the person has abnormal movement longer than the present delay. The delay is between 7 – 20 seconds [4].

This bed sensor is specially design to give benefits to the people with epilepsy to support and compliment professional care where individuals are concerned about having seizures over night.

Besides, the oral sound and tilt sensor are also used when trying to detect seizures. The alarm may be representing by a sound or a radio signal depending on the product. A problem with these alarms is the difficulty in separating natural activity and seizures. The manufacturer delegates the individual setting of the alarm to parents or service-apartment personnel. To correctly set the frequency and amplitude threshold is not always an easy task.

Based on the idea from bed sensor, the author takes the decision to use the concept of vibration and movement to detect the epilepsy seizures.

The main reason is the delay time of the vibration when a person get the epilepsy attack is longer than the vibration of a normal person which is around 7- 20 seconds. Besides, there are differences in term of movement between epilepsy movements from non- epilepsy movements.

By referring to the concept of bed sensor, the author agreed that the vibration and movement can detect the epilepsy seizures. The author have come out with the another idea but the concept of the detection is almost the same.

But, through the monitoring alarm system, the author tries to design and fabricate a portable and friendly sensor that uses a non mercury sensor to ensure that the devise is not harmful to human health.

2.3 Vibration, Movement and Mercury-Free Sensor (Portable)

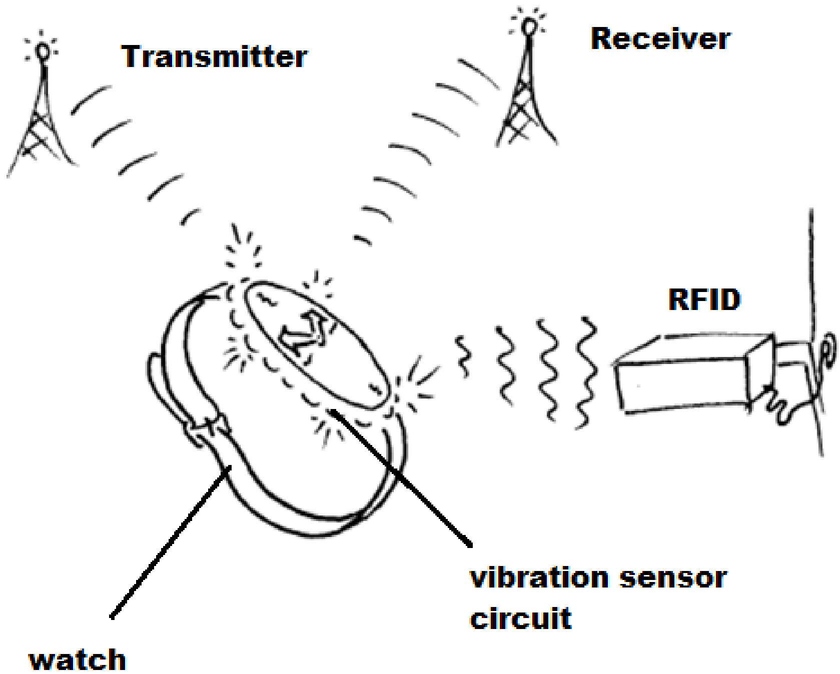


Figure 3: Proposed System [5]

For the first part, the author plan to detect the epilepsy seizures by using vibration and movement sensor. That sensor will be placed around the human's wrist as shown in Figure 3.

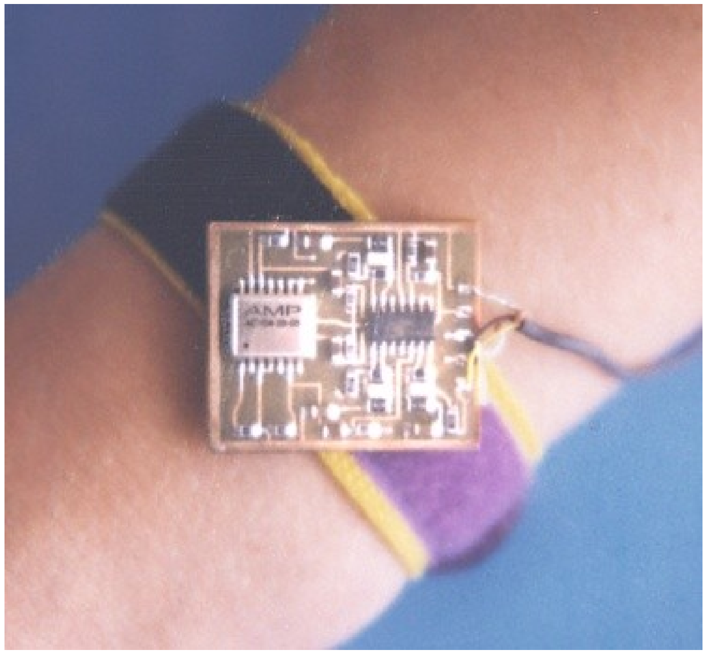


Figure 4: Vibration and Movement Sensor [5]

Then, the output of detection will be transmitted along Wi-Fi or RF to alert and tell the public that the person is under seizures.

