

**DEVELOP EARTHQUAKE SYSTEM FOR SAFETY
BY USING WIRELESS SENSOR NETWORK (WSN)**

MOHD SAFFWAN BIN MOHD REIP

BACHELOR OF COMPUTER SCIENCE

UNIVERSITI MALAYSIA PAHANG

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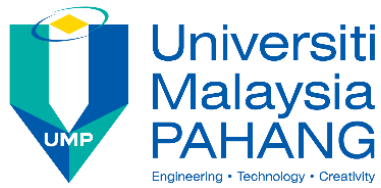
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DEVELOP EARTHQUAKE SYSTEM FOR SAFETY
BY USING WIRELESS SENSOR NETWORK (WSN)

MOHD SAFFWAN BIN MOHD REIP

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ABSTRAK

Bagi menggantikan rangkaian berasaskan kabel yang sedia ada, rangkaian sensor tanpa wayar bertukar menjadi mekanisme untuk pemantauan kesihatan struktur kejuruteraan kerana ianya mudah untuk dipasang dan dikendalikan secara amnya. Walaubagaimanapun, masih terdapat ujian yang tidak disesuaikan yang merupakan kepercayaan khusus aplikasi berkenaan pengenalan kesalahan sensor dan toleransi. Kebolehpercayaan juga dipengaruhi oleh pengurangan sifat semakin semasa melegakan kewajipan WSN. Ini boleh dicipta oleh kekurangan dalam memegang sensor, rasuah ketepatan, peningkatan intensifikasi, kecenderungan, terapung, kekecohan, dan sebagainya. Usaha ini menumpukan pada memerhati penghantaran maklumat dalam sistem sensor tanpa wayar untuk menjamin kualiti pemeriksaan kesihatan struktur yang teguh dengan mencadangkan strategi lain untuk system.

ABSTRACT

As a contrasting option to current wired-based networks, wireless sensor networks (WSNs) are turning into an inexorably convincing stage for monitoring building structure because of generally minimal effort, simple establishment, thus forth. However, there is as yet an unaddressed test which is the application-particular trustworthiness regarding sensor fault identification and tolerance. The reliability is additionally influenced by a lessening on the nature of checking while relieving WSN obliges. This can be created by deficiencies in sensor holding, accuracy corruption, intensification increase, inclination, float, commotion, et cetera. This venture is concentrating on observing information transmission in wireless sensor system to guarantee the unwavering quality of structural health checking by proposing another strategy for system.

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LIST OF ABBREVIATIONS

RAD	Rapid Application Development
SDLC	Software Development Life Cycle
WSN	Wireless Sensor Network

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Nowadays, there are many skyscrapers in the world, and most of the building have earthquake detector and some do not have. Based on the articles on April 22, Harian Metro, Manila, Philippines an earthquake measuring 6.3 magnitude shakes the middle of the Philippines, US Geological Survey Center (USGC). The quake was recorded 60 miles northwest of Manila at a depth of 40 kilometers. This natural disaster can be worst if there is no earthquake system in the building. By using technology this natural disaster can save more lives. In this technology, earthquake system is the mature way to save thousand lives.

Earthquake system are actualized for structures, for example, spans. Structures to screen their operations and wellbeing status. The destinations of this system are to decide health status like the damage, which is a striking change around a sensor area of a structure, and gives both long haul observing and fast investigation in light of strange incident. In this case, this system only requires one sensor located at the skyscraper section to detect the tremors from the ground. Hence, the surrounding buildings require only one alarm device installed at each building near the sensor.

1.2 Problem Statement

Problem statement in this project is about a natural disaster that is often unexpected and also to ensure that every building in the world has a system of earthquakes. So, this project being able to help reduce the rate of natural disasters that often occur in this world.

In converging area, sending the information in quickest way is one of the way to improve safety in their life. Hence, this project will help people who live or work inside the building get an information about the earthquake in fastest way.

1.3 Objective

The main objective of this project:

- i. To study about current system of earthquake detector.
- ii. To propose an earthquake system for safety using wireless sensor network.
- iii. To test the data transferred wirelessly.

1.4 Scope

The scope of this project is focusing on some point that stated below:

- i. To study focus on the advantages using wireless architecture rather than wired architecture.
- ii. The sensors in Module A will detect the vibration and alert the people who live inside the building with buzzer and send the signal to the Module B and also alert the people with buzzer.
- iii. This prototype consist of Arduino NANO controller, Vibration Sensor Module, Buzzer and RF Module transceiver.

1.5 Thesis Organization

This thesis consists of five chapters of major division.

In Chapter 1, we will discuss about an introduction to the research. It describes about the project and its related issues. It also cover problem statement, objective and scope of the project

In Chapter 2, it shall discuss the literature review of the project contains the information about the project in general. It describe existing framework about the other parties. It also contain the solution of the problem related to the project.

In Chapter 3, it discusses about the overall approaches and the framework regarding the project. It include the introduction,

In Chapter 4, the implementation of the simulation WSN is discussed and it will tell about the result of the simulation.

Lastly, in Chapter 5, it explain the conclusion of the project. It covers research constraints and future work.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The title of this project is Earthquake system for safety using wireless sensor network. This project is carried out to identify earthquake system for use in country that have earthquake issue. This chapter will explain in more detail about the existing projects that are related with wireless sensor network. The main purpose of this chapter is to study and analyse the concept and features of the existing projects before it can be applied on the project that will be developed.

2.2 Review of Existing System

In this subchapter, it will briefly discuss about the existing system and proposed system in this project. There will be comparisons on several aspects of those systems.

2.2.1 Earthquake Alert! (Apps on Google Play)

Earthquake Alert is mobile apps device. This system usually use by mobile phone user that live in earthquake area. This apps can download for free in android or IOS background. This device also provide service that can give customer to see magnitude 1.0+ from the U.S. and magnitude 4.5+ earthquakes from all over the World.

Hence, this apps features is the user can tab between map and list, can check the latest quakes in the world, filter what you see, also can click quake to view on map, shows map magnitudes, and have alert and push notification.



Figure 2.0: Earthquake Alert system

2.2.2 Earthquake Detector

This systems have been existed for quite a while throughout the world. However this system are popular or recognized by country that have earthquake issue. This system can detect large earthquake that occur hundreds of miles away and can detect moderate to minor earthquakes for many miles around your local area. The advantage of this system is that it develops you and warns you when the earthquake begins. Sounds also important in earthquake detection and by itself can be misleading. This detector also easy to setup mounts easily to wall no screws, nails or tools required. This Earthquake Detector also provides early warning by detecting an earthquake's sound wave, fully adjustable sensitivity setting, loud distinctive alarm to wake you up and others.



6" high x 3" wide x 1-1/4" deep

Figure 2.1: Earthquake Detector alarm

2.2.3 Earthquake System For Safety using Wireless Sensor Network (WSN)

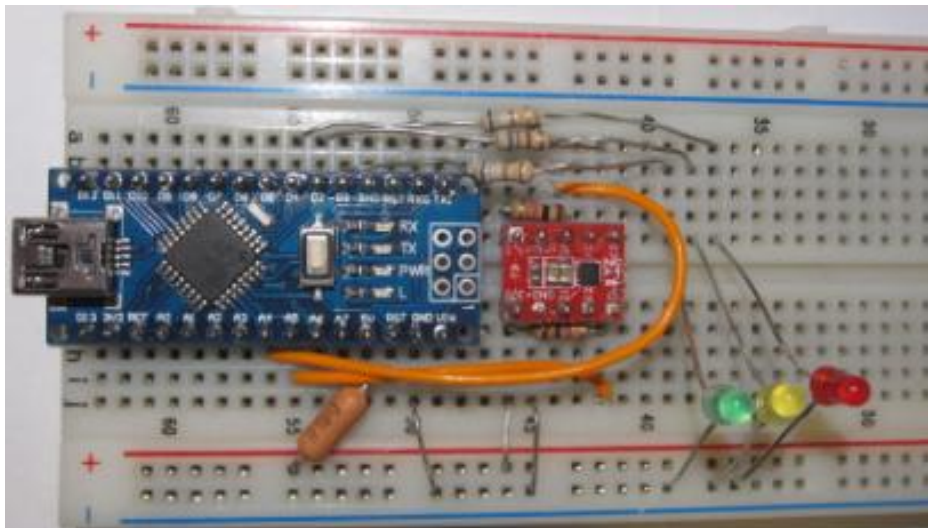


Figure 2.2: Earthquake system



In this system, all security units designated by each company are able to enhance the security of a safer and more secure. Every skyscraper built has many lives involved if an earthquake takes place. With this system, it can further reduce mortality due to frequent earthquakes in certain areas. Furthermore, the tool is only in an area where the building is adjacent to only the alarm device, and when the

earthquake tracking device detects vibration, the entire building with an alarm device will sound.

2.3 Comparison of tools

There are several tools that can be considered and use to develop this project. The elements of the tools such background, framework, advantages and disadvantages are being compared and shown in the table 2.1.

Table 2.1: Comparison of tools

Features	 Earthquake Alert (Google Play)	 Earthquake Detector Alarm	Earthquake system for safety
Microcontroller Used	<ul style="list-style-type: none"> • Mobile Apps 	<ul style="list-style-type: none"> • Electronic Monitored 	<ul style="list-style-type: none"> • Arduino Nano
Sensor Used	<ul style="list-style-type: none"> • GPS system • Android studio 	<ul style="list-style-type: none"> • Alarm sensor • S wave detector 	<ul style="list-style-type: none"> • RF Module Transmitter • nRF24L01 transceiver • Vibration sensor module • Buzzer
Advantages	<ul style="list-style-type: none"> • Easy access by phone • Free to use 	<ul style="list-style-type: none"> • High sensitivity • Low power consumption 	<ul style="list-style-type: none"> • Scalable • Wireless sensor nodes can easily be deployed
Cost	<ul style="list-style-type: none"> • High 	<ul style="list-style-type: none"> • High 	<ul style="list-style-type: none"> • Low

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter explained the process of the Earthquake System tools development. Rapid Application Development (RAD) model is used as the methodology of the Software Development Life Cycle (SDLC). The information of the methodology will be discussed in this chapter.

