

DESIGN AND DEVELOPMENT OF SOFTWARE DEFINED RADIO

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Dedicate to my lovely father and mother.

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ABSTRACT

Final year project is a project or compulsory activity for UTeM's student before being awarded the degree. Final year project can give benefit for students that will be exposing to actual working environment. The primary purpose of this report is more to brief to the reader with a detailed and comprehensive study of theory, design, modulation and demodulation technique, result and problem encountered in the designing Software Defined Radio. The approaches used to achieve this project are through literature, coding and modulation scheme, and computer software simulation. Software defined radio having initially been used in the field of military. However, with the increasing capabilities of DSP on one hand, and the requirements for fast time to market on the other, it is emerging as an important commercial technology. A software defined radio is a radio transmitter and receiver that uses digital signal processing (DSP) for coding or decoding and modulation or demodulation. By using the IEEE 802.11a standard as a guideline, Quadrature Amplitude Modulation (QAM) with Orthogonal Frequency Division Multiplexing (OFDM) are uses to create coding and modulation scheme. This project will be constructed and programmed entirely in Matlab and Simulink.

ABSTRAK

Projek Sarjana Muda merupakan projek atau aktiviti wajib kepada pelajar UTeM sebelum dianugerahkan ijazah. Projek Sarjana Muda memberikan faedah kepada pelajar yang akan menempuh alam pekerjaan yang sebenar. Tujuan utama laporan ini adalah untuk memberikan maklumat secara terperinci kepada pembaca mengenai teori, rekabentuk, proses modulasi dan demodulasi, keputusan dan permasalahan yang mungkin wujud dalam proses mereka bentuk. Pendekatan digunakan bagi mencapai projek ini adalah melalui kajian latar belakang, proses pengekodan dan modulasi dan simulasi perisian komputer. “Software defined radio” pada mulanya telah digunakan dalam bidang ketenteraan. Bagaimanapun, dengan perkembangan dalam bidang pemrosesan isyarat digit, dan permintaan yang tinggi di pasaran, ia telah muncul sebagai satu teknologi komersil yang penting. “Software defined radio” adalah pemancar dan penerima radio yang menggunakan isyarat digit untuk membuat proses modulasi dan demodulasi. Berdasarkan piawaian IEEE 802.11a sebagai panduan, teknik ‘Quadrature Amplitude Modulation (QAM)’ bersama ‘Orthogonal Frequency Division Multiplexing (OFDM)’ digunakan untuk mereka kod dan modulasi skim. Projek ini direka sepenuhnya menggunakan program ‘Matlab’ dan ‘Simulink’.

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LIST OF ABBREVIATIONS

| | | |
|-------|---|---|
| ATC | - | Air Traffic Control |
| CDMA | - | Code Division Multiple Access |
| CORBA | - | Common Object Requesting Broker Architecture |
| DMT | - | Discrete multi-tone modulation |
| DSP | - | Digital Signal Processing |
| FCC | - | Federal Communications Commission |
| FDM | - | Frequency Division Modulation |
| FGPA | - | Field Programmable Gate Arrays |
| FM | - | Frequency Modulation |
| GIG | - | Global Information Grid |
| HF | - | High Frequency |
| HPSDR | - | High Performance Software Defined Radio |
| ICI | - | Inter Carrier Interference |
| IEEE | - | Institute of Electrical and Electronics Engineers |
| ISI | - | Intersymbol Interference |
| JPEO | - | Joint Program Executive Office |
| JTRS | - | Joint Tactical Radio System |
| NCO | - | Network Centric Operations |
| NO | - | Number |
| OFDM | - | Orthogonal Frequency Division Multiplexing |
| PC | - | Personal Computer |
| PCI | - | Peripheral Component Interconnect |
| PLL | - | Phase Locked Loop |
| POSIX | - | Portable Operating System Interface for Unix |
| QAM | - | Quadrature amplitude modulation (QAM) |

| | | |
|----------|---|---|
| RF | - | Radio Frequency |
| SCA | - | Software Communications Architecture |
| SDR | - | Software Defined Radio |
| SINCGARS | - | Single Channel Ground and Airborne Radio System |
| SSB | - | Single Side Band |
| TDMA | - | Time division multiple access |
| UAV | - | Unmanned Aerial Vehicle |
| UCAV | - | Uncorrected Visual Acuity |
| UHF | - | Ultra High Frequency |
| USRP | - | Universal Software Radio Peripheral |
| VHF | - | Very High Frequency |
| WiMAX | - | Worldwide Interoperability for Microwave Access |
| WNW | - | Wideband Networking Waveform |

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CHAPTER I

INTRODUCTION

This chapter will provide brief explanation about the project done. Besides, it also covers the objectives, problem statement, scope of work, methodology, and report structure of the project.