CHAPTER 3

METHODOLOGY

3.1 Procedure Identification

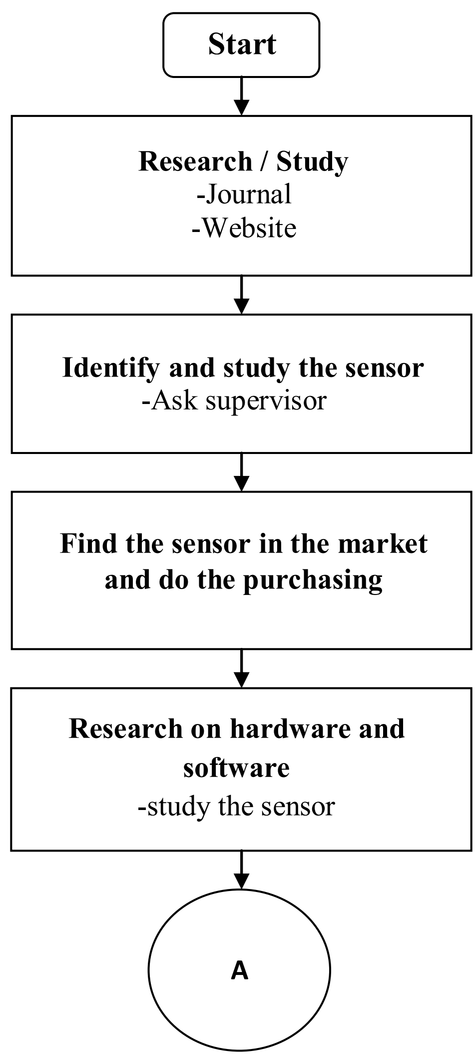


Figure 5 (a): Project Flow Diagram

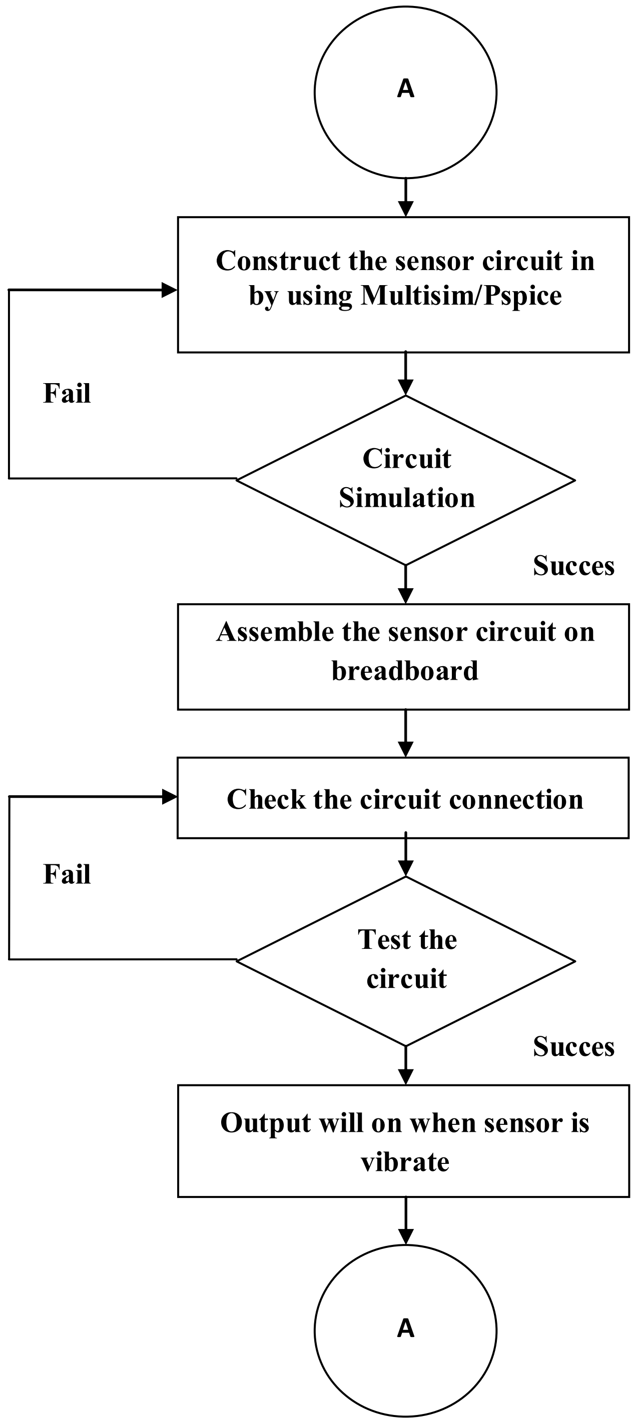


Figure 5 (b): Project Flow Diagram

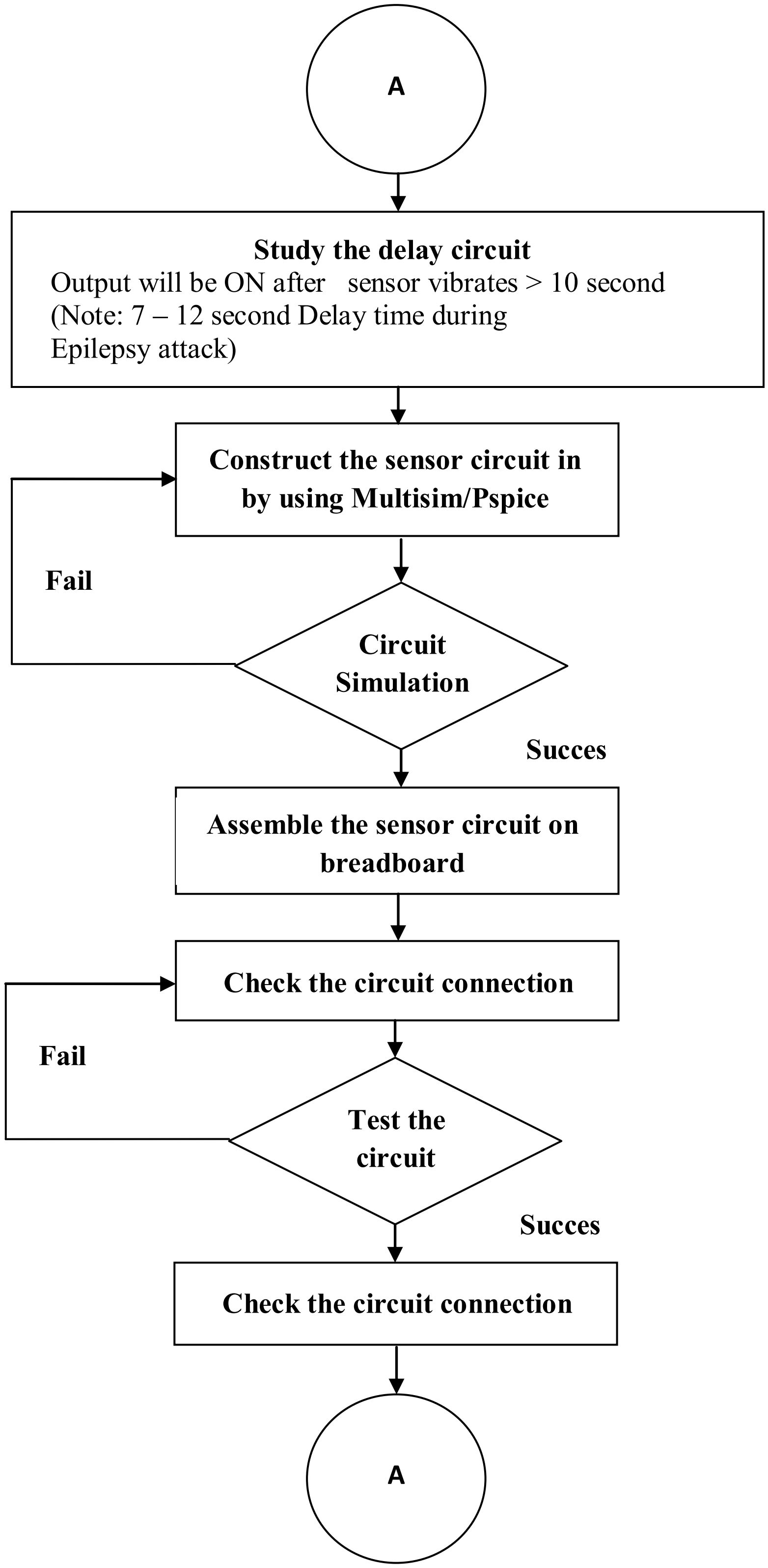


Figure 5 (c): Project Flow Diagram

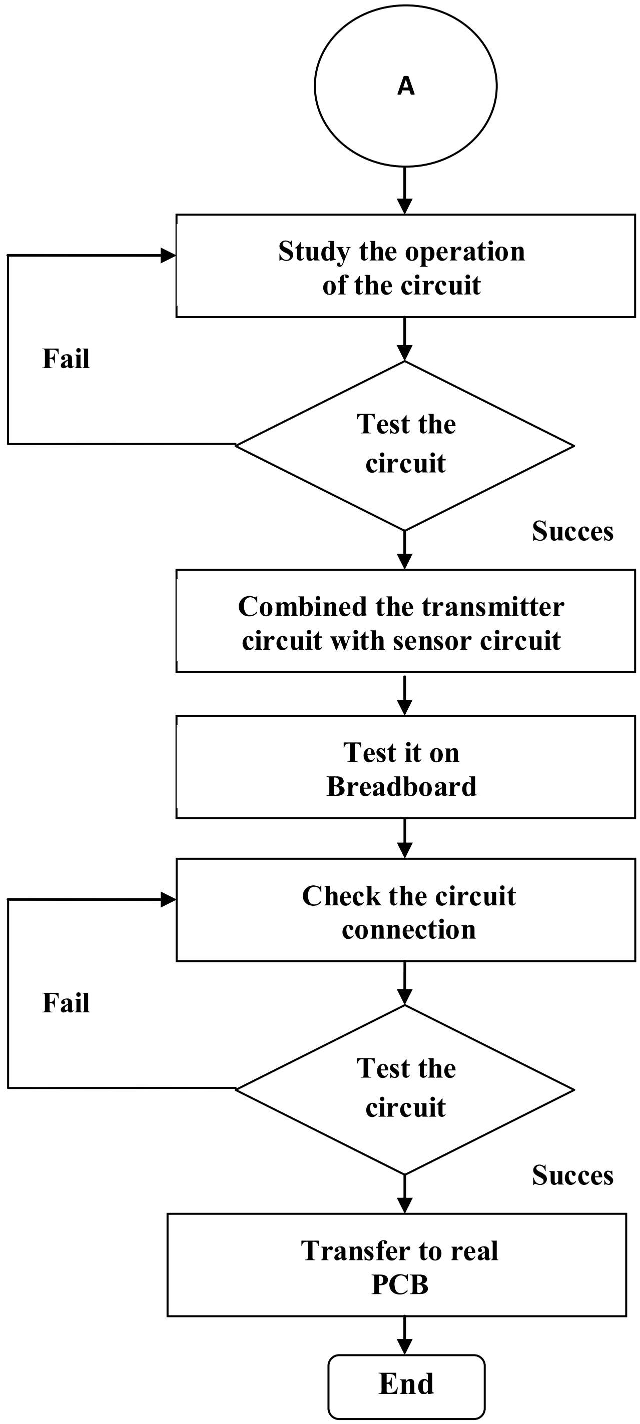


Figure 5 (d): Project Flow Diagram

3.2 Concept

There are four important parts in this project that should be designed in order for it successfully achieves the project objective. Those four steps are:

1) Identify and fabricate the sensor circuit.
2) Sending the signal to controller.
3) RFID to transmit and receive the signal.
4) Device that can alert ambulance, hospital and neighbor's house.

Figure 6 shows the overall system of the Simple and Safe Epileptic Seizure Monitoring System with Alarm.

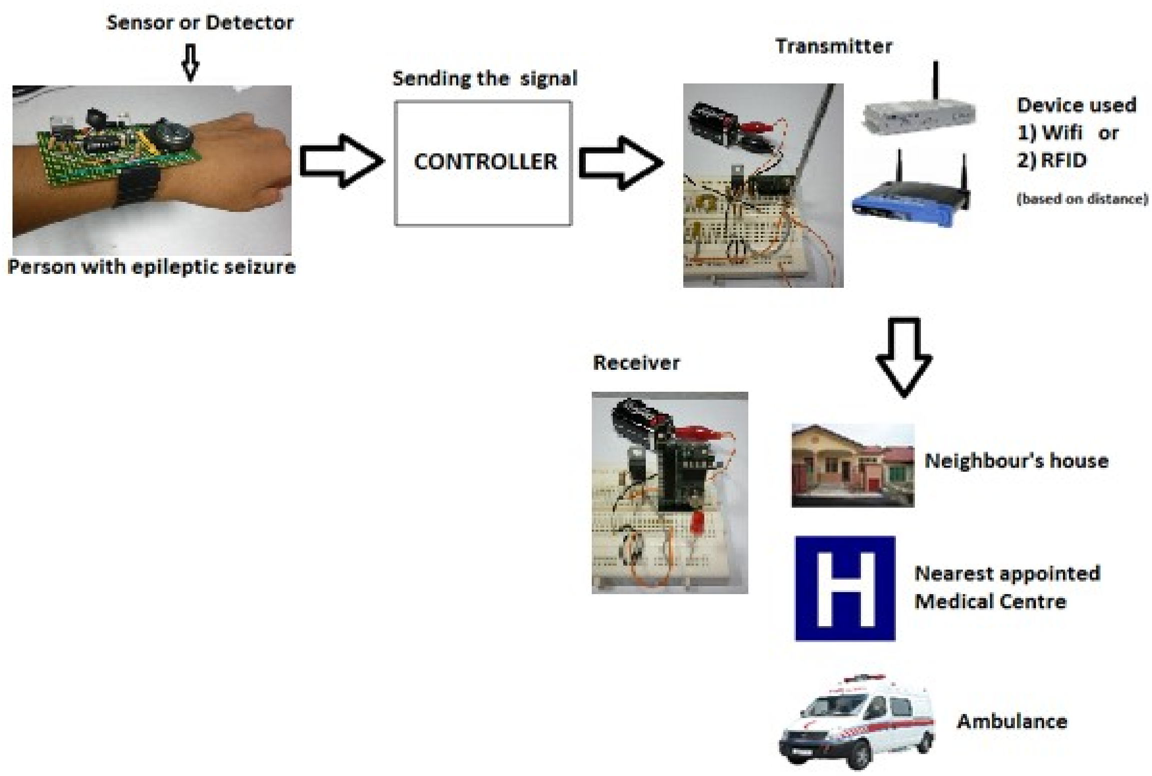


Figure 6: Simple and Safe Epileptic Seizure Monitoring System with Alarm

3.3 Tools and Equipments Required.

During the research in the internet and journals, one of the epilepsy symptoms is time period for the patient vibrating is 7 - 20 second in high frequency. Through that symptom, the author has used the concept of vibration to detect the epilepsy attack.

The author has purchased the vibration and movement sensor from RS Malaysia Sdn Bhd. Before the purchasing, the author has listed down the criteria of the sensor which are:

- Easy to get.
- Available in the local market.
- Cheap.
- Small.