3.2 Justification of chosen Methodology

SDLC stands for Software Development Life Cycle. SDLC is a method used for the process of system development. SDLC help to guide developer to develop a good system and to ensure the quality of the system. Figure 3.1 shows the SDLC process.



Figure 3.1: Graphical Representation of SDLC Process

SDLC consists of five process phase which are planning, analysis, design, implementation and maintenance. Each stage of SDLC has an important task for system development. SDLC consists of various models that can be followed by the system developer based on the characteristic of the system that going to be developed.

In order to develop and complete this project, RAD model approach will be used as the methodology. Rapid Application Development (RAD) is a suitable software development process for concrete strength measurement tools. RAD was chosen because using this methodology, a quality system can be produced in a short time (Home, 2017). Since this project do not have much time to be develop, RAD is suitable for this project. Figure 3.2 shows the graphical representation of four parts of the RAD model which are requirements planning, user design and construction, as well as the cutover.

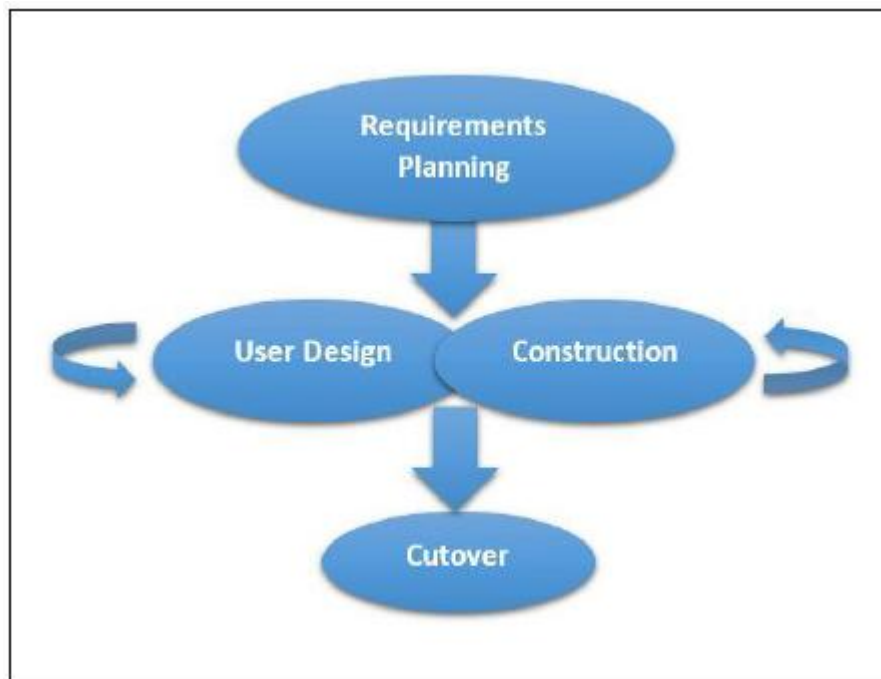


Figure 3.2: Four stages of the RAD model

Developing project needs are proper direction to make sure it can be done successfully. In using methodology, developer needs to explain each phase required to build this system. Each phase of methodology refers to activity and task must be followed by developer to make sure the smooth of project progress. The selection

RAD model can help developer to build a system. This methodology is the technique for gathering information to finish this research.

The advantage of using the RAD model approach is that it can reduced development time of a system. By using RAD method, a system can be modified or update if any changes need to be done. In case if after a system development is done by client request but then the client does not satisfy with the system and wanted to add or reduce any function, the developer can still fulfil the client request. However, the process of development can be very slow if the developer does not strictly follow the RAD model protocol. So, the developer can possibly have to face a risk of over-schedule and over-budget.

3.3 Methodology Phases throughout Project

Table 3.1 shows the description for each phase of Iterative RAD Model methodology and its deliverables.

Table 3.1: Project Methodology Description

Phase	Tasks	Deliverables
1.Requirement Planning	<ul style="list-style-type: none"> Gathering important information and analyse it regarding on the proposed project. Do the feasibility test to make sure that the requirement are testable. 	<ul style="list-style-type: none"> Project background Problem statements Objectives Scope of project Techniques to be used in the project List of appropriate software and hardware to be used
2.Design	<ul style="list-style-type: none"> Capture appropriate software and hardware to be used in this project. The flow of the project including the project flow chart and use-case diagram. 	<ul style="list-style-type: none"> Flow chart Use-case diagram
3.Construction	<ul style="list-style-type: none"> Implement the program with code with the selected software and hardware. 	<ul style="list-style-type: none"> Designing tasks up to this point that integrate the code and implement into the project.

4.Cutover	<ul style="list-style-type: none"> • Testing the project to identify if there are errors or issues that need to be fix 	<ul style="list-style-type: none"> • The project is completely finish and ready to be used by the user.
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3.3.1 Requirement Planning Phase

The first phase of this project is Requirements Planning where the process of identify project take place. During this phase, project title, problem statement, scope, method and tools that will be used are being discussed and analyzed in order to develop this project. Besides that, a few research related to the methodology and existed systems to be improved have been conducted to give an overview on what to do and how this project can give the user benefits.

This phase also can be a guideline while developing this project so that there will be no duplication of work happen. Various data and researches have been collected from articles, book and online journals to help in developing the proposed project including:

- Collecting information regarding the components when developing the project, along with the software and hardware to be used.
- Select and search the best development method for the proposed project.

3.3.2 Design Phase

Second phase is user design where the project begin to be design according to the requirements and methodology from the phase 1. In this phase the diagram such as context diagram, use case diagram are being created to show the flow of the designated system.

In this phase, the client requirement will be analysed carefully so that the requirement of system can be understand more before the system is developed. After all the

information is gathered, system architecture is determined, and this allow initial modelling and prototypes to be created. The previous requirement is then used to create and design Context Diagram, Use case diagram, and Hardware and Software. The system will be built based on the design. Below are the Context Diagram of the system.

3.3.2.1 Flowchart

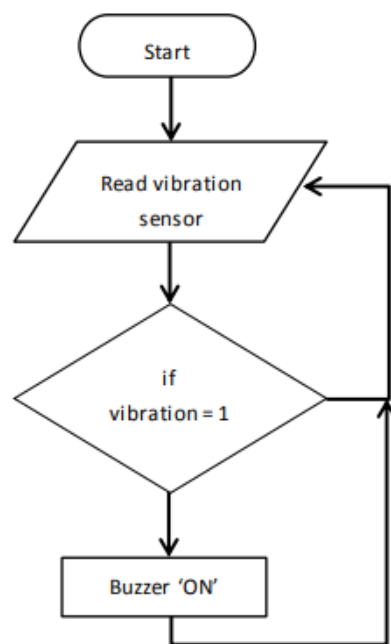


Figure 3.3: Flow Chart of Earthquake System

Figure 3.3 is the flowchart of Earthquake System. Firstly, the sensor which is Module A will read the vibration sensor and reflected the transmitted signal to the Arduino controller. If the sensor get the vibration it will notify the buzzer and if not it will loop to read the vibration sensor.

3.3.2.2 Context Diagram

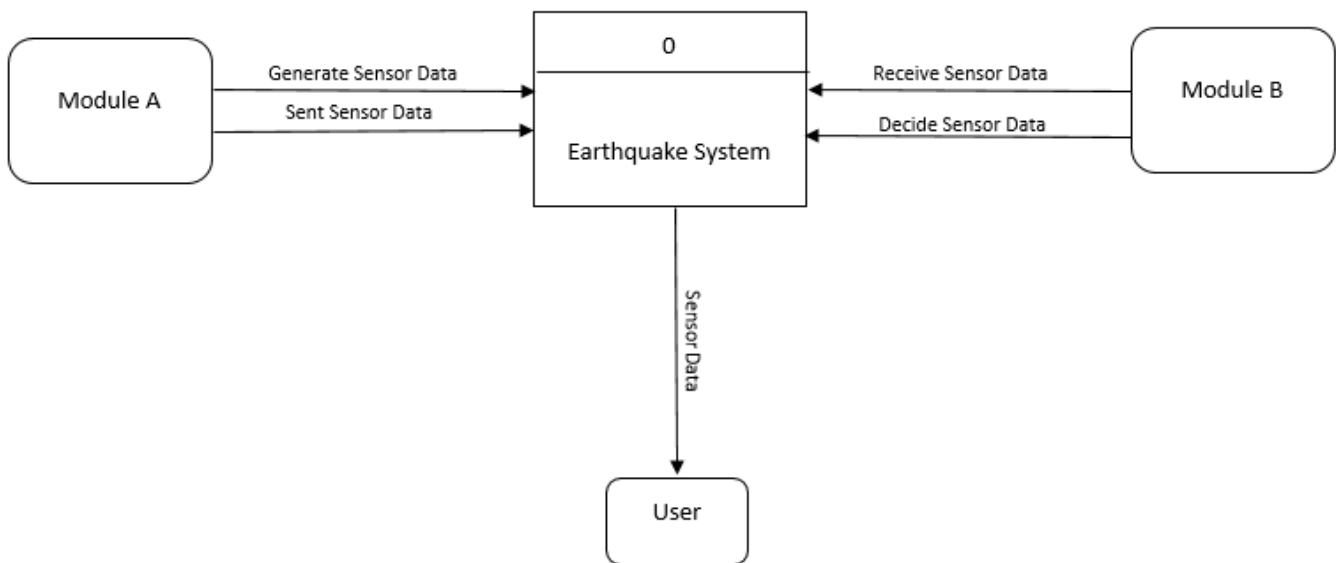


Figure 3.4: Context Diagram for Earthquake System

By referring to Figure 3.4 shows the context diagram for Earthquake System. All the interaction between the actors and the system is shown below. The context diagram defines the boundary between the parts of the system and its environment, showing the entities that interact with it.

