International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869 (O) 2454-4698 (P), Volume-5, Issue-2, June 2016

Survey on Tire Pressure Monitoring System

Premarsha.B

***Abstract*— The tire pressure monitoring system is an electronic system that monitors the air pressure and temperature of vehicle tires in real time and alerts the drivers by warning them and display the real time pressure as well as the temperature on a LCD. The whole programming will be controlled by either a microcontroller that is loaded with an embedded c program or RF protocol like zigbee. The main advantage to introduce the system is to reduce the number of accidents during driving and to provide proper vehicle handling.**

***Index Terms*— Microcontroller, LCD, Wireless network, Zigbee, Transmitter, Receiver, Pressure sensor, Radio frequency identification(RFID).**

I. INTRODUCTION

A **tire-pressure monitoring system** (**TPMS**) is an electronic system designed to monitor the air pressure inside the pneumatic tires on various types of vehicles. TPMS report real-time tire-pressure information to the driver of the vehicle, either via a gauge, a pictogram display, or a simple low-pressure warning light. TPMS can be divided into two different types – direct (dTPMS) and indirect (iTPMS). TPMS are provided both at an OEM (factory) level as well as an aftermarket solution. The target of a TPMS is avoiding traffic accidents, poor fuel economy, and increased tire wear due to under-inflated tires through early recognition of a hazardous state of the tires.

- Direct vs. indirect
- Indirect TPMS

Indirect TPMS do not use physical pressure sensors but measure air pressures by monitoring individual wheel rotational speeds and other signals available outside of the tire itself. First generation iTPMS systems are based on the principle that under-inflated tires have a slightly smaller diameter (and hence higher angular velocity) than a correctly inflated one. These differences are measurable through the wheel speed sensors of ABS/ESC systems. Second generation iTPMS can also detect simultaneous under-inflation in up to all four tires using spectrum analysis of individual wheels, which can be realized in software using advanced signal processing techniques. The spectrum analysis is based on the principle that certain Eigen forms and frequencies of the tire/wheel assembly are highly sensitive to the inflation pressure. These oscillations can hence be monitored through advanced signal processing of the wheel speed signals. Current iTPMS consist of software modules being integrated into the ABS/ESC units.

Premarsha.B, Department of Embedded System Technologies, Easwari Engineering College, Chennai.

A. Direct TPMS

Direct TPMS employ pressure sensors on each wheel, either internal or external. The sensors physically measure the tire pressure in each tire and report it to the vehicle's instrument cluster or a corresponding monitor. Some units also measure and alert temperatures of the tire as well. These systems can identify under-inflation in any combination, be it one tire or all, simultaneously. Although the systems vary in transmitting options, many TPMS products (both OEM and aftermarket) can display real time tire pressures at each location monitored whether the vehicle is moving or parked. There are many different solutions, but all of them have to face the problems of exposure to hostile environments. The majority are powered by batteries which limit their useful life. Some sensors utilise a wireless power system similar to that used in RFID tag reading which solves the problem of limited battery life by electromagnetic induction. This also increases the frequency of data transmission up to 40 Hz and reduces the sensor weight which can be important in motorsport applications.

A direct TPMS sensor consists of following main functions requiring only a few external components — *e.g.* battery, housing, PCB — to get the sensor module that is mounted to the valve stem inside the tire:

- pressure sensor
- analog-digital converter
- microcontroller
- system controller
- oscillator
- radio frequency transmitter
- low frequency receiver and
- voltage regulator (battery management)

BENEFITS OF TPMS:

- Fuel savings
- Extended tire life
- Decreased downtime and maintenance
- Improved safety
- Environmental efficiency

II. LITERATURE SURVEY

"An evaluation of existing tire pressure monitoring system" US department of transportation **[1]**

Wheel-Speed Based TPMS Since the WSB systems use wheel speeds to calculate the rolling radius of the tire, it was crucial that the tires had uniform tread wear, that the vehicle was properly loaded, and the tire pressures were set at the recommended placard cold inflation pressure while cold. Before testing, each WSB TPMS was reset and calibrated for each vehicle according to the manufacturer's recommended method. The calibration procedure allowed the TPMS to learn the rotation properties of each tire and form a baseline

expectation of the tires' rolling radii under different conditions. Since the dynamic rolling radius of a tire changes significantly with speed, the systems must be calibrated in multiple speed ranges. If a vehicle manufacturer recommends an increase in inflation pressure to accommodate a higher load, WSB systems require recalibration. For example, if a vehicle was to be tested at the gross vehicle weight rating at a specific tire pressure, it was also calibrated in that state.