Figure 7: Vibration and Movement Sensor

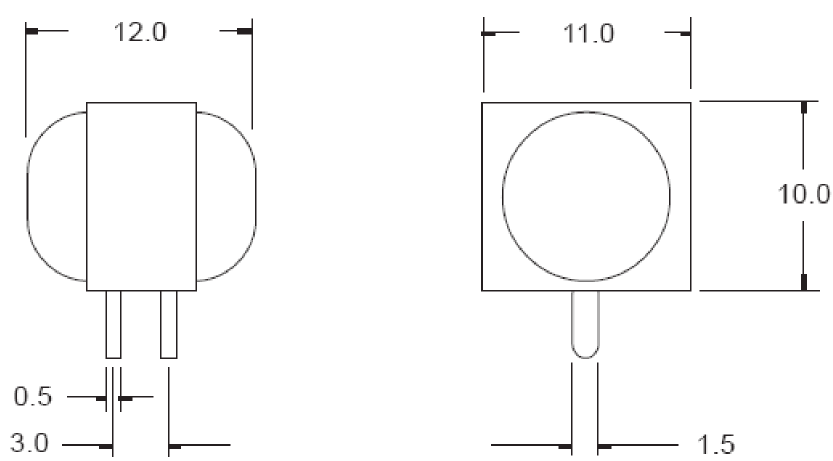


Figure 8: Dimension of Sensor in mm

The overview and dimension of sensor is showing in Figure 7 and Figure 8.

The specification of the sensor can be referred from Table 1

Table 1: Sensor, Movement, Vibration, Non Mercury Specification

SPECIFICATION	
CONTACT FORM	NORMALLY CLOSED
SUPPLY VOLTAGE Max Vdc	9
OPERATING TEMPERATURE Deg C	80
CONTACTS	Gold Plated
CASE MATERIAL	Plastic
FEATURES	Non-Position Sensitive Non-Mercury Contacts Omni-Directional

The author also has purchased the Transmitter and Receiver from Escol Electronics Trading. The main function of Transmitter and Receiver is to transmit and receive the signal from vibration sensor circuit.

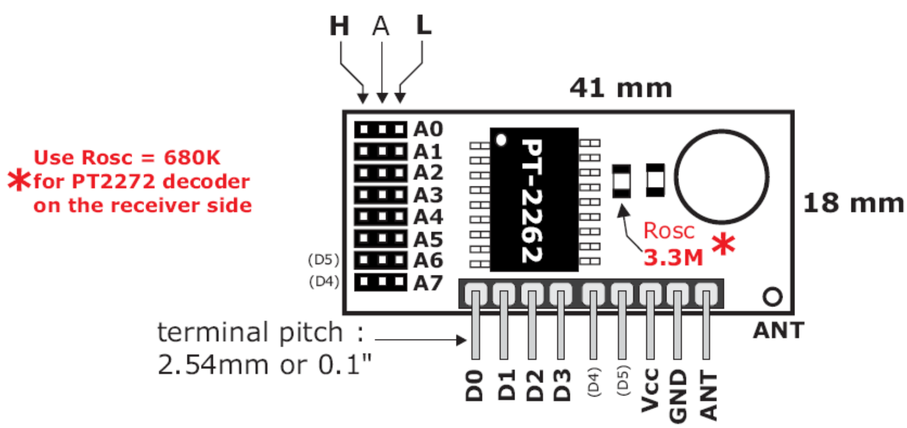


Figure 9: RF Transmitter Module with Encoder

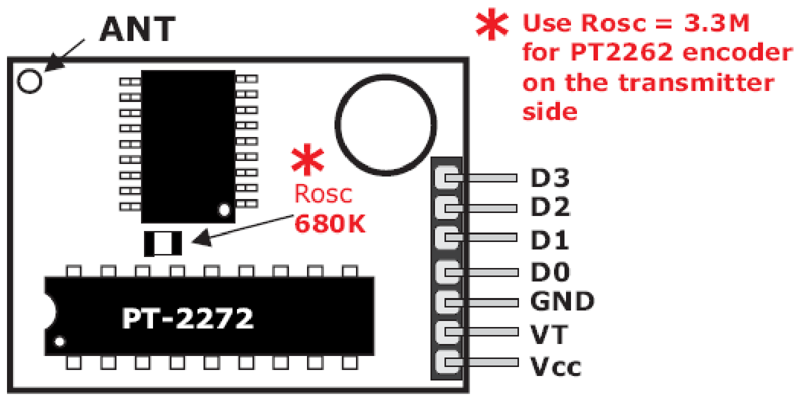


Figure 10: RF Receiver Module with Recoder

Figure 9 and Figure 10 shows the basic components in Transmitter and Receiver

3.4 Software

About the software part, the author has used

- PSpice
- Multisim
- EDGLE

The author has used Multisim software to design and simulate the circuit. After that, the author has constructed the circuit on to a breadboard.

During simulation in Multisim, voltage controller switch and pulse voltage is us as the vibration sensor as Multisim software did not have this compenent. Figure 11 shows the vibration sensor circuit in Multisim.

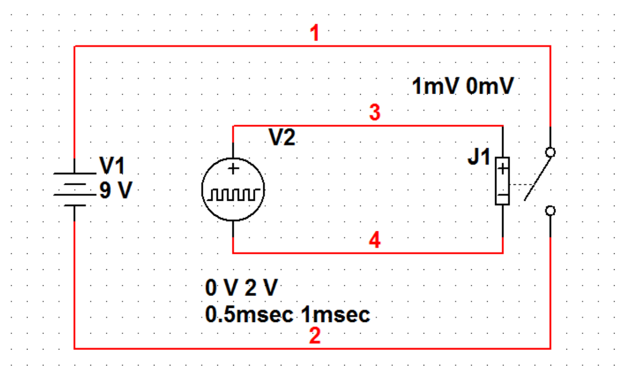


Figure 11: Vibration Sensor

CHAPTER 4

RESULT AND DISCUSSION

4.1 Circuit Design

A circuit needs to be design in order to amplify the produced signal and interface it with the sensor. The author has constructed 2 different circuits for vibration sensor which are

1) Circuit 1: Using Capacitor, Resistor and NAND gate as Vibration Sensor Circuit.
2) Circuit 2: Using Capacitor, Resistor, NAND gate and diode as Delay Circuit

4.2 Circuit 1

The Circuit 1 is constructed in Multisim and shown in Figure 12.

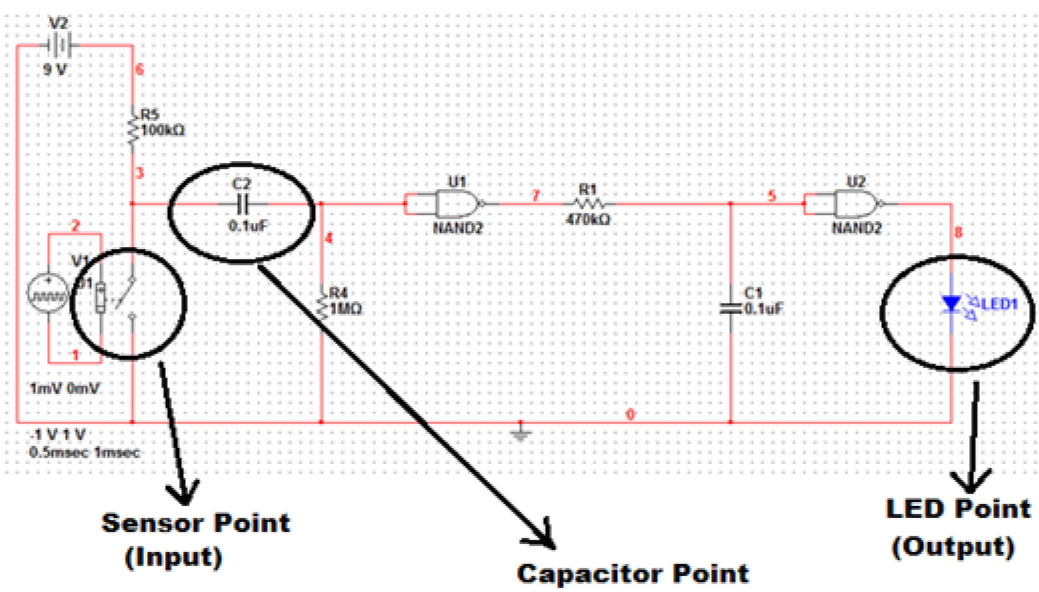


Figure 12: Circuit 1 in Multisim

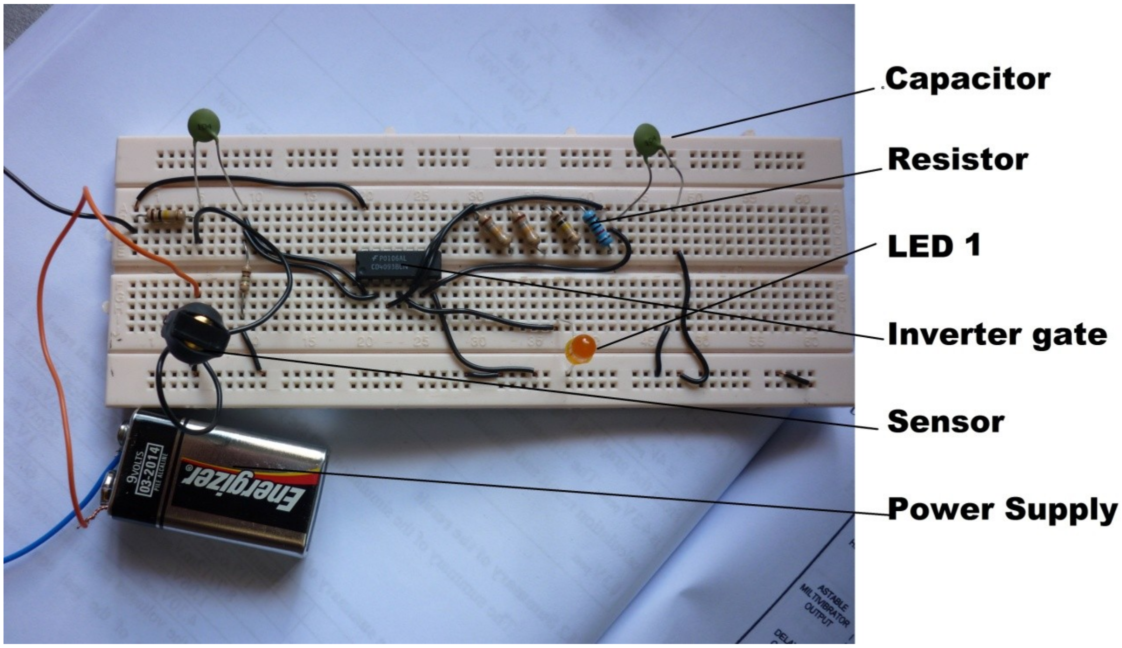


Figure 13: Circuit 1 in Breadboard.

The circuit is supplied with 5 V supply. LED 1 is used to indicate the output of the sensor circuit. The vibration sensor will be switch ON and OFF repeatedly to show the vibration of the sensor in Multisim. The output LED will be ON if vibration sensor vibrated and LED will be OFF if vibration sensor stops vibrating.