3.3.2.3 Usecase Diagram

Figure 3.5 shows the use case diagram for Earthquake System. This diagram define the user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved. Module A involved in Generate Data Sensor. Module B involved in Receive Sensor Data, and Send Sensor Data send to user.

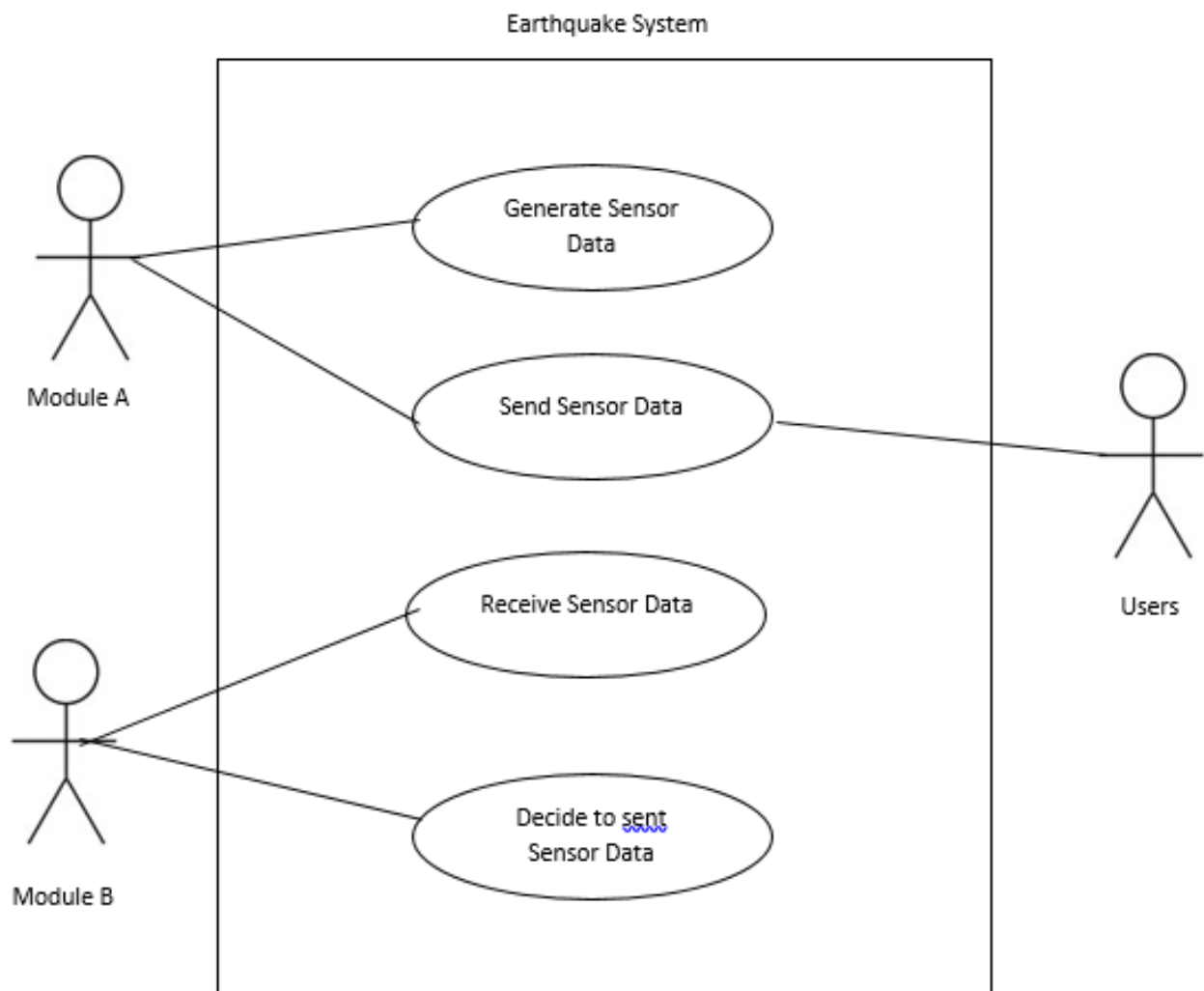


Figure 3.5: Use Case Diagram for Monitoring Building Structures

3.3.2.4 Hardware and Software requirement

This section explains briefly the hardware and software that need in this project. The most important requirements for this project are hardware and software. Hardware can be a memory, processor while the output devices can be a hard disk that needs to store a program or a monitor that display on screen. But, hardware cannot work on its own, without software attached to it. Hence, in order to develop this project, both hardware and software are required.

Hardware requirement is important to carry out tools and developing application effectively and successfully. This project is currently using the latest hardware to make sure it is efficient. **Table 3.2** shows the lists of hardware and **Table 3.3** shows the lists of software used in terms of price and its specification.

Table3.2 Hardware requirement

Hardware	Function/Purpose
Laptop	- To implement the coding for controller
Controller - Eg: Arduino Nano	- Act as a connector to input and output device. Plus it also act as a brain for this project.
Sensor - Eg: Vibration Sensor Module	- Act as input device and detect the temperature.
Transmitter - Eg: RF Module	- Act as a transmitter that transmit data from one controller to another controller
Buzzer	- Give a signal to user

Table3.3 Software Requirement

Software	Function/Purpose
Microsoft office	<ul style="list-style-type: none"> - Word: Preparing the documentation - Project: Preparing the Gantt Chart of the project - Power point: Preparing the presentation slide

Arduino IDE C/C+	- Works as developing coding for the controller and GSM
XCTU	- Works as configuring source and destination address of XBee module in every controller.
Windows 10	- Use operating system for developing application
Web Browser: Google	- Search engine

3.3.3 Construction Phase

Third phase is construction phase. The system design from second phase are being implemented and developed. The tasks that take place during this phase are programming and application development, coding, unit-integration and system testing. The output of the system may be different from what have been planning and it still can be modified to give the best output. This shows that the RAD methodology are flexible in terms of implementation.

3.3.4 Cutover

Last phase is cutover. The final tasks including data conversion, testing, changeover to the new system, and user training are take place during this phase. Compared with traditional methods, the entire process is compressed. As a result, the new system is built, delivered, and placed in operation much sooner.

Cutover is the last phase in RAD method. This phase will resemble the final tasks in the SDLC implementation phase. This phase includes data conversion, testing and user training. The user or client will accept the test. The user will test the system and see if the requirements is fulfilled or not. The testing test can help the developer to detect if there are any changes need to be done or error need to be fix.

In conclusion, the methodology that were used to develop Monitoring Building Structure is RAD where the process and tasks are being identify and split according to each phase.

3.4 Prototype

Arduino circuit is developed to complete this prototype. There will be 2 types of controller circuit in this project. The first type, is the one who act as input device that collect the sensitivity data from building. It is called as Module A. The second type, is there will be a circuit of controller that act receiver station that is called Module B.

At base of building there be will have a one circuit of controller board that consist one (1) vibration sensor as an input device to collect data. Vibration Sensor, Transmitter, and Buzzer will connect to Arduino controller board. Data collected from sensor Module A will trigger the buzzer and send to Module B. **Figure 3.6** shows the prototype of Sensor board.

Next, Module B consists of Receiver and Buzzer connected to Arduino controller board shown in **Figure 3.7**. Data sent from Module A is evaluated. If the sensor from Module A detect the vibration it will sent the data to Module B and trigger with buzzer.



Figure 3.6 : Prototype of Module A

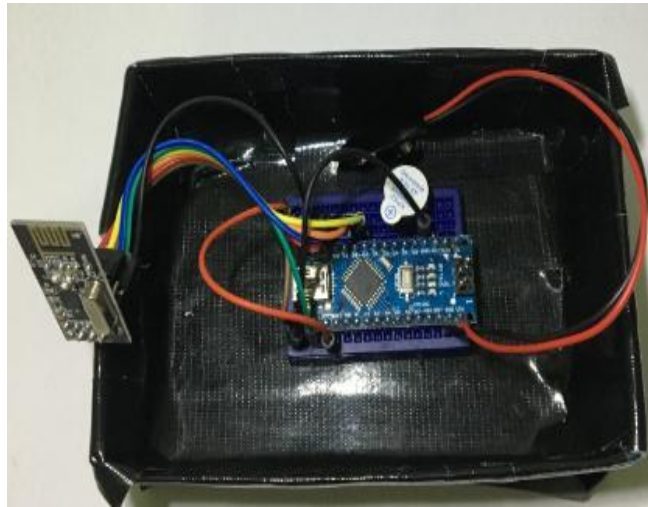


Figure 3.7: Prototype of Module B

3.5 Gantt chart

Figure 3.8 show the Gantt chart for develop earthquake system. It important to have a Gantt chart to avoid from over-schedule problem and help this project keep on track along development period. (Refer Appendix A for a Gantt chart)

3.6 Summary

As a conclusion, this chapter explain about the methodology used to develop Concrete Strength Measurement Tools. RAD has been chosen for the methodology and it is chosen because it is the most suitable method for the development of this project. The software and hardware also has been analysed. The chosen software and hardware is important because without it this project cannot be develop and to ensure the process of project development can run smoothly.

CHAPTER 4

IMPLEMENTATION, TESTING AND RESULT DISCUSSION

4.1 Introduction

In this chapter, it will explain about the process of implementation of Monitoring Building Structure by using Wireless Sensor Network for safety. This implementation tells about process of development of this system. Testing process is clarified by the system functionalities provided. The development of this system is divided into 3 parts which is, downloading Arduino, downloading XCTU and implementation of hardware. Every process that carried out during the system's implementation will be explained further.

4.2 Implementation on Data

Based on the system, there are three (3) steps of implementation that need to be done in order to develop the Structural Health Monitoring by using Wireless Sensor Network. The three (3) are:-

- i. Implementation on Arduino Nano
- ii. Implementation on Hardware
- iii. Implementation of System's Hardware

4.2.1 Implementation on Arduino Nano

Generally, Arduino Uno is the main part or role that has been taken in order to control the sensor system. Arduino Uno itself cannot make a decision of there is no coding being implemented in it. So, the first step is downloading the Arduino GUI from the developer website. The website is <https://www.arduino.cc/>. **Figure 4.1** shows the homepage of Arduino website.