Pressure-Sensor Based TPMS This section details the results of the PSB TPMS evaluations. Testing of the pressure-sensor based systems was conducted both statically and dynamically. The static tests had three objectives:

1) To determine the threshold warning threshold by lowering the pressure in increments

2) To investigate the effects of temperature change on PSB systems and

3) To determine the response time of the systems to a rapid tire deflation.

"Tire pressure monitoring system using wireless communication" Sanju Rani ,etc..,**[2]**

Tire pressure monitoring system is an electronic system that monitors the air pressure and temperature of an automobile tire in real time and alerts the driver by a horning alarm and display the real time pressure as well as temperature on a LCD. A drop in tire pressure results in decreased mileage, tire life, safety and vehicle performance. Tire pressure monitoring system results in Improved Mileage, long tire life, reduce number of accidents, proper handling of vehicle etc.).The whole programming is controlled by a microcontroller that is loaded with an intelligent embedded c program. The main advantage to introduce such a system is to reduce the number of accidents and a lot of inconvenience during driving and to increase the durability of tires, fuel Mileage and to provide proper vehicle handling. The pressure and temperature are displayed on the physical interface i.e. LCD Screen with the help of a Radio Frequency Identification (RFID).

"Designing a Pseudo Tire Pressure Monitoring System Transmitter using Software Defined Radios" Stella banou, etc.,**[3]**

The purpose of this project is to create a software defined radio based transmitter that can mimic the signals of the Tire Pressure Monitoring System (TPMS) sensors. The team used an amplifying receiver to read signals as well as decode data. The transmitter was built using a USRP N210 software defined radio running MATLAB code. The team conducted a series of tests to verify the functionality of the pseudo transmitter using both computer simulation and over-the-air and with a real vehicle. The results of the tests verified that the pseudo transmitter can communicate properly with the receiver of the previous project as well as a real TPMS receiver in a vehicle. The results of this project are useful in identifying breaches in the TPMS security and offering data for developing a more secure tire pressure monitoring system.

"Tire pressure management system"Jennifer Drain ,etc..,**[4]**

Improper tire pressure is a safety issue that is often overlooked or ignored. A drop in tire pressure by just a few pounds per square inch (PSI) can result in the reduction of gas mileage, tire life, safety, and vehicle performance. To address this problem, an automated system that will alleviate the need for actively maintaining tire pressure was designed. This report documents the design process for an on-board tire pressure management system (TPMS) consisting of a centralized processor, air compressor, air control valves and rotary seals near each wheel. The rotary seals allow the airline to transfer from the chassis to the wheel without entanglement. The system takes periodic tire pressure readings and makes adjustments according to the desired pressure setting. TPMS comes with several pre-defined tire pressure settings and allows the user to enter their own pressure setting if needed. Pressure settings, current pressures and flat/leak notifications are all displayed on a liquid crystal display (LCD) located in the dash. This system will take the maintenance out of upholding tire pressure and increase tire life, fuel efficiency and vehicle safety and performance.

"Wireless tire pressure monitoring system using zigbee" Odafe Ojenikoh**[5]**

Tyre pressure monitoring systems are electronics systems in motor vehicles to monitor the air pressure inside the tires. This was first installed as factory default in high end vehicles only. TPMS are implemented using the radio frequency technology to avoid rotating contact wiring. A typical TPMS is battery powered sensors with transmitters within the tire cavities. A RF communication protocol called zigbee is used in the wireless TPMS and how it effects the power consumption of the system and facilitating two way communications in TPMS design.

III. Conclusion

The different papers for the tire pressure monitoring system are discussed here. The main focus here is on monitoring the tire pressure using different communication protocols.

References

[1] An evaluation of existing tire pressure monitoring system, US department of transportation.

[2] Tire pressure monitoring system using wireless communication communication Akshay Vishnoi, Sanju Rani, Deeksha Singhal, Ashish Singh, Kshitij Shinghal International Journal of Scientific Research and Management Studies (IJSRMS) ISSN: 23493771 Volume 2 Issue 2.

[3] Designing a Pseudo Tire Pressure Monitoring System Transmitter using Software Defined Radios Stella Banou ,Felicia Gabriel ,Adriana Reyes ,Syed Shehroz Hussain Major Qualifying Project completed in partial fulfillment of the Bachelor of Science degree at Worcester Polytechnic Institute

[4] Tire pressure management system. Jennifer Drain ,Rodney Hall ,Christopher Pentland ,Michael Snedeker ,Aaron Thurber University of arizona

[5] Wireless tire pressure monitoring system using zigbee ,Odafe ojenikho , University of kent, Canterbury.