Basically, the sensor circuit above was constructed by using two loops of RC circuit. The first loop of RC circuit is to detect the vibration of the sensor and the output will be send to the second loop. The second loop of RC circuit is to hold the final output which is LED1. The time period of LED1 to maintain ON can be adjusted by increasing the value of R3.

The contact form of vibration sensor is normally closed which is short circuit if vibration sensor is not vibrating. The contact form will be open if the vibration sensor is vibrating.

4.3 Circuit 1 Analysis

The simulation for the circuit has been done by using Multisim software. Besides, the author have used digital oscilloscope in the laboratory to observe the waveform from the real circuit.

A few points on the circuit like voltage at vibration sensor point which is input, voltage at capacitor point and voltage at LED point which is output of the circuit had been captures in order to show the output of these points in waveform.

4.3.1 Voltage at Vibration Sensor Point

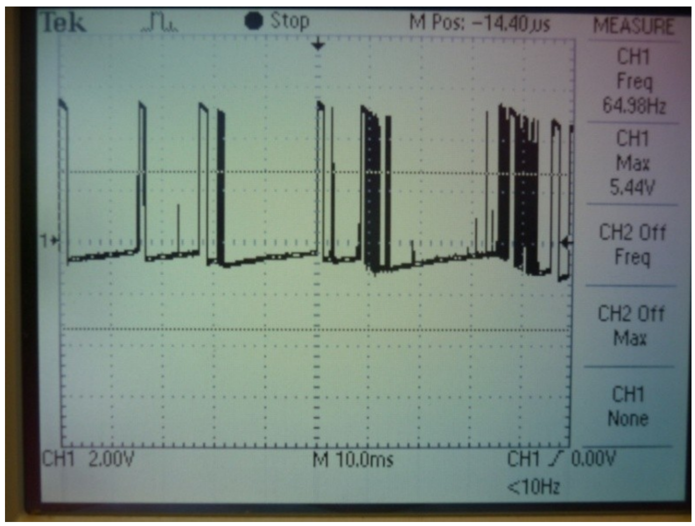


Figure14: Experimental Result on Digital Oscilloscope

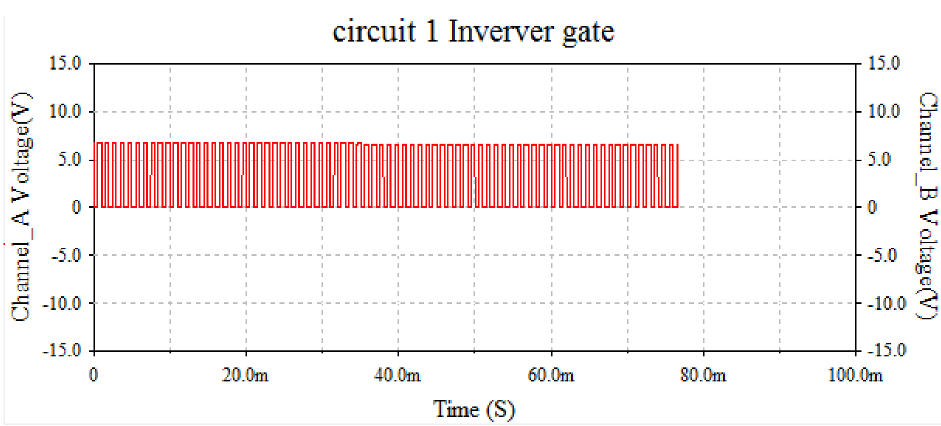


Figure 15: Simulation Result in Multisim

Figure 14 and Figure 15 shows the comparable waveform between the simulation and oscillation output at vibration sensor point. This waveform has been captured during the vibration of sensor. The output voltage at this point is approximately 5.71 Volt which is high voltage level.

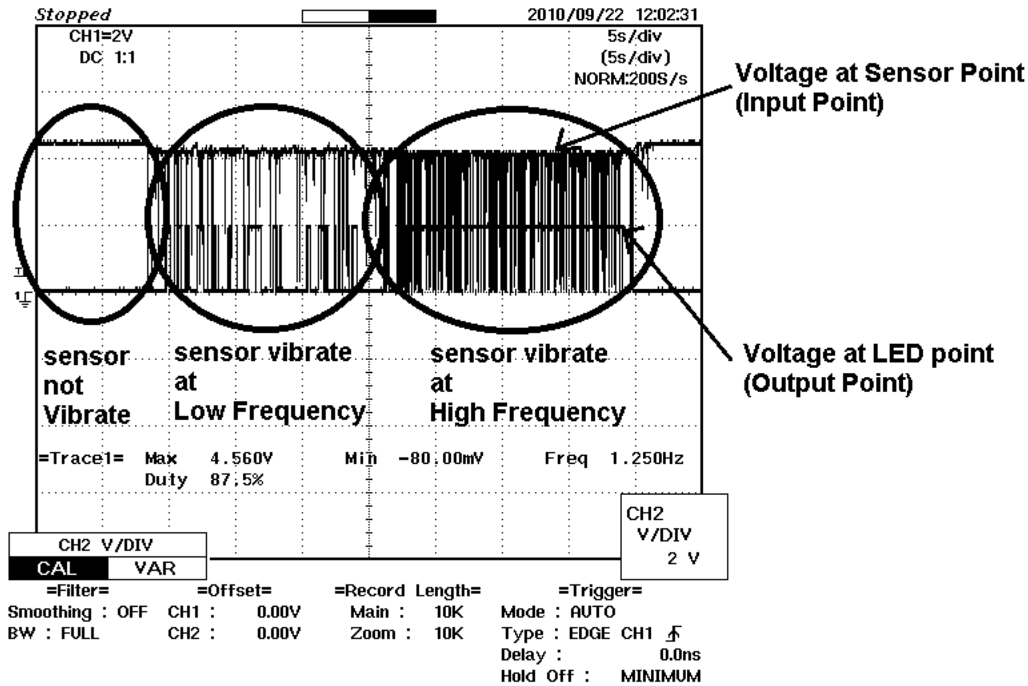


Figure 16: Experimental Result on Digital Oscilloscope

Figure 16 shows the oscillation output waveform at vibration sensor point (channel 1-input) and LED point (channel 2-output). This waveform has been captured under three conditions which are

i) Sensor in the normal condition (not vibrate) – channel 2 of oscilloscope shows that the output is 0 (low).

ii) Sensor vibrate at low frequency - channel 2 of oscilloscope shows that the output is like pulse signal. (On and off repeatedly).

iii) Sensor vibrate at high frequency- channel 2 of oscilloscope shows that the output is 1 (high).

Details of output waveform are showing in Figure 17.

4.3.2 Voltage at LED 1 Point (Output)

Figure 17 shows the oscillation output waveform at LED point which is output point of the circuit.