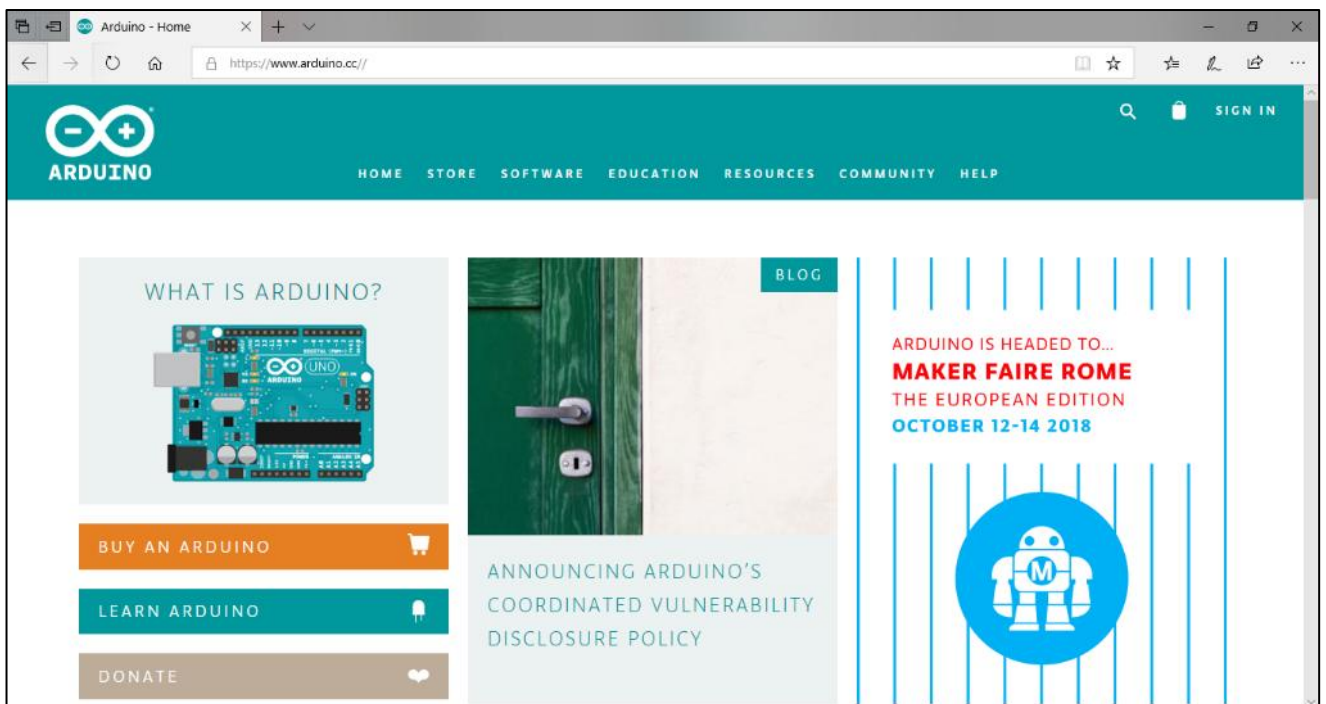


Figure 4.1: Homepage of Arduino

In this page, click on software tab to download the open-source Arduino Software. It is used to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. User need to click on the type of Operating System that they used to download the Arduino Software. Figure 4.2 shows the page that consist links to download the Arduino IDE.

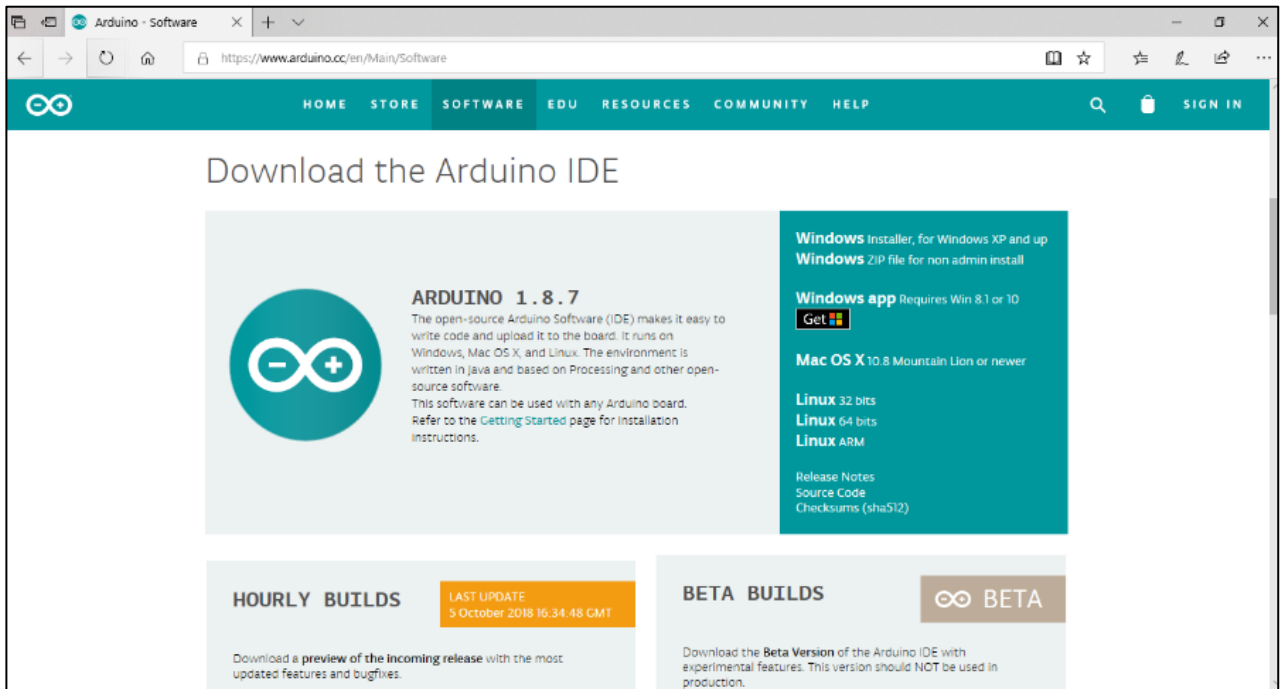


Figure 4.2: Arduino Download Page

After click on the Operating System link, the download page will appear. Then, user need to click on the “Just Download” button to begin the download. Figure 4.3 shows the page to begin download of the Arduino Software.

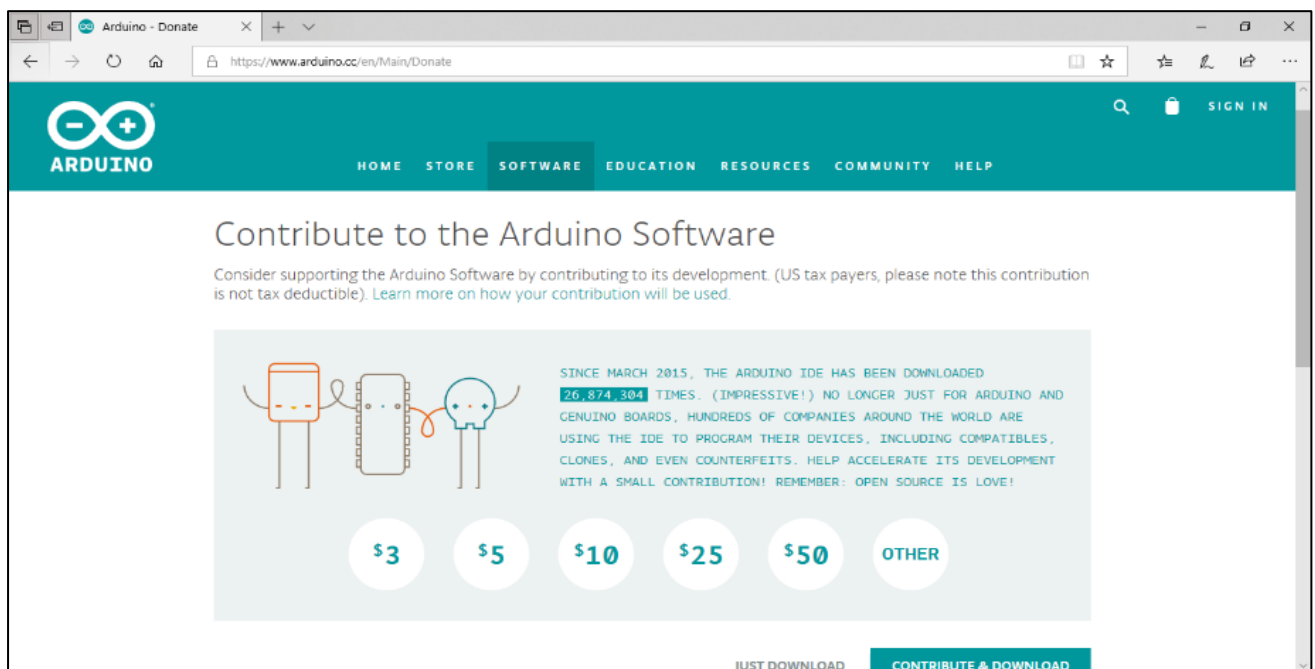


Figure 4.3: Download Arduino Software

Once the download is finished, open the Arduino IDE to start a coding. But, before user begin to code, they need to click on File tab and choose New to create a new file. Once it is saved, shown in Figure 4.4, the interface is already set some of codes which is Void Setup () and Void Loop ().

