

CHAPTER III

RESEARCH METHODOLOGY

3.1 INTRODUCTION

A key component to designing a secure Wireless Sensor Network is through knowledge and understanding of the influence of a specific network for which the key network management is intended. The main contribution is to find a solution to send an encrypted key using ECC to a remote WSN network using commercial FM stations without worrying about coverage issues or key security.

The V-Model will be used for WSN system development. Figure 3.1 shows the development model demonstrates the relationship between each stage of the research life cycle and its associated phase of testing. The horizontal and vertical axes represent time or project completeness (left-to-right) and level of abstraction (coarsest-grain abstraction uppermost), respectively.

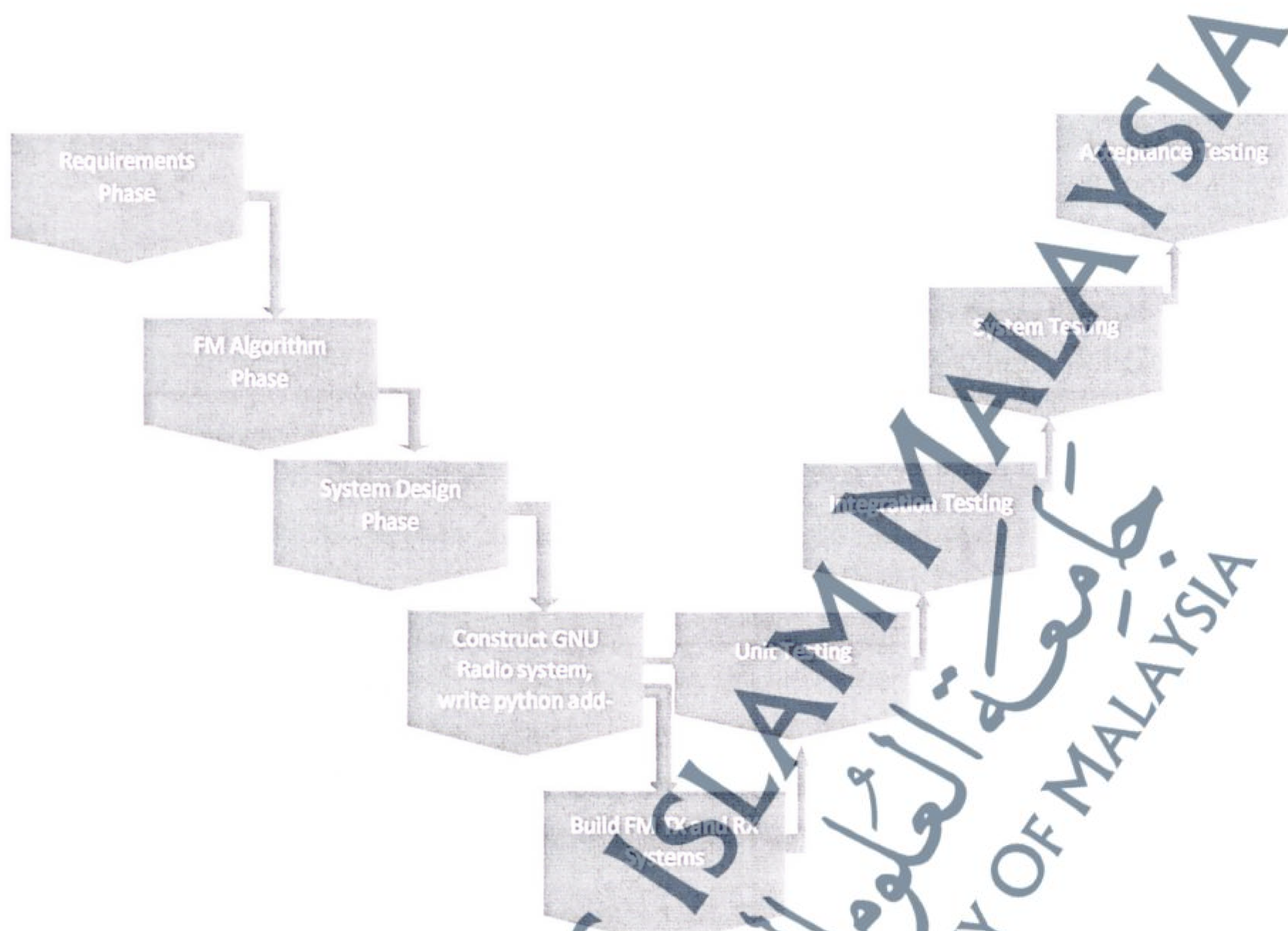


Figure 3.1: Development model for the FM solution.