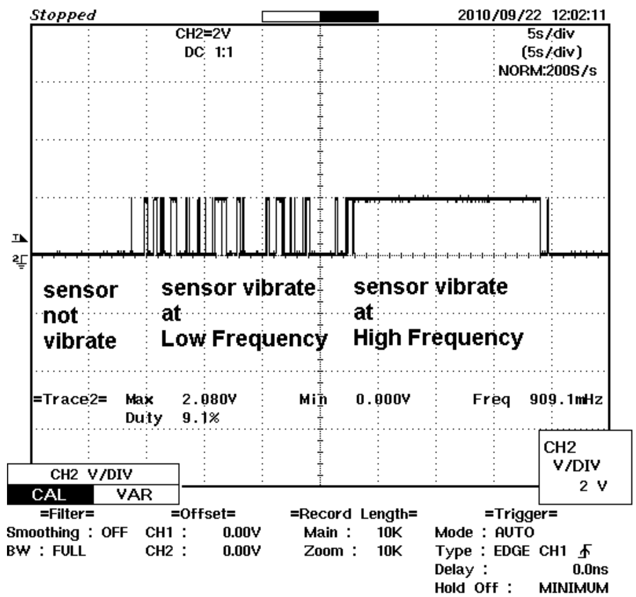


Figure 17: Experimental Result on Digital Oscilloscope

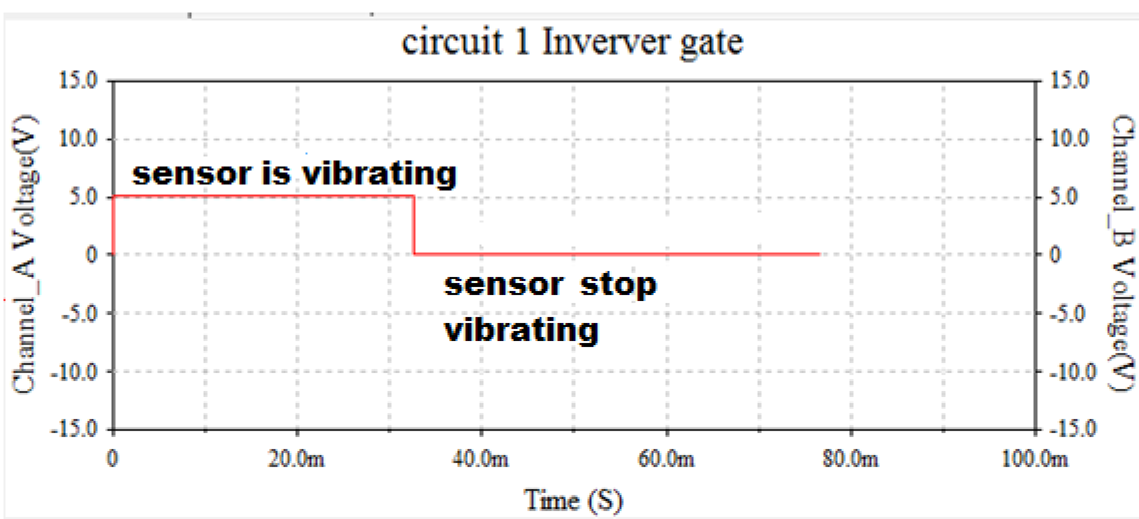


Figure 18: Simulation Result in Multisim Using Low Value for R1

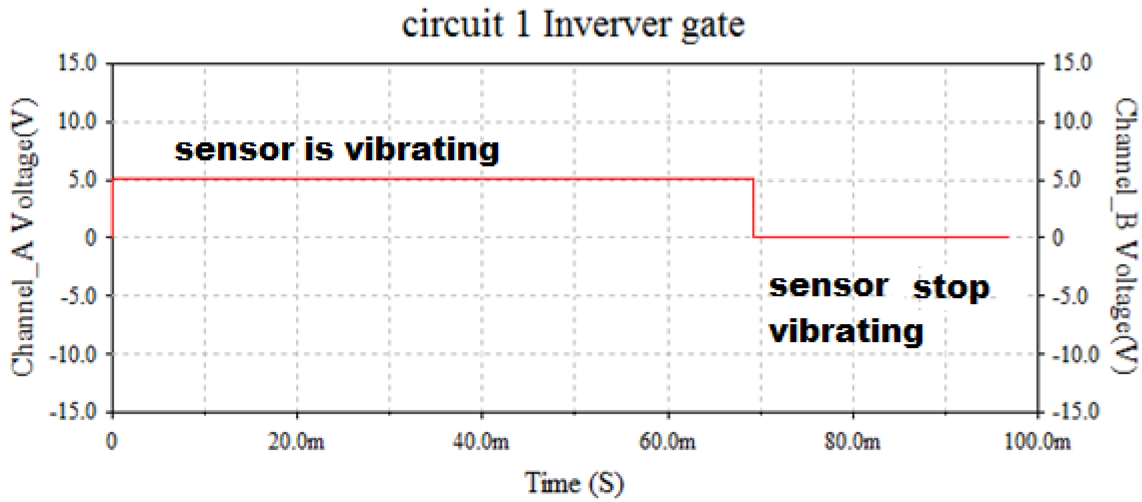


Figure 19: Simulation Result in Multisim using High Value for R1

By referring to the waveform for Figure 18 and Figure 19, it shows the different shape of the waveform for the output. In figure 18, the author has used the low value for R1 which is 470k Ohm while for figure 19 the author has used the high value for R1 which is 1M Ohm. The function of R3 is to hold the output.

Based on RC circuit, $\boldsymbol{\tau = RC}$. When C is constant, τ (time constant) is proportional to R.

4.3.3 Voltage at Capacitor Point.

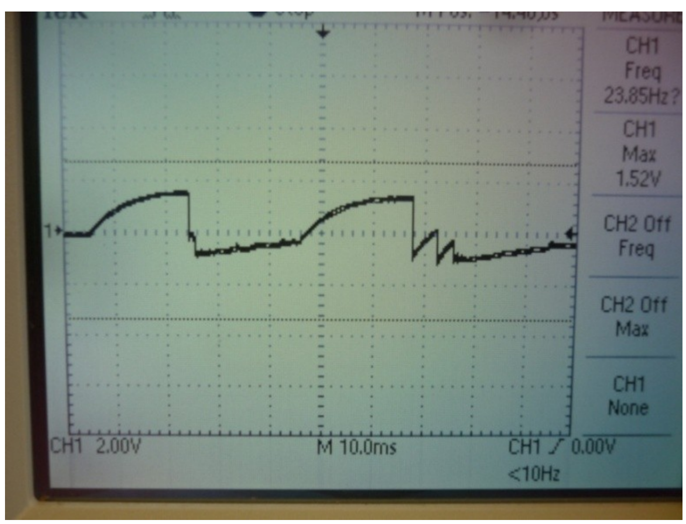


Figure 20: Experimental Result on Digital Oscilloscope

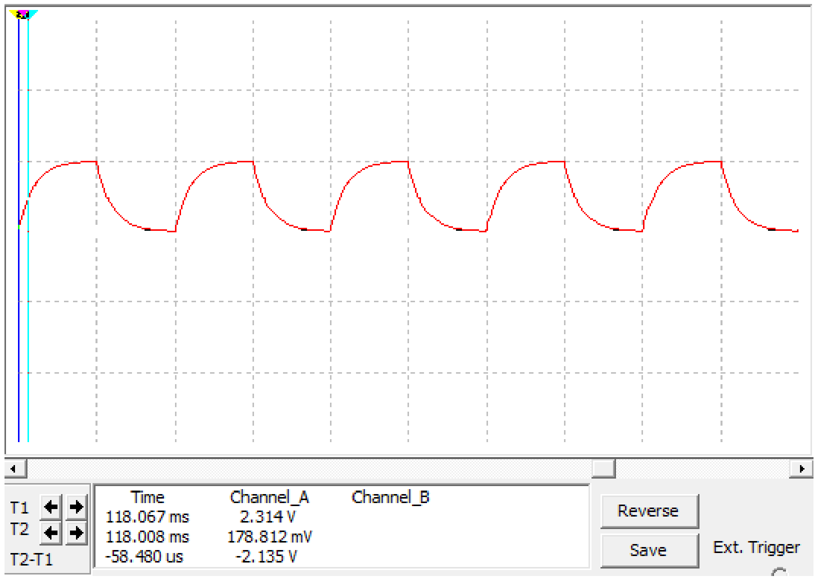


Figure 21: Simulation Result in Multisim

Figure 20 and Figure 21 shows the comparable waveform between the simulation and oscillation output at capacitor point. However, the shapes of waveforms are different from each other due to the force applied to the sensor. The input pulses are changing from positive peak to negative peak as shown in Figure 20 and Figure 21. This is due to the charging and discharging of the capacitor.

4.4 Circuit 2

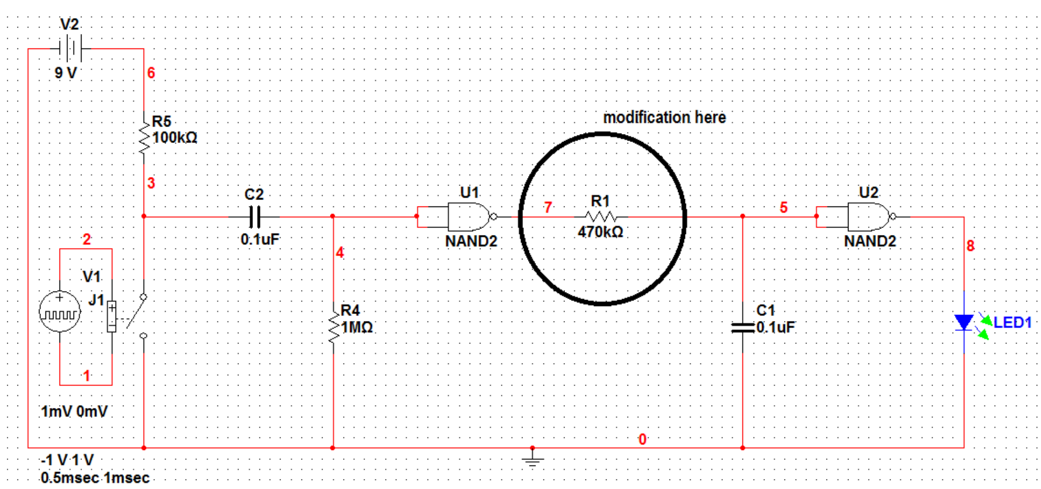


Figure 22: Original Circuit (Circuit 1)

Basically, Circuit 1 has been modified in order to make the delay in output. The original circuit (Circuit 1) as shown in Figure 20 has been modified where a diode has added to make it parallel with resistor. The complete modification is showing in Figure 23.

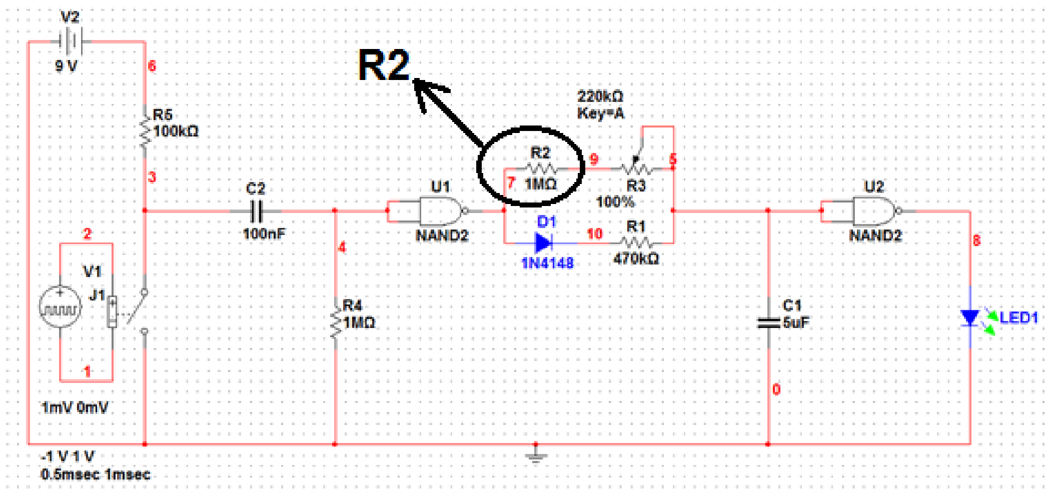


Figure 23: Modified Circuit

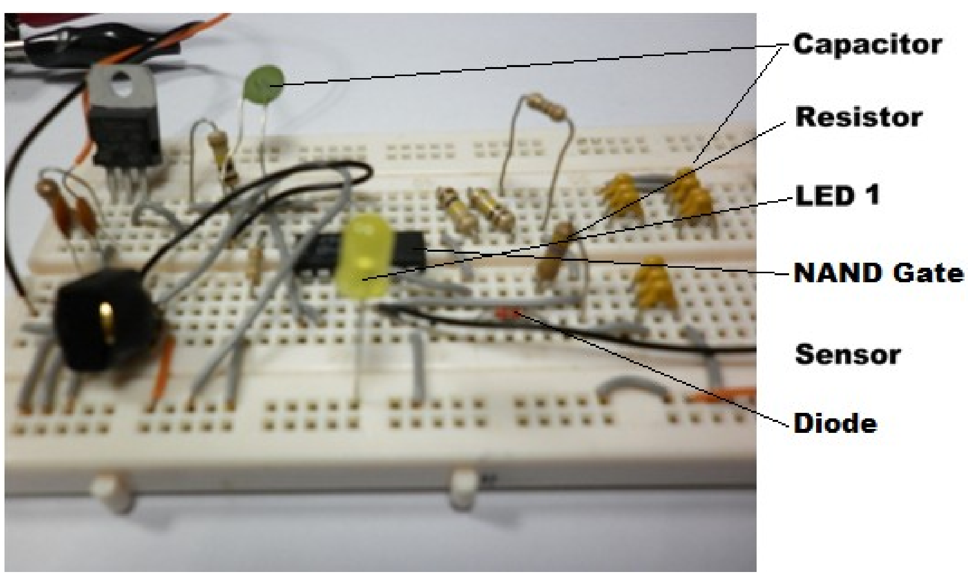


Figure 24: Modified Circuit on Breadboard

The author has decided to change 470k resistor probably to 1M resistor and 220k potentiometer. Besides, integrator capacitor, C1 has been replaced with 5micro F. The author tried to increase the charging current with a diode and parallel resistor.