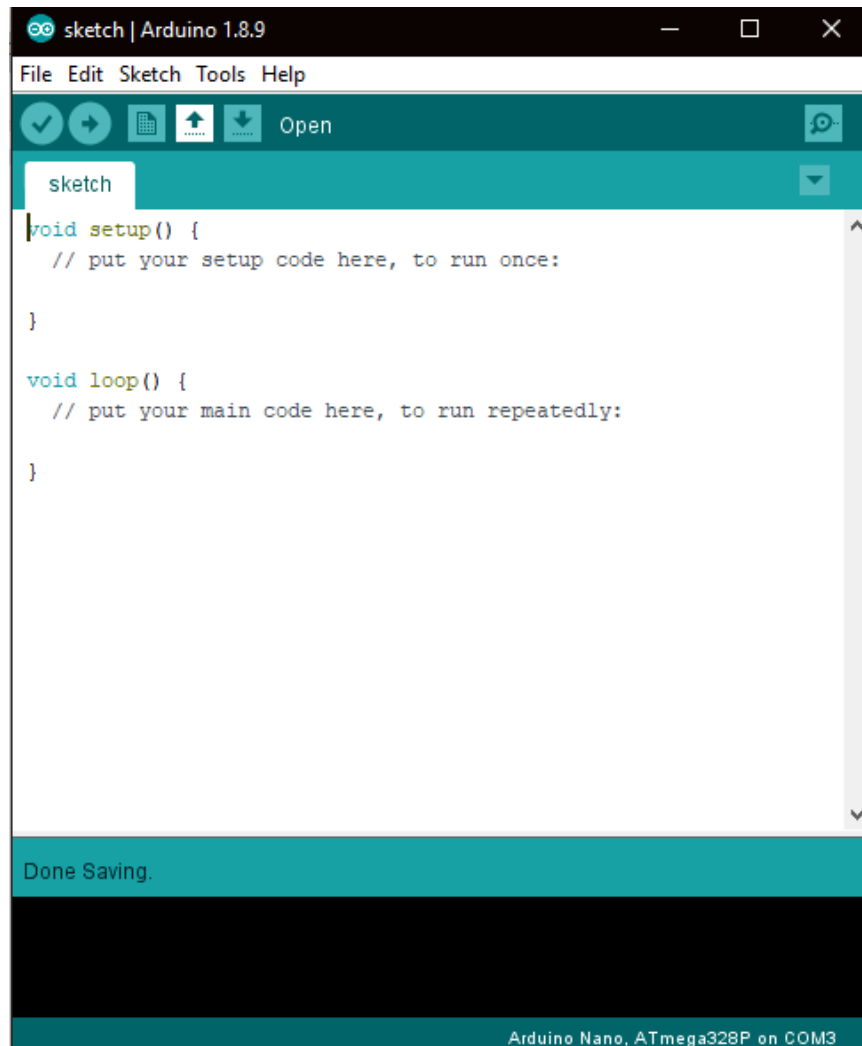


Figure 4.4: Arduino sketch interface

Then, user need to choose the type of Arduino Board that is used. They have to click on Tools tab and choose Board type in the list arrow. User can select the type of board you use. In this project, we choose Arduino Nano as shown in **Figure 4.5**.

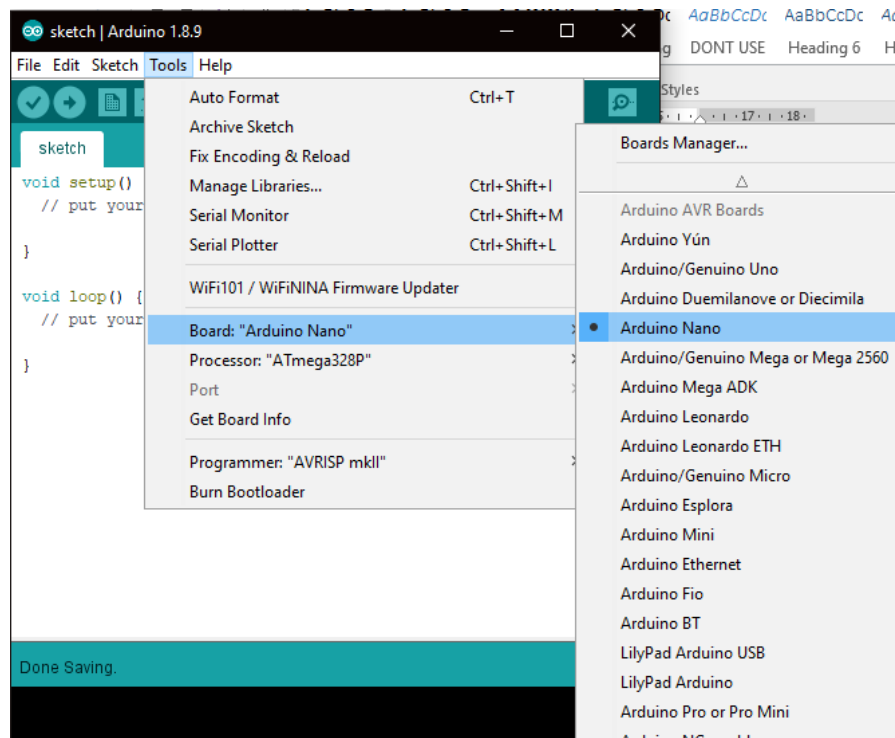


Figure 4.5: Type of Arduino Board

Lastly, after finish the setting, user can start to write the code. Once the coding is completed, user have to click on “Tick” symbol to verify the coding. Its function is to check whether it has error or not. If there is no error, user may proceed by clicking on “Right Error” symbol shown in **Figure 4.6**. The function of this symbol is to upload the code to Arduino board. When the code is implement, Arduino now is working as what it is coded by user. (Refer Appendix B for a coding sketch).

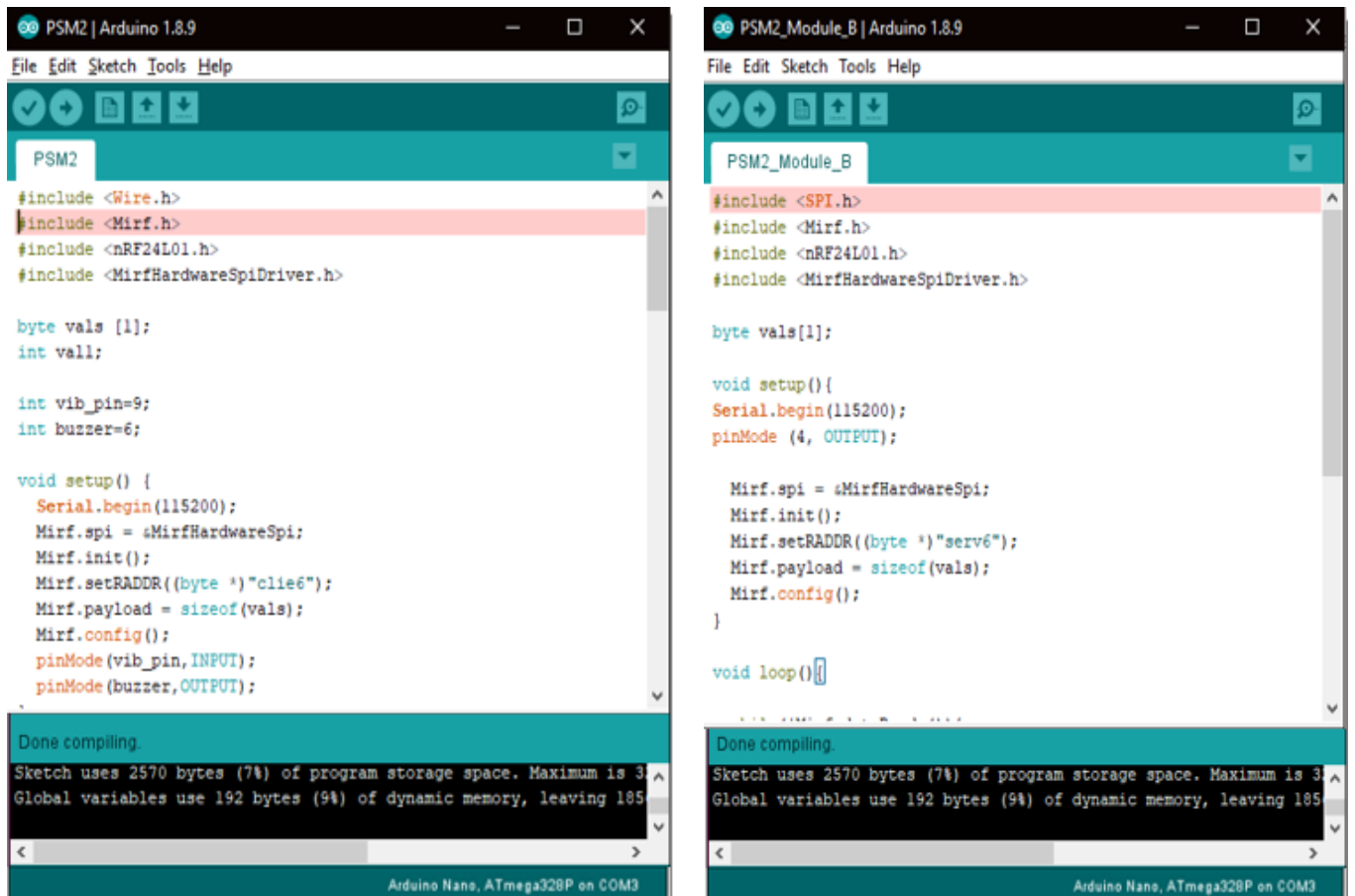


Figure 4.6: Sketch coding interface

4.2.2 Implementation on Hardware

In this section, will discuss about the implementation the component and device. It will show by using figure.

4.2.2.1 Connection of Arduino Nano and RF Module

In this project, wireless transceiver module is connected to the breadboard. It is connected the controller board (Arduino Uno) by using wire connector. **Figure 4.7** shows the Arduino circuit connection with nRF24L01 Wireless Transceiver Module. This board called module A (Transmitter).

