CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Every year, many accidents occurred and for certain cases, accidents are caused by under-inflated tyres. Under-inflated tyres could promote to problems such as blowouts, decreased tyre life, and handling. Due to this awareness of the importance of tyre pressure, US government has introduced Transportation Recall Enhancement Accountability and Documentation (TREAD) Act (www.nhtsa.gov, February 2010). This act requires all passenger cars, van, and light trucks to include low tyre pressure warning systems as standard equipment. The National Highway Traffic Safety Administration (NHTSA) oversees the TREAD Act and has expressed an interest in extending the legislation to other types of vehicle. As a result, NHTSA established Federal Motor Vehicle Safety Standard which requires the installation of tyre pressure monitoring systems (TPMS’s) that warn the drivers when a tyre is significantly under-inflated (25% of the right pressure).

The significant of running the tyres at the specified pressure helps provide proper vehicle handling (thus, reducing the chance of accident) while avoiding premature tyre wear. The right pressure for a vehicle is well-stated on the tyre information label or tyre placard located on a door edge or door jamb, or inside the glove-box door. The label also lists maximum load and tire size (including spare). Underinflated tyres wear on the outsides of the tread. Also, the tyres flex excessively which produces extra heat and more rapid wear. Over inflation causes the center of the tread to wear. The tyre cannot flex normally and this puts stress on the sidewalls and plies.
It is not convenient to frequently check the tyre pressure using pressure gauge. For long journey, tyre pressure may vary from time to time due to load, road irregularities, and temperature. Hence, one could not possibly know the condition of the tyre and that had caused many tyre blowouts especially for heavy trucks. Hence, TPMS is introduced. TPMS is an electronic system that observes and monitors the air pressure. Certain TPMS also monitors the temperature of the automobile tyre. The system alerts the driver of the vehicle of the air pressure inside the tyres by displaying the real pressure or just a warning light. Some of the car manufacturers already installed their own TPMS on their vehicles.

TPMS has two styles of indicating the tyre is underinflated or overinflated, that is directly and indirectly. In direct TPMS, pressure sensor is used where the measurement is directly taken from the tyre pressure itself. Generally, a direct TPMS consists of transmitting and detection unit at each tyre (temperature and pressure sensor, microcontroller unit (MCU), transmitter, battery, and protective casing) and a receiving and display unit (battery, receiver, MCU, display unit, casing, switch set, and display screen). The transmitting and detection unit will take the reading of the tyre pressure and temperature and transmit it via radio signals to receiving and display unit. This unit will process the data and show in display or just give a warning light (LI Wei, & Chen Hongling., 2005).

Indirect TPMS uses existing sensors and software algorithm to identify the tyre’s condition (under/over-inflated). There are many on-going researches and development projects on this method and could be classified into two main classes. The first class is by using vibration analysis. It treats the tyre as a spring that is excited by the road irregularities. The concept is to monitor the resonance frequency which is correlated to the tyre pressure. The second class is by using wheel radius analysis which based on the fact that the tyre pressure affects the effective rolling radius of the tyre (N. Persson, & F. Gustafsson., 2002).

The method used for this project is direct TPMS. It will be discussed further in Chapter 3 and Chapter 4.
1.2 PROBLEM STATEMENTS

The first problem statement is the location of the system. The transmitting and detection unit will be located inside the tyre. The location of the system is crucial for safety aspect and precision of the data that will be gained. The second problem statement is the size of the system which the size of the transmitting and detection unit needs to be small enough if it were to locate inside the tyre. The third is wireless transmission; when tyre is rotating, the transmitting and detection unit will be transposed. Tyre identification might be miscorrelated and the information displayed on the screen about the pressure and temperature as correlated with the tyre is wrong.

The fourth problem statement is sensor is using battery. Traditional direct TPMS requires battery in each tyre to power the sensor and the circuits, but the use of batteries raise potential problems including limited life span, temperature-dependent capability, added weight, environmental concerns, and larger maintenance cost. The fifth and the last problem statement is self-generating power. In this project, self-generating power system is to be designed to replace the battery’s function as main power supply.

1.3 OBJECTIVE

The objective of this project is to design and develop direct tyre pressure monitoring system.