Here, the author has two choices which are:

i) **Using large value of integrator capacitor, C1 and low value of integrator resistor.**

In this chase, the larger capacitor will increase the delay time before the second NAND gate turn on the LED. In fact, a larger capacitor will easily prevent the integrator from ever dropping low enough.

ii) **Using low value of integrator capacitor, C1 and large value of integrator resistor.**

In this case, a large value of resistor will help to steer the circuit in fact it will create an oscillator if we let it overdrive the current from the first NAND gate.

As conclusion, the author has decided to choose the second option since the large value of integrator capacitor; C1 did not affect much on delay process.

4.5 Circuit 2 Analysis

The different value of R2 resistor has been used during the experiment in order to see the respond in time delay.

The values of R2 resistor used are

i) 1 Mega Ohm
ii) 1.5 Mega Ohm
iii) 2.0 Mega Ohm
iv) 2.4 Mega Ohm

Digital oscilloscope has been used to record and observe the waveform from the real circuit. A few points on the circuit like voltage at vibration sensor point (input) and voltage at LED point (output) of the circuit had been captures in order to show the output of the points in waveform.

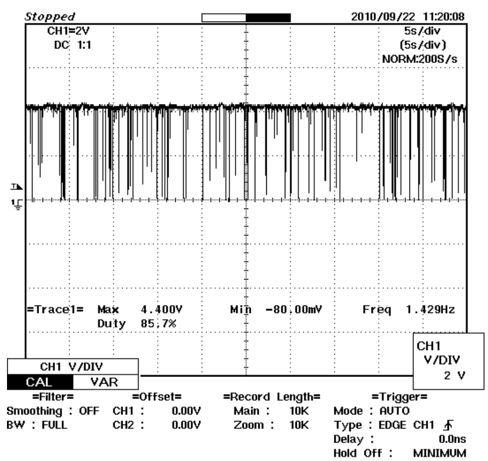


Figure 25: Low Frequency Vibration

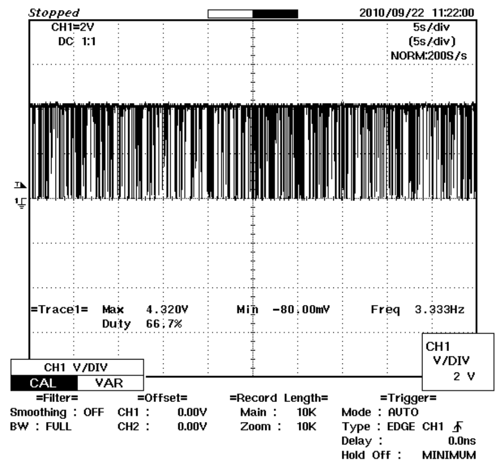


Figure 26: High Frequency Vibration

Figure 25 and Figure 26 shows the voltage at vibration sensor point which is input point. During the experiment, the author has applied two types of vibration to the circuit which are low frequency vibration and high frequency vibration. The reason is to observe whether the vibration level effect time delay or not instead of using the different value of R2 resistor.

4.5.1 Using 1 Mega Ohm Resistor

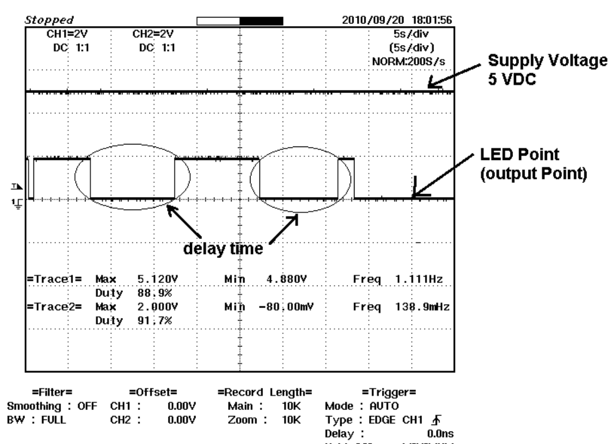


Figure 27: Output Waveform with Low Frequency Vibration

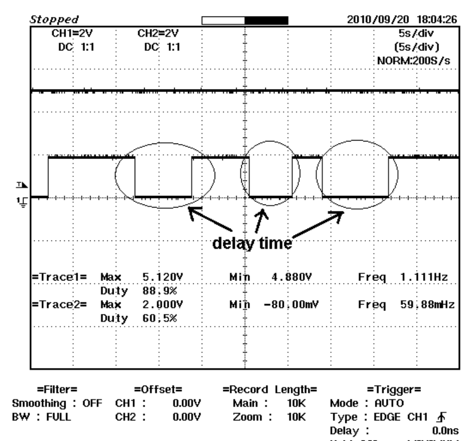


Figure 28: Output Waveform with High Frequency Vibration

Figure 27 and Figure 28 shows the oscillation output waveform at LED point which is output point when vibration sensor is vibrating. Figure 27 shows the output waveform with low frequency vibration while Figure 28 shows the output waveform with high frequency vibration. From the figures, there are different in time delay when different level of vibration applied to the circuit.

4.5.2 Using 1.5 Mega Ohm Resistor

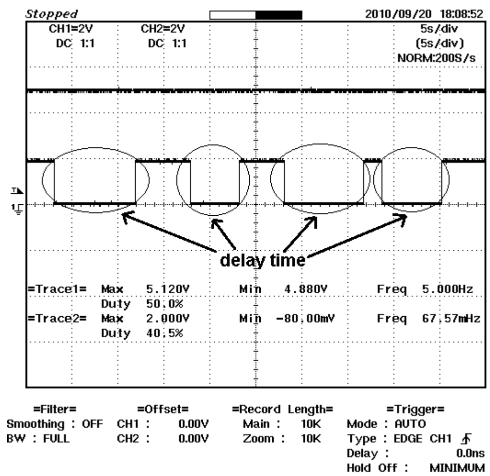


Figure 29: Output Waveform with Low Frequency Vibration

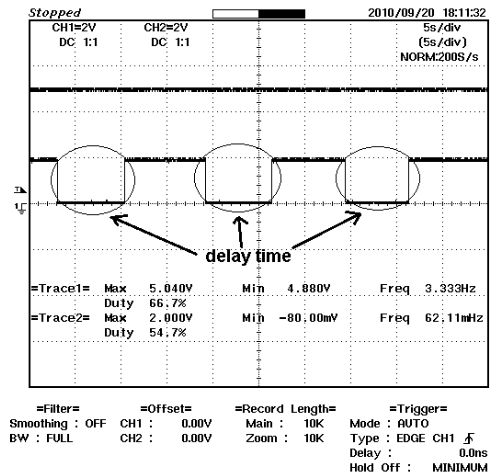
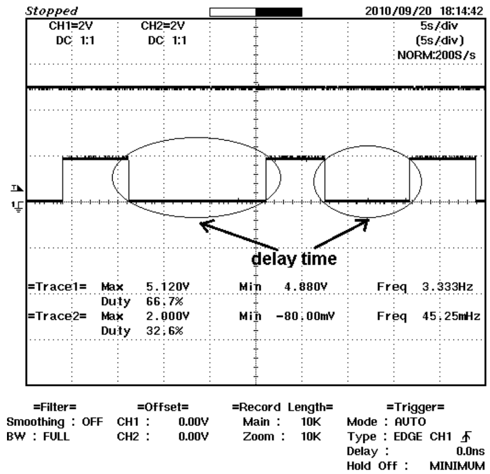


Figure 30: Output Waveform with High Frequency Vibration

Figure 29 shows the oscillation output waveform at LED point which is output point for low frequency vibration. Figure 30 shows the oscillation output waveform at LED point which is output point for high frequency vibration.

4.5.3 Using 2.0 Mega Ohm Resistor



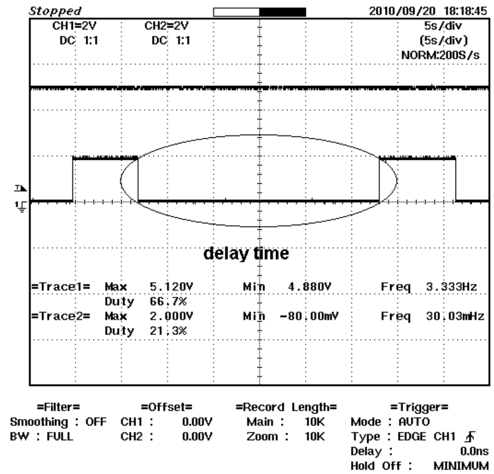
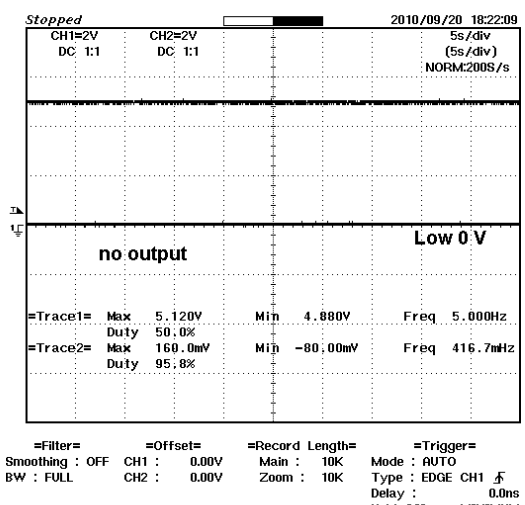


Figure 31: Output Waveform with Low Frequency Vibration

Figure 32: Output Waveform with High Frequency Vibration

Figure 31 shows the oscillation output waveform at LED point which is output point for low frequency vibration. Figure 32 shows the oscillation output waveform at LED point which is output point for high frequency vibration.