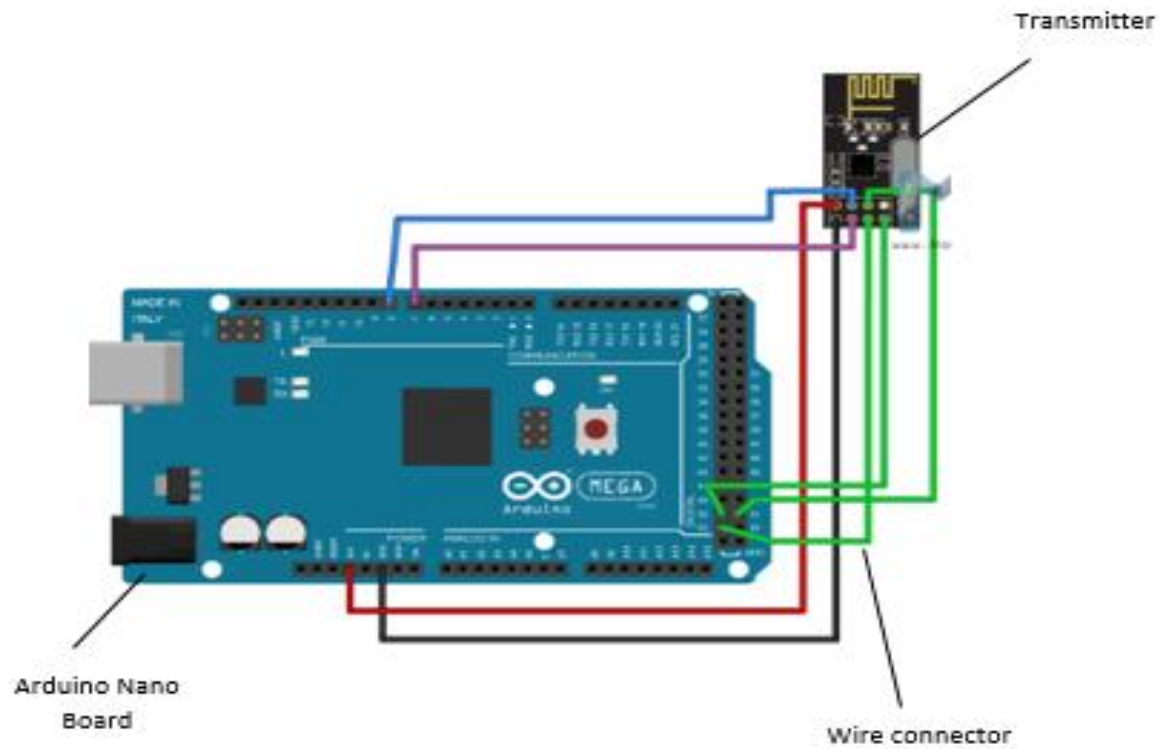


Figure 4.7: Module A (Transmitter)

For the Module B (Receiver), the receiver has connected to the Arduino Nano board, and this module will be a receiver to the Module A based on Figure 4.8. The data that has been collected from Module A will sent to the receiver Module B. This sketch show the connection between the component that use, which is RF Module Receiver, Arduino Nano board and wire connector.

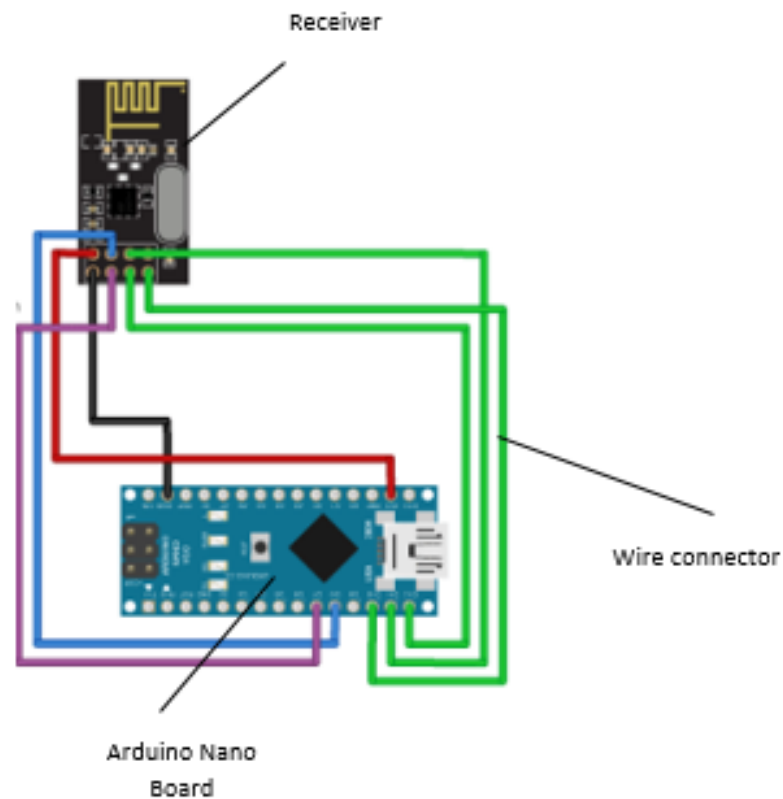


Figure 4.8 Module B (Receiver)

4.2.2.2 Connection of Arduino Nano and Vibration Sensor Module

Vibration Sensor Module is connected to Arduino Uno controller board by using wire connector. Vibration sensor is used as vibration switch because of its high sensitivity. It also sensitive to environment vibration, and generally used to detect the vibration strength. Figure 4.9 shows the Arduino circuit connection with Vibration Sensor Module.

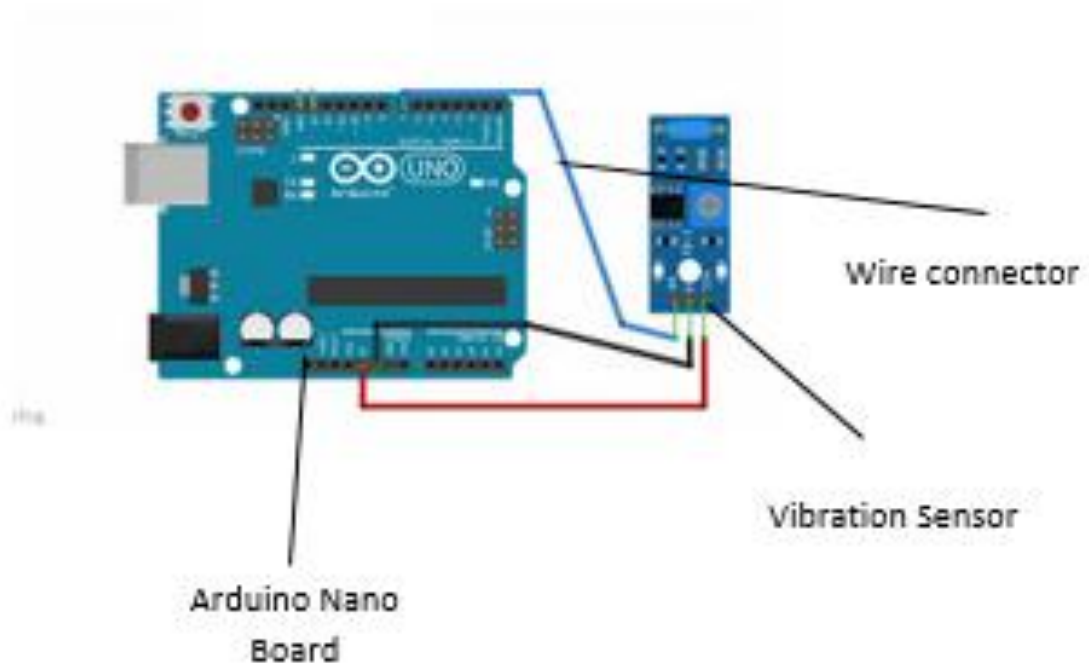


Figure 4.9: Arduino and Vibration Sensor Module

In this project, we will connect Arduino with Vibration sensor and Buzzer. When no vibration is detected, Vibration sensor output is 0, otherwise its output is 1. If Arduino get 1 from vibration sensor it will turn the buzzer on, and if 0 there buzzer off. Figure 4.10 shows the Vibration Sensor Module.

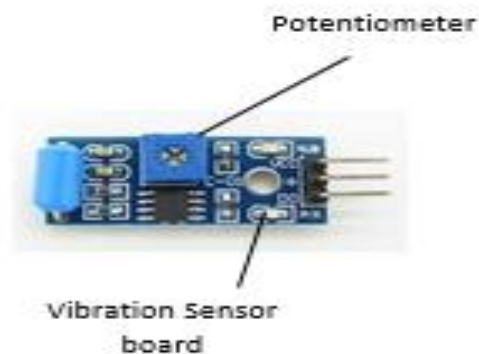


Figure 4.10: Vibration Sensor Module

Based on Figure 4.10, small digital output can be directly connected to the microcontroller, for the microcontroller to detect low level, thereby to detect the ambient vibration. Small digital output can directly drive the relay module, which can

be composed of a vibration switch. The sensitivity of this sensor will be adjust with the potentiometer at the board, and we can decide that need to detect low level or high level.

4.2.2.3 Connection of Arduino Nano and Buzzer

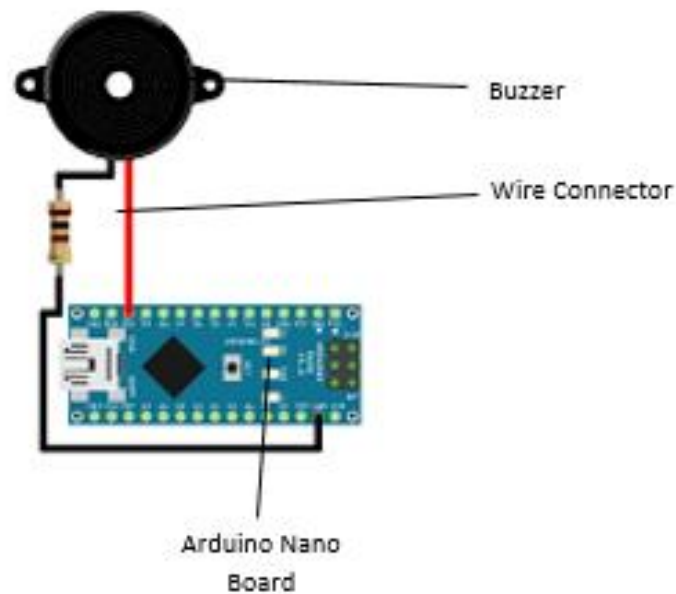


Figure 4.11 Arduino and Buzzer

In this section, buzzer is the tools that give warn to user. Once the data was receive, buzzer will notify the user. This tools will apply at Module A and Module B. The function still same, if Module A trigger the buzzer, Module B also trigger the buzzer. For this prototype, the system just apply buzzer in the board and if this system was upgrade it will be alarm and so on.