3.1.1 REQUIREMENTS PHASE: The first phase of the development process, is to gather information about current WSN reachability and security and the lack of available solutions to solve these issues i.e. studying various and latest research that covers all related aspects to have a better understanding of what kind of solution our system will provide; and gather them in the Literature Review chapter. Including and summarizing the main aspects will make the whole development process clearer and easier to understand and will provide a better understanding of the current issues and how to solve them using FM solution.

3.1.2 FM ALGORITHM PHASE: FM system is analyzed and understood to be used in remote WSN systems which depends on the study of the current WSN requirements and issues to build the overall algorithm. And to study the current low cost open source solutions using Software Defined Radio (SDR) equipments e.g. (RTL-SDR Dongles) and GNURadio to build the system. The main part of the study is to understand the way that GNURadio works and how to build TX and RX FM systems using it.

3.1.3 WSN SYSTEM DESIGN: this is a two-part phase: hardware and software design. Hardware will be designed by choosing the compatible open source SDR tools that are compatible with GNURadio companion to build the WSN FM system. While the software design will concentrate on GNU Radio requirements and development needed to build the system. The design doesn't include the software and hardware only, it includes choosing and customizing the hosting OS that is needed to run the GNURadio companion to build the systems.

3.1.4 CONSTRUCT GNURADIO SYSTEM: GNURadio has built-in blocks that will be used in the development TX and RX systems. As not all the GNURadio blocks will do the project, python will be used to write a code that is needed to build the TX and RX systems. Each code will be evaluated individually to make sure that it does what it should.

- 3.1.5 BUILD GNURADIO AND SDR SYSTEM:** all the blocks and python code will be gathered to build the whole system. SDR hardware will be used for broadcasting, receiving and analyzing the FM wave.
- 3.1.6 UNIT TESTING:** Every phase will be evaluated individually to make sure that it does its required function.
- 3.1.7 INTEGRATION TESTING:** This phase is needed to check whether each phase can communicate with the other in a proper way.
- 3.1.8 SYSTEM TESTING:** This is where all phases will be connected together to perform an overall testing for the TX and RX systems.
- 3.1.9 ACCEPTENCE TESTING:** In this phase, performance testing for the TX and RX systems will be done to make sure that the system can be used in real time.

3.2 MATERIALS AND TOOLS

GNU Radio will be used to build the FM system. GNU radio is a free, open source SDK used to build Software Defined Radio (SDR). It can use external RF to create SDR (Hack one RF), or it can be used as simulation-like SDK. GNU Radio uses blocks to build the system along with Python and C++ codes. Some blocks are built-in, custom ones can be developed using C++/Python, or custom Python can be used to enhance the GNURadio system.

For FM radio broadcast we have used “HackRF One”. Figure 3.2 shows HackRF, an opensource SDR platform. “HackRF One” is a Software Defined Radio peripheral capable of transmission or reception of radio signals from 10 MHz to 6 GHz. Designed to enable

testing and development of modern and next generation radio technologies. Figure 3.3 shows a DVB-T USB dongle that is an open source hardware platform that can be used as a USB peripheral or programmed for stand-alone operation. While Raspberry Pi will be used as a WSN base station. Table 3.1 shows materials used and its quantity.

Table 3.1: Materials used and its quantity.