4.5.4 Using 2.4 Mega Ohm Resistor



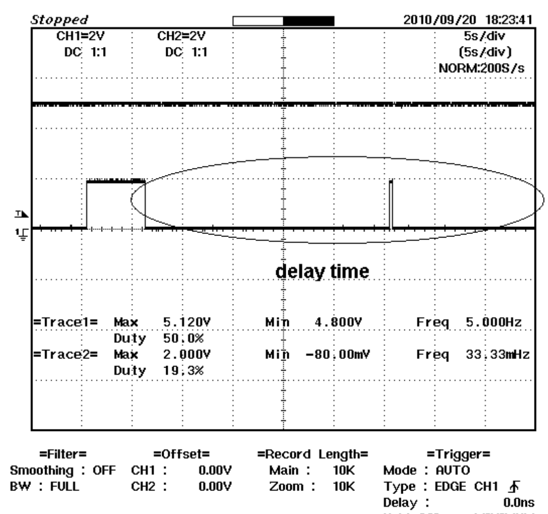


Figure 33: Output Waveform with Low Frequency Vibration

Figure 34: Output Waveform with High Frequency Vibration

Figure 33 shows the oscillation output waveform at LED point which is output point for low frequency vibration. Figure 34 shows the oscillation output waveform at LED point which is output point for high frequency vibration.

Figure 33 shows that the oscillation output waveform at LED point is low (0). It means that there is no output when low frequency vibration applied to the circuit. Figure 34 shows that the time delay for the output (LED) to turn on is quit long compare to time delay in Figure 28, Figure 30 and Figure 32.

Details of time delay for the output (LED) to turn on are showing in Table 2.

Table 2: Time Delay for Low Frequency Vibration and High Frequency Vibration with The Different Value of Resistors.

Value resistor	**Time Delay for Low Frequency Vibration (Second)**	**Time Delay for High Frequency Vibration (Second)**
1.0 Mega Ohm	7.0	6.0
1.5 Mega Ohm	8.1	7.0
2.0 Mega Ohm	12.5	24.0
2.4 Mega Ohm	No output	25.0

Table 2 shows the time delay for low frequency vibration and high frequency vibration with the different value of resistor. The resistor value will determine the time delay for LED to be turn on. Larger value of resistor means longer time delay for the LED to be turn on.

4.6 Transmitter and Receiver Analysis

The transmitter and the receiver part for this project will be using FR Transmitter Module with Recorder and RF Receiver Module with Recorder.

The output signal from the vibration sensor circuit will be sent to transmitter part. Once the transmitter part receives the signal, it will be sent to receiver part.

Figure 35 and Figure 36 shows the transmitter part and receiver.

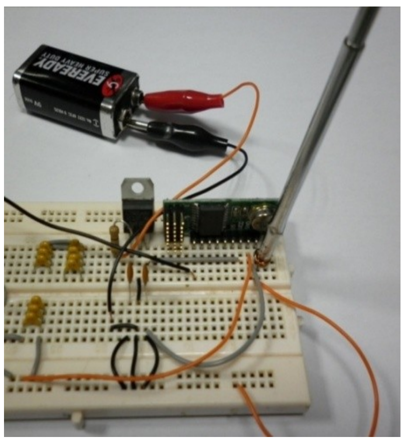


Figure 35: Transmitter Part

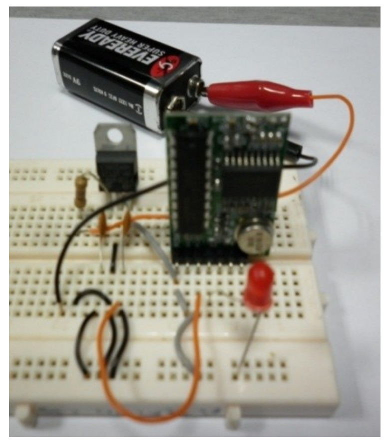


Figure 36: Receiver Part

4.6.1 Transmitter and Receiver Operation

Table 3: Transmitter and Receiver Operation

Condition	**Output (LED)**
Vibration sensor vibrates	LED on
Vibration sensor stop vibrating	LED off

Table 3 shows the operation of transmitter and receiver. The input of the receiver is connected to the vibration sensor circuit. LED has been used as output in the receiver circuit. When the vibration sensor vibrates, LED in the receiver circuit will be on. When the vibration sensor stops vibrating, LED will be off.

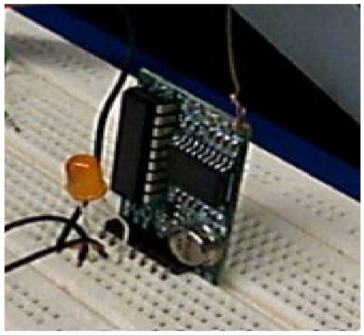


Figure 37 : LED Off

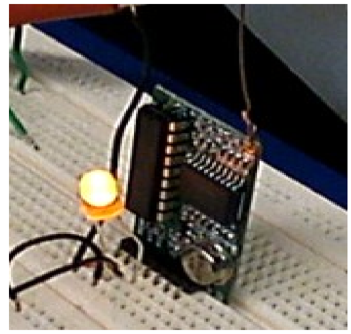


Figure 38 : LED On

Figure 37 and Figure 38 shows that LED is off when vibration sensor stops vibrating and LED is on when vibration sensor is vibrating.

4.7 Printer Circuit Board (PCB)

The circuit was constructed to the real PCB layout and those components are puts as near as possible to make the circuit as compact as possible. Figure 39 shows the layout of vibration sensor circuit in PCB

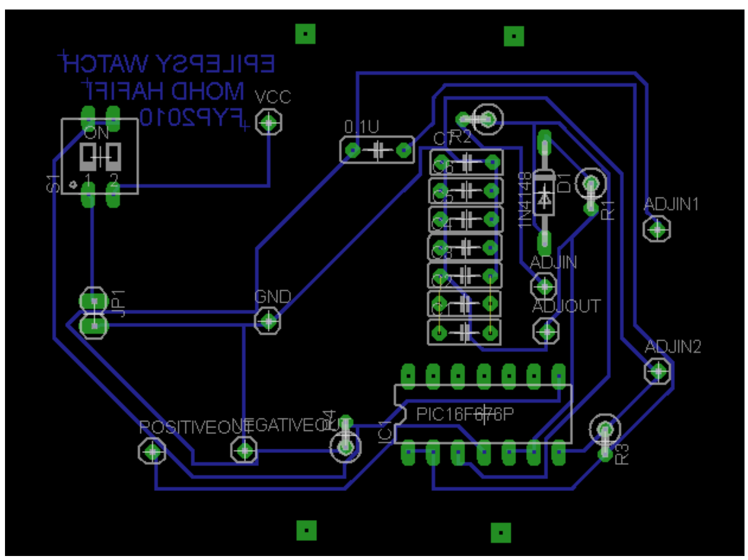


Figure 39: PCB Layout

Once the layout was successfully transferred into the PCB as shown in Figure 39, the circuit is tested for the continuity for each track. After that, all the components will be soldered on it. Then, the polarity of components is checking. Finally, the voltage is applied and checks to see if there are any smoky or hot components.

4.8 Final Product

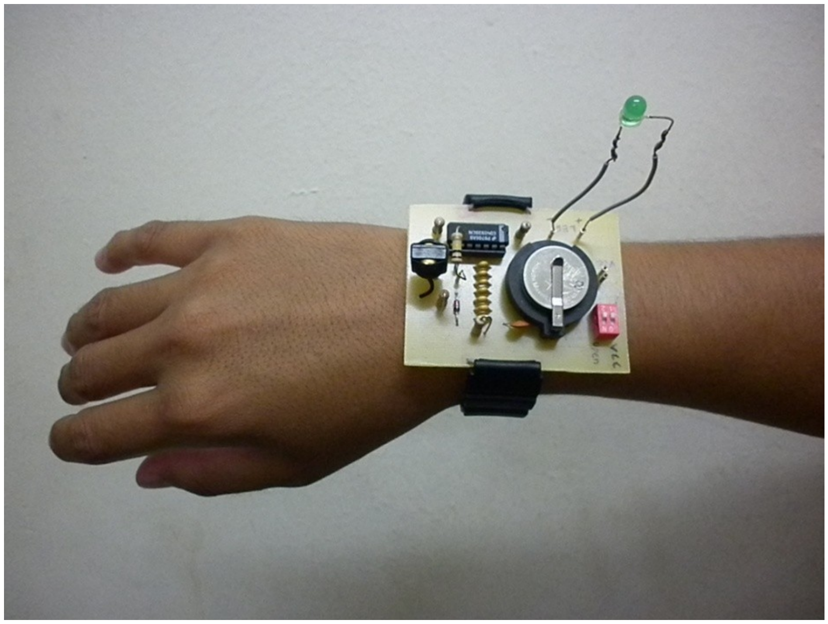


Figure 40: Epilepsy Watch

Figure 40 shows the final product which is the epilepsy watch. The details of datasheet about the product can be referring in Table 4.

Table 4: Product Datasheet

SPECIFICATION		
Contact Form (Vibration Sensor)		Normally Closed
Supply Voltage	Max.VDC	9
Operating Temperature	Deg.C	80

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

From the research, the author gets the idea to detect the epilepsy by using vibration and movement sensor. The idea comes from the application of bed sensor. The author was planned to design the monitoring system to detect the epileptic seizure.

The most common method to help patient with epilepsy is by using the prevention device. The concept of vibration sensor can be used to detect the epilepsy attack. The alarm triggers if the patient has abnormal movement longer than the present delay. The delay is between 7 – 20 seconds.

5.2 Recommendation

Hopefully, this device can be used to help the patient with epilepsy. It is because the concept of vibration can be used to detect the epilepsy attack. Hopefully, this device can reduce the Sudden Unexpected Death (SUDEP) among the patient.