4.2.3 Implementation on System's Hardware

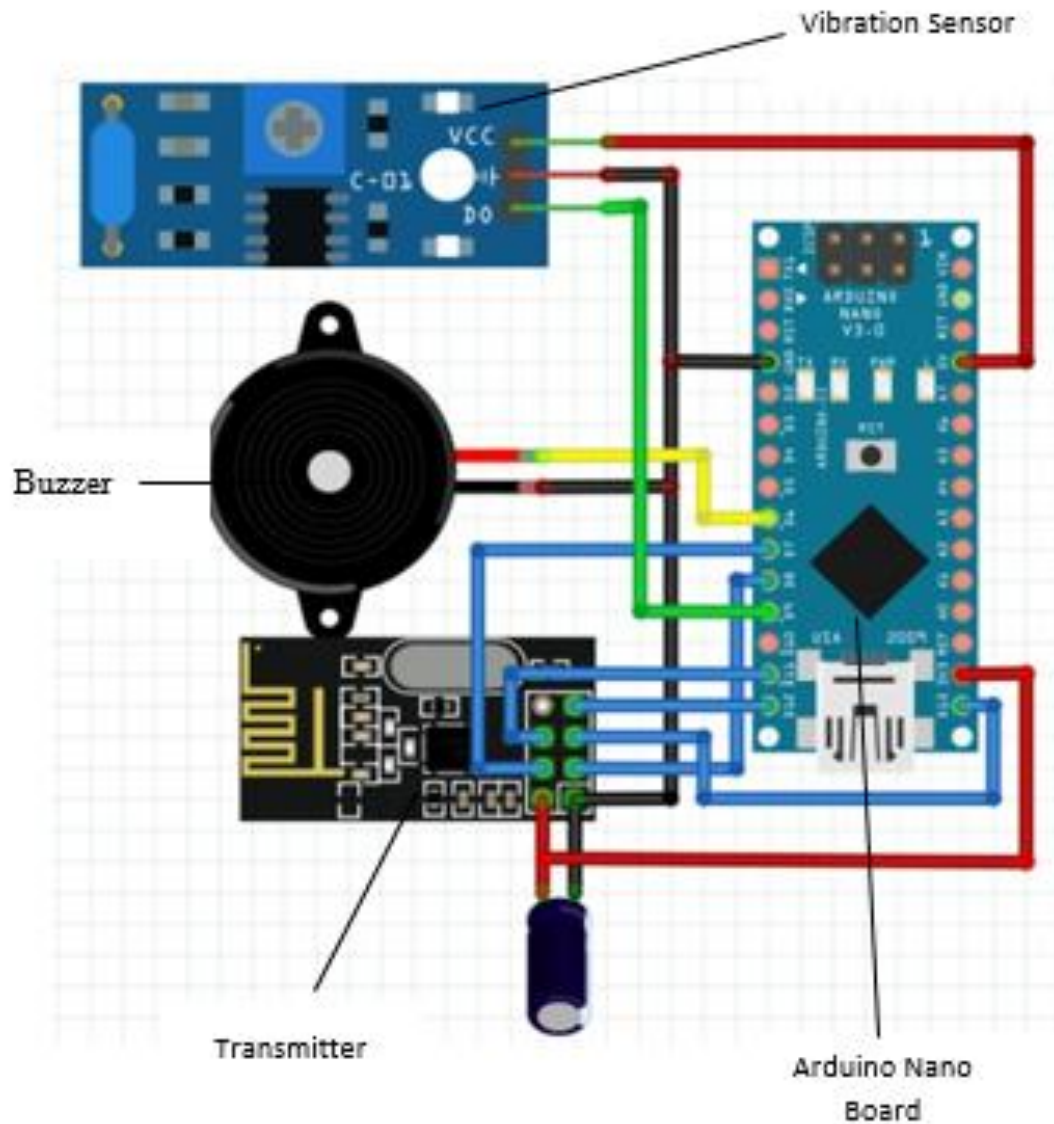


Figure 4.12: Module A Sketch (Transmitter)

This figure shows the sketch of Module A during this project. The implementation of all the component in one board. Arduino Nano board function to assemble the hardware in one board. For Module B, it will shows in Figure 4.13 as shown below.

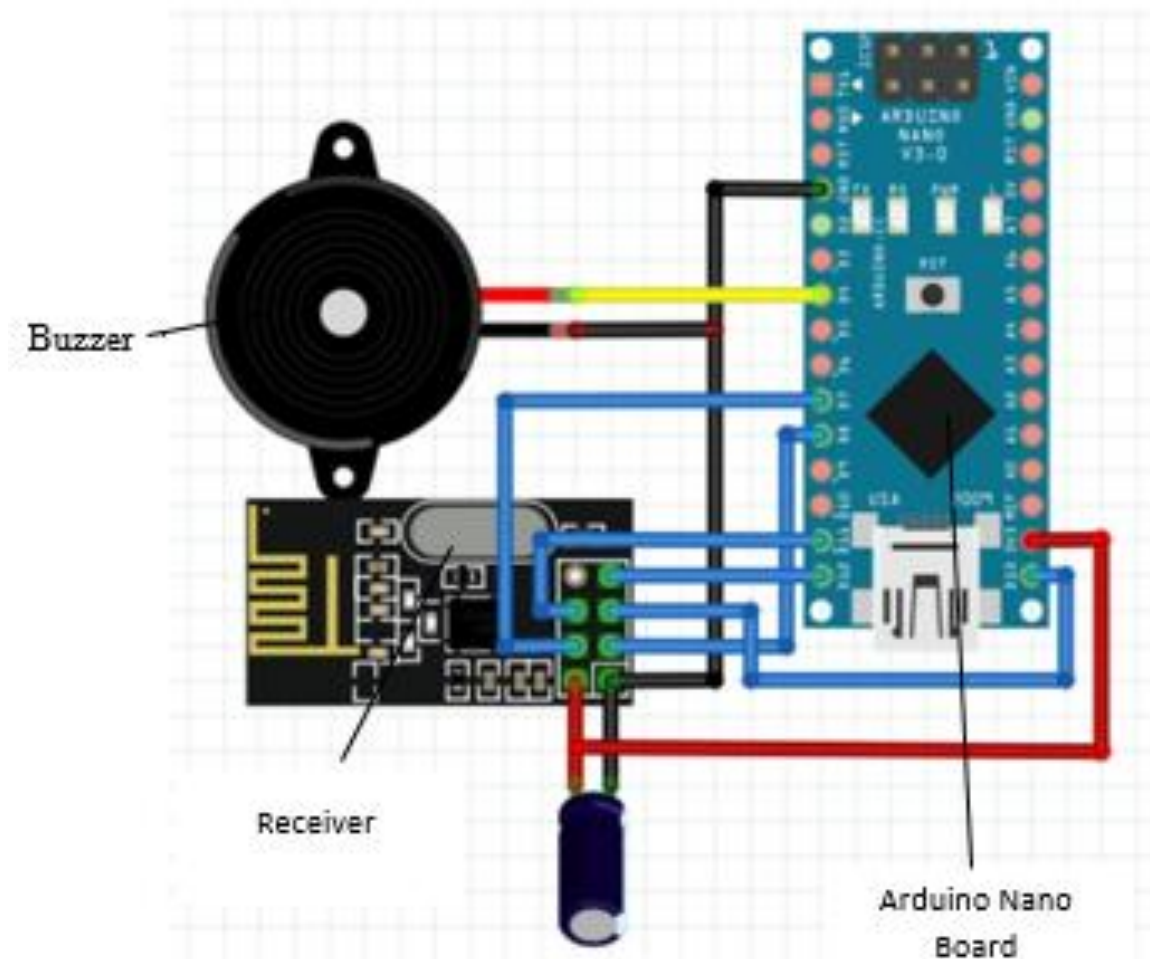


Figure 4.13: Module B Sketch (Receiver)

The figure also shows the implementation of all component in Module B. As we can see, the different between Module A and Module B just the Vibration Sensor Module which is, in this project we just apply at Module A. It cause, we relate to the number three objective of this object which is to test the data transferred wireless. The data from Module A will sent to Module B and trigger both buzzer.

4.3 TESTING AND RESULT DISCUSSION

This phase will show about the result of testing this system.

4.3.1 Testing Phase

On this phase, the developer has tested the system individually and the result is shown on Table 4.1. It also shown the system had been tested on their functionality.

Table 4.1: Result testing on testing phase

Type of Hardware	Functionality	Success / Fail
Arduino Nano	- To receive input from RF Module	Success
RF Module Transmitter	- To transmit data from vibration sensor to receiver	Success
RF Module Receiver	- To receive data from RF Module Transmitter	Success
Vibration Sensor	- To detect vibration	Success
Buzzer	- To warn people about the earthquake issue.	Success

4.3.2 Result Discussion

Based on testing done for this system, the result conclude that is earthquake system with wireless sensor network is a new method for earthquake detector that can work wirelessly with minimal packet loss. The figure below shows the success of transfer data from Module A to Module B.

