An Intelligent Tire Pressure Monitoring System

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Abstract - Pressure of tire is measured using Tire Pressure Monitoring System (TPMS) model. By measuring the tire pressure, the fuel can be saved and the vehicle can be controlled in better way. The real of tire pressure can be monitored in real time and if the pressure of the tire goes out of the threshold this system gives alarm and alert the driver to ensure the driver safety. Hence the life of the driver can be safeguard and pre-warn the driver and passengers. TPMS consists of an electronic unit that sense the tire pressure displays it to user in a LABVIEW platform. This unit includes a pressure sensor and Data Acquisition System. The output of the pressure sensor is given to the Data Acquisition System. Then the DAQ is interfaced with PC to display the tire pressure in the dashboard using the LABVIEW platform. If the tire pressure crosses safe pressure level a warning is generated.

Keywords - Pressure sensor, DAQ, LABVIEW

1. Introduction

The tires are used to move the vehicle and it also provide the link between ground and vehicle. The tires are to be maintained for ensuring safety of both driver and passengers. Various layers of fabric and steel encased with rubber is used to make a tire. To drive safely tires pressure need to be maintained, if pressure is not maintained properly and also if the tire pressure is low pressure the elasticity of the rubber is stretched beyond its limits of fabric and steel. As a result of the problem the link between various parts and tires will be get weaken and if it is not noticed or left miserably, the tires will eventually fail. So, the pressure of the tire is to be maintained as specified by the tire manufacturer. On maintaining the right pressure, the safety of driver and passenger can be increased, tire life and fuel efficiency also increased. On maintaining the tire pressure comfortable traveling and the life of suspension assemblies improves. In USA among 26% of cars and 29% of trucks were operating with tire pressure at least in one tire 25% or more below the specification, which not only has negative impact on fuel economy and the tire wear but poses a significant safety risk to the motorist. The natural ambient air temperature also gets alter by tire pressure.

Weight of the vehicle increments additionally because of flexing of side dividers and track which results in vehicle burden and motor as this produces heat. Risks of low tire pressure are (i) the tire get weaken and driving behaviour changes, (ii) the contact force between the road and tire lowers, (iii) the rolling drag heights and the fuel consumption is increased, (iv) indirect steering behaviour in front, (v) tires increases Over steering risk at rear, (vi) the contact force between the road and tire lowers, (vii) Sudden tyre burst caused due to temperature and also high temperature amplifies the abrasion of tyre. Similarly, high tire pressure risks, (i) the contact force of tyre and road is decreased, (ii) under steering at front side, (iii) Over steering at rear side and (iv) irregular abrasion. If the drivers are not checking the tyre pressure very often and then it will lead to an inflation of tyres and also it increases consumption of fuel and also there is increase in Carbon-dioxide emissions. Most of the time the tire gauges of Petrol stations are in-accurate and also fuel consumption is more.

To overcome the above discussed problem this paper proposes a tire pressure monitor system which will indicate the driver the tire pressure online using fuzzy logic algorithms. Benefits of having a tire pressure monitoring system is (I) Increased eco-friendliness, (ii) longer tire life, (iii) diminished tire victories (less mishaps), (iv) right vehicle dealing with (riding and voyaging solace), (v) longer suspension gathering life, (vi) if any cut, the driver gets the alarm so he can respond to the circumstance and (vii) by implication decrease in contamination.

The proposed framework is planned by having a high accuracy MEMS constrain sensor to detect the tire pressure. The yield of the sensor is taken care of to the sign moulding hardware comprising of a speaker, DAQ. The information is procured by a processor (PC) to show the genuine weight and alongside the pointer of the tire well-being for driving condition.

2. Existing Method

In the current technique the information relating to the tire pressure is acquired with a high exactness MEMS pressure sensor [1]. The yield of the MEMS pressure sensor is enhanced and sent to the handling unit put on the scramble of the vehicle utilizing remote correspondence (RF). The handling is continuing utilizing fluffy rationale calculations on LabVIEW stage. The yield pressure is shown alongside the marker speaking to the quality. Pointer is green when the tire pressure is in the ideal reach indicated by the maker. Yellow when the weight has dropped and should be expanded. Red demonstrates tire pressure is underneath the wellbeing driving conditions. In the wake of testing and approving the whole framework utilizing LabVIEW [2]. The whole code is changed over to Verilog code and unloaded on to FPGA chip (Spartan 3E) utilizing FPGA module of LabVIEW with CompactRIO, for usage of
FPGA chip on ongoing framework. The framework subsequent to executing on continuous framework estimated genuine weight of tire on the web [3].