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[4] Product data, epilepsy sensor
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APPENDICES

APPENDIX A

GANTT CHART

GANTT CHART for Semester 1

No	Activities/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Selection of Project Title	■	■												
2.	Data Gathering on Title		■	■	■	■	■	■	■	■	■				
3.	Preliminary Report Submission			■											
4.	Construct the vibration sensor circuit			■	■	■									
5.	Testing circuit					■	■	■	■	■	■	■	■	■	■
6.	Submission Of Progress Report					■									
7.	Seminar							■	■						
8.	Result Gathering							■	■	■	■	■	■	■	■
9.	Submission of Interim Report													■	■
10.	Oral Presentation													■	■

GANTT CHART for Semester 2

No	Activities/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Modified vibration sensor circuit	■	■	■	■	■	■	■	■						
2.	Testing circuit	■	■	■	■	■	■	■	■						
3.	Study PIC and Construct Circuit			■	■										
4.	Construct the circuit in PCB										■	■	■	■	
6.	Submission of Progress Report 2								■						
7.	Poster Exhibition											■			
8.	Submission of Draft Report														■
9.	Oral Presentation	**Last Week**													

APPENDIX B

TX9902B

RF Transmitter Module With Encoder

(SAW resonator stabilized) (DC 3 ~ 12V)

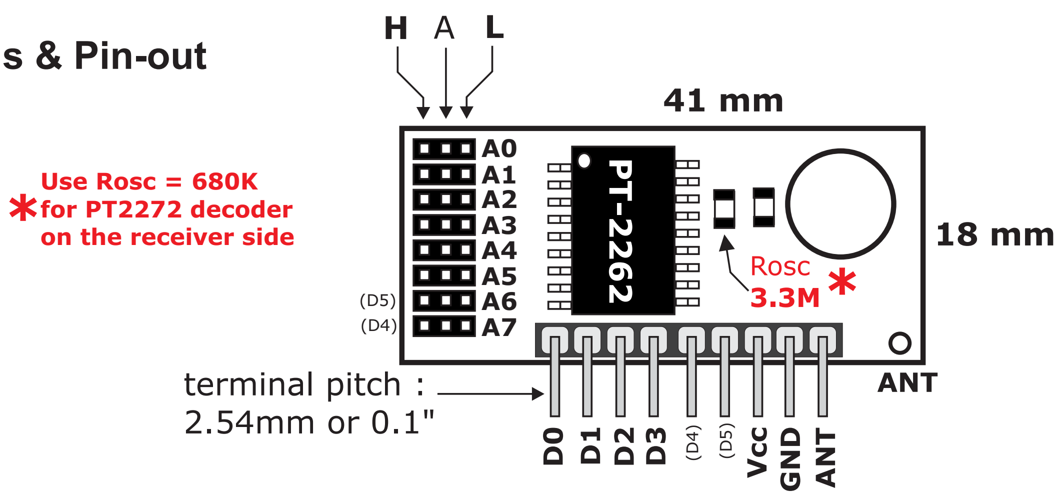
Application

1) Industrial remote control, remote monitoring & sensing
2) Wireless security alarm or low baud rates digital signal transmission receiver
3) Remote control for household electrical appliances and robotic projects.

Technical Specifications

Operating voltage	3 ~ 12V DC
Operating current	max: < 5mA(12V), < 2mA(3V)
Oscillator	SAW filter stablilized
Modulation	OOK, ASK
Frequency	**315 MHz or 433.92 MHz**
Frequency tolerance	± 150 KHz (max)
Transmission (RF) power	50mW (at 315 MHz & 12V)
Data transmission rate	<= 10K bps
On board Encoder IC	**PT2262** or compatible chips (SC2262, CS5211, etc)
Antenna length	**24 cm** (315MHz), **18 cm** (433.92 MHz)

Dimensions & Pin-out

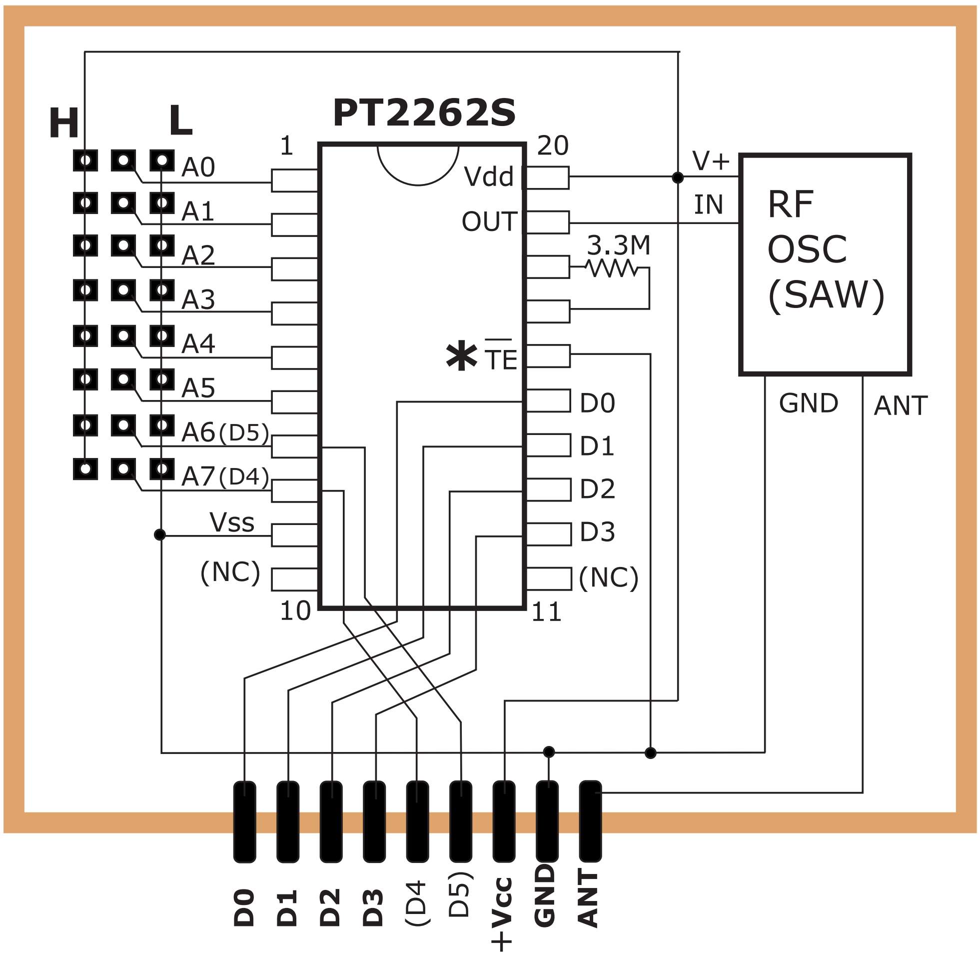


IMPORTANT NOTES

1) **Antenna :** Use any soft/hard wire with the specified length. If a telescopic antenna is used, be sure that it is fully extended. Length of antenna is important and frequency dependent (refer to the specs section above for the correct length)

2) If the transmitter module is housed in a metal casing, an external antenna should be used. For best result, use 50 Ω coaxial cable for connecting the antenna to the module.

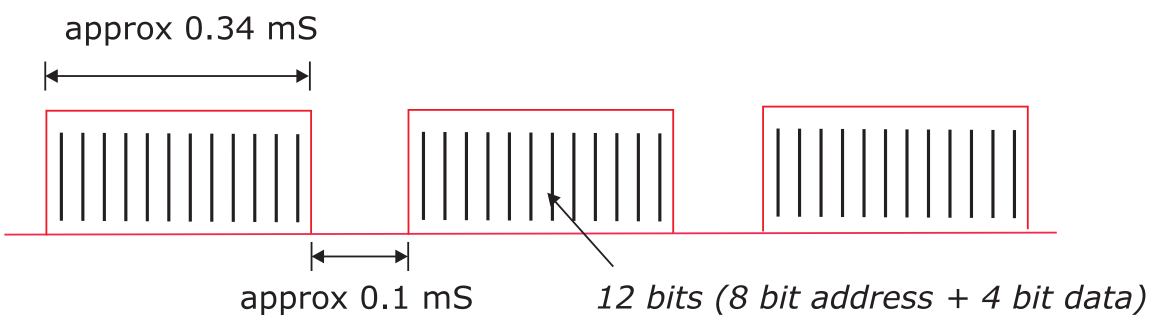
Simplified Block diagram



* NOTE : TE pin is permanently tied to GND. The transmitter is in the continuous transmission mode.

Waveform at PT2262 output pin

(please refer to PT2262 datasheet for more info on signal format & timing)



RX9926

RF Receiver Module with Decoder

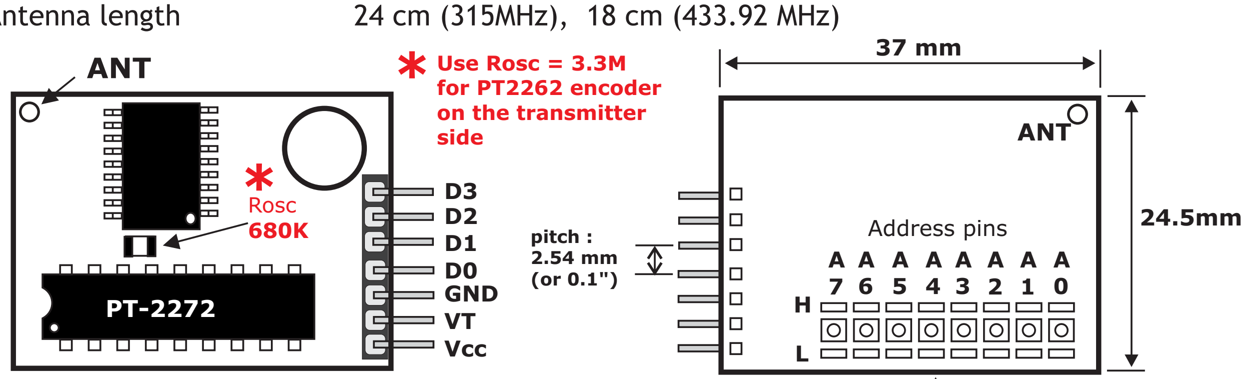
- Superheterodyne
- SAW resonator based design
- High sensitivity

Application

1) Low baud rates digital signal link
2) Industrial remote control, remote monitoring & sensing
3) Wireless security alarm receiver and remote control for household electrical appliances.

Technical Specifications

Operating voltage	5.0 VDC ± 0.5V
Operating current	<= 5 mA (Vs=5.0 V DC)
Receiver config.	Superheterodyne
Modulation	OOK, ASK
RF Frequency	315 MHz or 433.92 MHz
Channel width	2MHz (315MHz @ 3 dBm rolloff)
Sensitivity	> -100 dBm (50)
Data transmission rate	< 9.6 Kbps (315MHz, -95 dBm)
On board decoder IC	**PT-2272-L4** or compatible chip **(8-bit trinary address, 4-bit binary data)**
Output	TTL compatible
Antenna length	24 cm (315MHz), 18 cm (433.92 MHz)



Each address pin can assume one of the 3 possible logic states.
i.e. : logic high (H), logic low (L) or floating (no connection)
The module is supplied with all the address pins open.

IMPORTANT NOTES

1) **Antenna :** Use any soft/hard wire with the specified length. If a telescopic antenna is used, be sure that it is fully extended. Length of antenna is important and frequency dependent (refer to the specs above for the correct length)

2) Supply voltage should be stable & with low ripple.

3) Note that output waveform may become distorted if the transmitter is too close to the receiver (» a few cm). This is inherent to superheterodyne receivers and is considered as normal