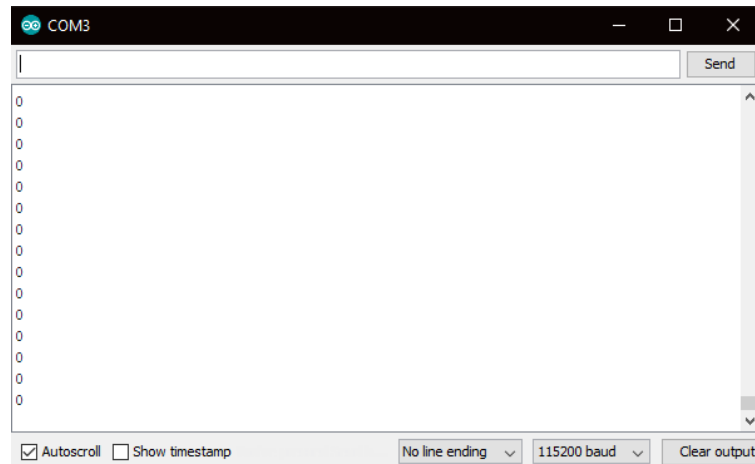


Figure 4.14 Serial monitor

Based on figure 4.14 the serial monitor shows 0 that means there is no vibration detected on the device. In this project, it just uses the digital output for the vibration and the output will show just 1 or 0 only.

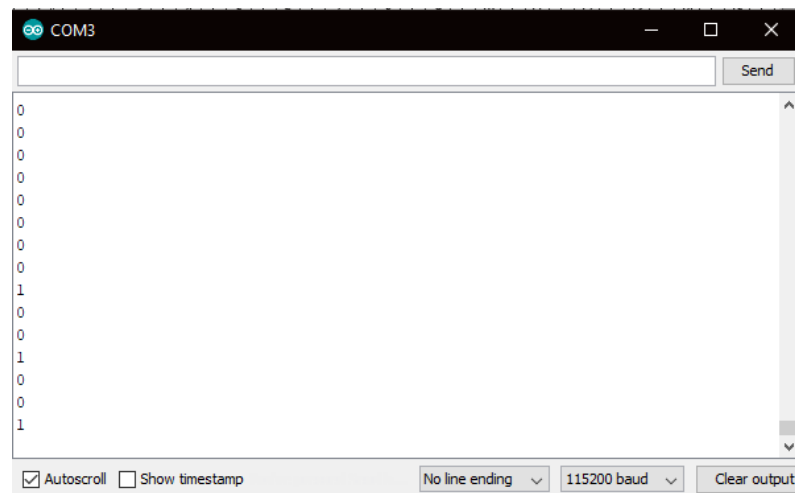


Figure 4.15 Serial monitor

Figure 4.15 shows the serial monitor detecting the vibration and the output shows 1.

4.4 CHAPTER SUMMARY

As for the summary of this chapter, the process of detecting vibration from the base ground is successful. The safety team of the building managed to warn people who lived inside the building by triggering the buzzer after detection.

CHAPTER 5

CONCLUSION

5.1 Introduction

As a conclusion, in this chapter will be discuss about conclusion of the project. The objective problem statement and project scopes are recognized to provide a solution.

The main objective Earthquake System that achieves as follows object. First, to design an earthquake system for safety using wireless sensor network. Secondly, to study about current system of earthquake detector. Lastly, to test data transferred wirelessly without fail. By implementing this system, hopefully it can help to reduce many live that occur to earthquake issue in keeping the safety of the people.

The method used for developing this system is Rapid Application Development. It help a lot towards this development of this system. The steps provides in this method helps the implementation of this system to be completed faster along all the stages exactly on the time given. There are four stages that occurs in development of this system which are Planning Requirement, User Design, Construction and Cut Over.

5.2 Research Constraint

For this system, there a few constraints that limit the development process in some stages. The first is the stability of Arduino Nano. During the development of this project, Arduino Nano seems good in compiling the code and run the program. However, it will have problem if the device is used for long-term. Because the poor connection between breadboard and Arduino Nano, the project need to be redevelop in order to make it run again.

Next, RF Module transmitter and receiver provided for Arduino Nano is not stable. For instance, the signal of is hard to stable. This project using multiple software serial port, so only one can receive the data at a time.

Last but not least, in terms of time management, it is hard to finish this project on time due to time limitation. As a student, there are many classes have to attend and assignments need to be done on time. So this project is finished with struggling on time management itself.

5.3 Research Constraint

In this future, we expect to extend this system to detect and describe other types of unexpected events, such as natural disasters. By implementing this system in various type of building, it could save a lot of people lives. In other words, I hope that this system will implement the other sensor that related to earthquake system as it is not used in this project in order to make it more reliable and stable.

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APPENDIX A

GANTT CHART

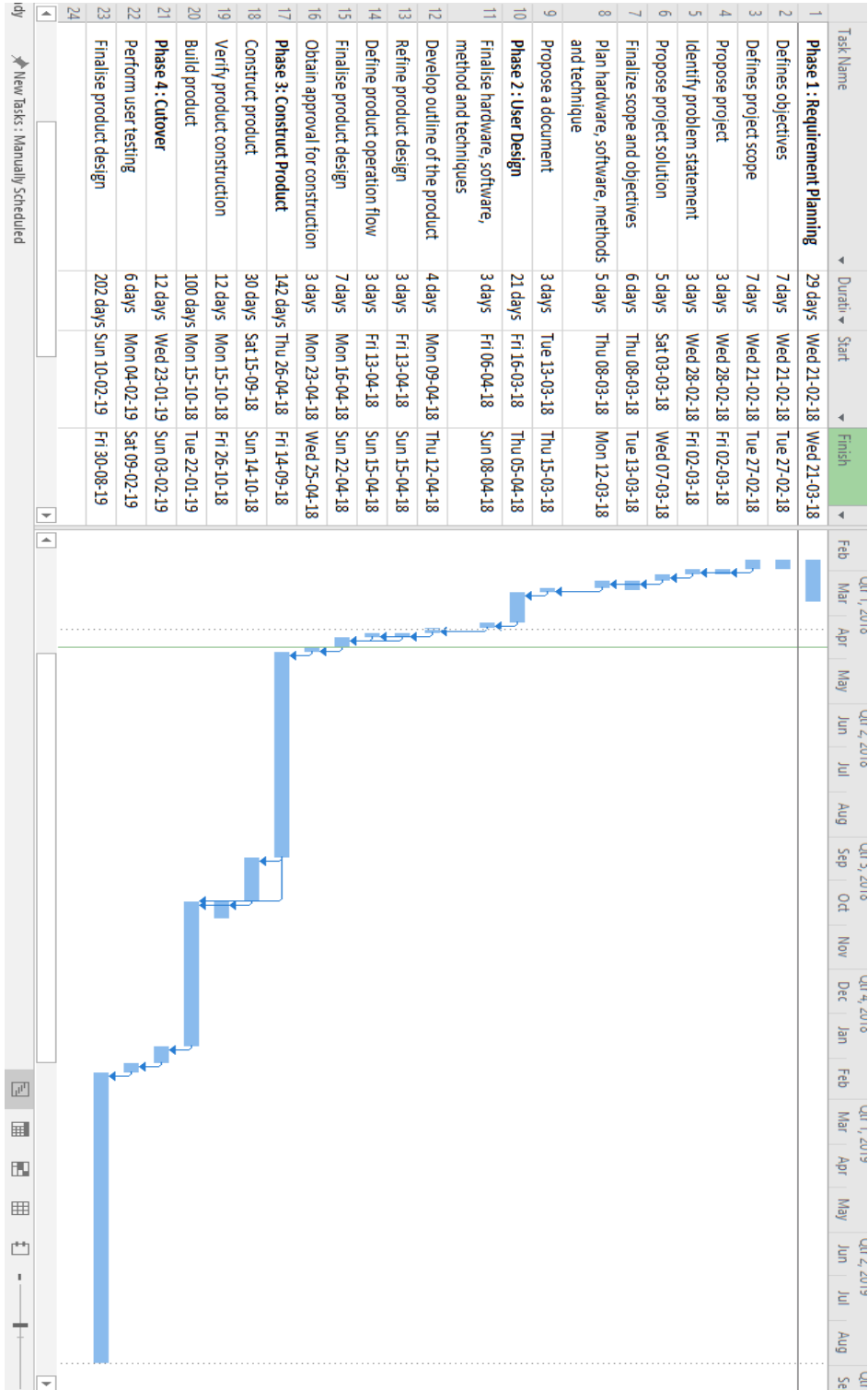


Figure 5.1: Gantt Chart

APPENDIX B

SKETCH CODING

Module A

```
#include <Wire.h>
#include <Mirf.h>
#include <nRF24L01.h>
#include <MirfHardwareSpiDriver.h>
```

```
byte vals [1];
int val1;
```

```
int vib_pin=9;
int buzzer=6;
```

```
void setup() {
  Serial.begin(115200);
  Mirf.spi = &MirfHardwareSpi;
  Mirf.init();
  Mirf.setRADDR((byte *)"clie6");
  Mirf.payload = sizeof(vals);
  Mirf.config();
  pinMode(vib_pin,INPUT);
  pinMode(buzzer,OUTPUT);
}
```

```
void loop() {
  int vib;
  vib = digitalRead(vib_pin);
  Serial.println(vib);
```

```

if(vib == HIGH)
{
    vals[0] = 1;
    digitalWrite(buzzer,HIGH);
    delay(1000);
    digitalWrite(buzzer,LOW);
    delay(1000);
}
else
{
    vals[0] = 0;
    digitalWrite(buzzer,LOW);
}

```

```

    Mirf.setTADDR((byte *)"serv6");
    Mirf.send((byte *) &vals);
    while (Mirf.isSending()) {
    }

}

```

Module B

```

#include <SPI.h>
#include <Mirf.h>
#include <nRF24L01.h>
#include <MirfHardwareSpiDriver.h>

byte vals[1];

```

```

void setup(){
  Serial.begin(115200);
  pinMode (4, OUTPUT);

  Mirf.spi = &MirfHardwareSpi;
  Mirf.init();
  Mirf.setRADDR((byte *)"serv6");
  Mirf.payload = sizeof(vals);
  Mirf.config();
}

void loop(){

  while(!Mirf.dataReady()){
  }

  Mirf.getData((byte *) &vals);

  Serial.println(vals[0]);

  if (vals[0] == 1)
  {
    digitalWrite(4 ,HIGH);
    delay(1000);
  }
  else
  {
    digitalWrite(4 ,LOW);
  }
}

```