![FPGA Chip Diagram](image)

**Fig. 1: Transmitter and Receiver**

The block diagram representation of the existing instrument is given in Figure 1 shows the transmitter module placed on the tyre of the vehicle, Figure 2 shows the receiver module which can be placed on the dash of the vehicle Figure 1.

### 3. Proposed Methodology

**System Design**

NPC 1220 Series pressure sensor is utilized to quantify the tire weight and Thermocouple Amplifier Board is utilized to gauge the temperature of the tire to foresee mileage of the tire. For each 10°C ascent in temperature, the weight of the tire gets expanded by 1 PSI. The yield voltage from the two sensors is given to the ADC channel of ARM Cortex M3 processor for additional preparing. At that point the handled sign is moved to PC through RS-232 link to notice the yield. FPGA chip is supplanted by a Nuvoton board which will be clarified point by point in the accompanying area. The general scheme of the TPMS is shown in Figure 3: Sensor+DAQ+PC (LABVIEW to display the output).

![TPMS Diagram](image)

**Fig. 2: TPMS**

In this tire pressure checking framework an NPP-301 Series silicon MEMS pressure sensor in surface mount bundles which gives the savviest technique for estimating pressures up to 100 psi. It is a tiny silicon combination fortified, super high soundness reasonable piezoresistive chip is put in a plastic bundle that misuses high volume, lead outline bundle innovation to deliver a minimal effort sensor option in contrast to OEM client [4]. As shown in Figure 4, this sensor has a wide working temperature scope of about -40°F to 257°F. It is entirely appropriate for robotized part gathering and it is a four component Wheatstone connect arrangement which improves the circuit plan adaptability and strong state dependability [5]. This sensor changes over the physical quantity(pressure) to electrical signal (Voltage signal). The yield of the sensor is given to the DAQ framework by associating positive pin of the sensor to the positive pin of the DAQ and the negative pin of the sensor is associated with the negative pin of the DAQ framework [6],[7].

![Sensor Diagram](image)

**Fig. 3: TPMS**

![Sensor Diagram](image)

**Fig. 4: Sensor**
**Data Acquisition System**

Here we are utilizing a NuMicro as a DAQ. The NuMicro NUC100 Series is 32-bit microcontrollers with inserted ARM® Cortex-M0 center for modern control and applications which need rich correspondence interfaces. The Cortex-M0 is the most up to date ARM implanted processor with 32-cycle execution and at a cost equal to customary 8-digit microcontroller. NuMicro NUC100 Series incorporates NUC100, NUC120, NUC130 and NUC140 product offering.

The NuMicro NUC140 Connectivity Line with USB 2.0 max throttle and CAN capacities installs Cortex™M0 center approaching 50 MHz with 32K/64K/128K-byte implanted glimmer, 4K/8K/16K-byte inserted SRAM, and 4K-byte loader ROM for the ISP. It likewise outfits with a lot of fringe gadgets, for example, Timers, Watchdog Timer, RTC, PDMA, UART, SPI, I2C, I2S, PWM Timer, GPIO, LIN, CAN, PS/2, USB 2.0 FS Device, 12-digit ADC, Analog Comparator, Low Voltage Reset Controller and Brown-out Detector.

**Receiver**

The ARM Cortex M3 processor process the received analog signal into digital signal and transmits the signal to PC through RS-232 to display the output in LabVIEW platform is shown in Figure 5.

**Interfacing Sensor with Data Acquisition System**

As shown in Figure 6, the yield of the sensor is given to the DAQ framework by interfacing positive pin of the sensor to the positive pin of the DAQ and the negative pin of the sensor is associated with the negative pin of the DAQ framework.

**Results and Discussion**

This is the simplest method of displaying the temperature and pressure of the vehicle. In this method pressure and temperature is displayed using pressure meter and thermometer [8].

The pressure and temperature of the tyres is sensed and the analog values are sent to ARM CORTEX board. The data from ARM CORTEX is transmitted through UART with the RS 232 cable which is connected to PC. The data transferred is viewed in LABVIEW with the VISA configure serial port. In order to convert it into voltage of optimum range, it is then multiplied with a constant value and the results are displayed in LABVIEW platform as shown in Figure 7, Figure 8 and Figure 9.
This can also be implemented using IoT. IoT is defined as the physical objects are networked and also it is connected through internet [9].

4. Conclusion
In this plan incredible accentuation has been made to make TPMS framework easy to understand and vehicle cordial. The framework was executed utilizing the ac- accessible equipment talked about above. Vehicle testing gave dependable and stable reaction. Contrasted with TPMS frameworks accessible in market, this framework has its own points of interest like minimal effort and high dependability. In future by using cloud computing, we could able to store the data in cloud.

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