1.1 INTRODUCTION

Software defined radio having initially been used in the field of military. However, with the increasing capabilities of DSP on one hand, and the requirements for fast time to market on the other, it is emerging as an important commercial technology. Like many technologies these days, it has trickled down to where the amateur can have high-quality voice communication without exceeding SSB bandwidth or needing expensive broadcast studio equipment.

A software defined radio is a radio transmitter and receiver that uses digital signal processing (DSP) for coding and decoding, and modulation and demodulation. By using the IEEE 802.11a standard as a guideline, Quadrature Amplitude Modulation (QAM) with Orthogonal Frequency Division Multiplexing (OFDM) are uses to create

coding and modulation scheme. This project will be constructed and programmed entirely in Matlab and Simulink.

1.2 PROJECT OBJECTIVE

Software Defined Radio is one of the communication media that widely used and become one of the important technologies in the new ere. However, there are some sort of problems occur in our communication. The problems might be encounter using the suitable technique.

The objective for the project is:-

- To successfully implement the coding technique and modulation scheme (Quadrature Amplitude Modulation (QAM) with Orthogonal Frequency Division Multiplexing (OFDM))
- To design and develop the Software Define Radio Communication with less noise and interference.

1.3 PROBLEM STATEMENT

Communications have become one of the very important things in our life. With the increasing power of technologies that spread very fast, there is a lot of equipment, gadget and computer with high capability had been designed in order to fulfilled the users requirement. One of the technologies that highly develop is Software Defined Radio. Since it is one way of communication, it has been introduce with the channel or transmission media which can cause a noise. This design and development of Software

Defined Radio will design in order to solve the problems like:-

1. The lower quality of the voice and intonation in terms of noise and interference.
2. Limited functions being changeable by software.

1.4 SCOPE OF WORK

This project is to design and develop a Software Defined Radio that using implements the coding technique and modulation scheme (Quadrature Amplitude Modulation (QAM) with Orthogonal Frequency Division Multiplexing (OFDM)).

Scopes of this project are:

This project consist of three main part which is at

- At the beginning of the project, it will focus on the literature review of the project.
- Then, we proceed to the Simulink design and architecture
- At last, the implementation of the design.

1.5 PROJECT METHODOLOGY

At first, the project will start with the literature review from related journals, articles, books, information from internets and others. From the information, all the parameters and requirement in the designing of the Software Define Radio are studied and analyzed. Then, an ideal of transmitter/receiver pair will be design. Using the 802.11a standard as a guideline, a software radio will be developed that will modulate and demodulate binary data.

Then, proceed to the Simulink design. Simulink block will be design and simulate based on the information obtained. The design must be approximately equal with the theoretical. Simulate the design and troubleshooting the problems occur. Matlab Software needs to be learnt and familiar. Lastly, implement the design and troubleshoot the problems occur until it successfully function. After all, the report will be completed.

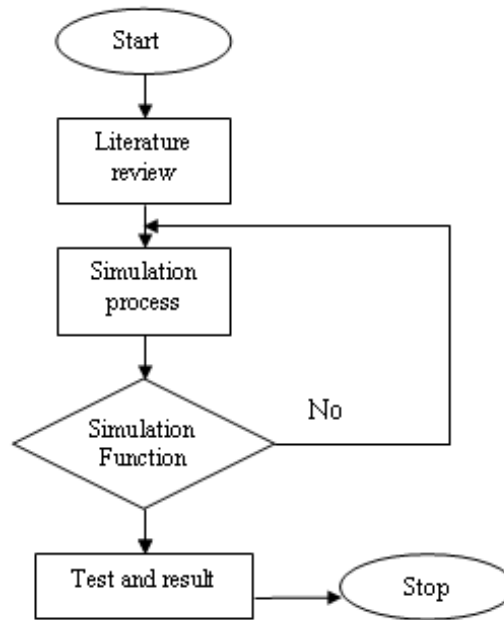


Figure 1.1 Project Methodology Flow chart

1.6 THESIS OUTLINE

Chapter I – Presenting the introduction of the project. It consist of objective, problem statement, scope of work, project methodology and thesis outline.

Chapter II – In this chapter, it will discuss the introduction of Software Defined Radio, the history, type and evolution in communication. Will also discuss about the literature review of the project, the application of the Software Defined Radio and the also the features of Matlab.

Chapter III – Discusses on the method that used in this project. It covers the reason of choosing certain technique and scheme. Diagram for each part in Software Define Radio also will be attached.

Chapter IV – Explains the results of this project and the operation of the Simulink block. These chapters also analyze the result obtained.

Chapter V - Conclusion; defines the conclusion of the system and the thesis development. This chapter presents the advantages and the disadvantages of the system, the objectives accomplishment, and future enhancement of the system.