Item	Quantity
GNURadio: free, open source SDK used to build Software Defined Radio (SDR).	2
HackRF One: SDR peripheral capable of transmission or reception of radio signals.	
RTL-SDR RTL2832U Dongle: SDR peripheral capable of reception of radio signals.	2
Raspberry Pi 2 Model B: credit card-sized single-board computers will be used to build RX system.	1
Refurnished HP EliteBook 2540p: a laptop will be used to construct FM TX System.	1

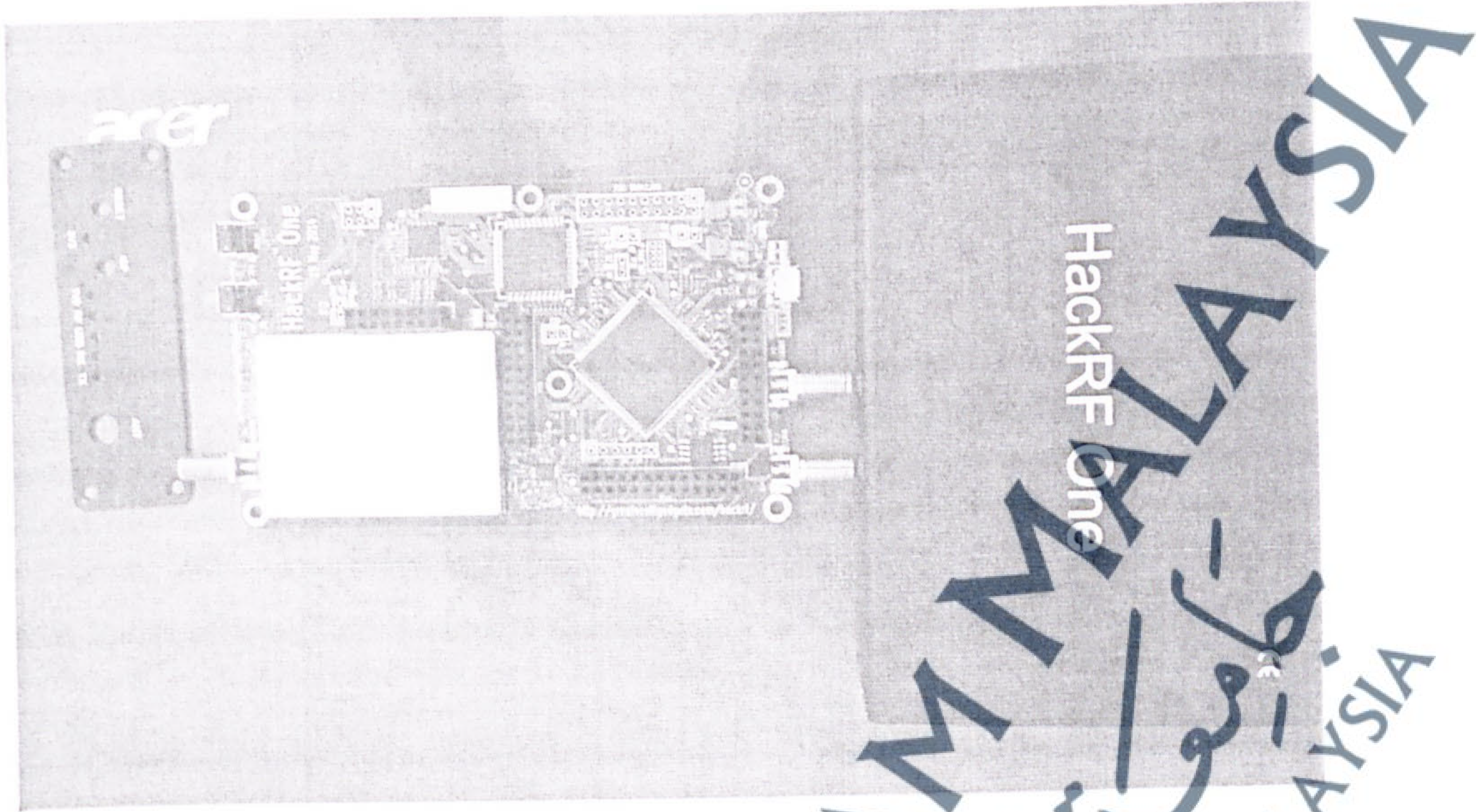


Figure 3.2: HackRF One SDR.



Figure 3.3: DVB-T Realtek RTL2832U Elonics R820T RTL-SDR.