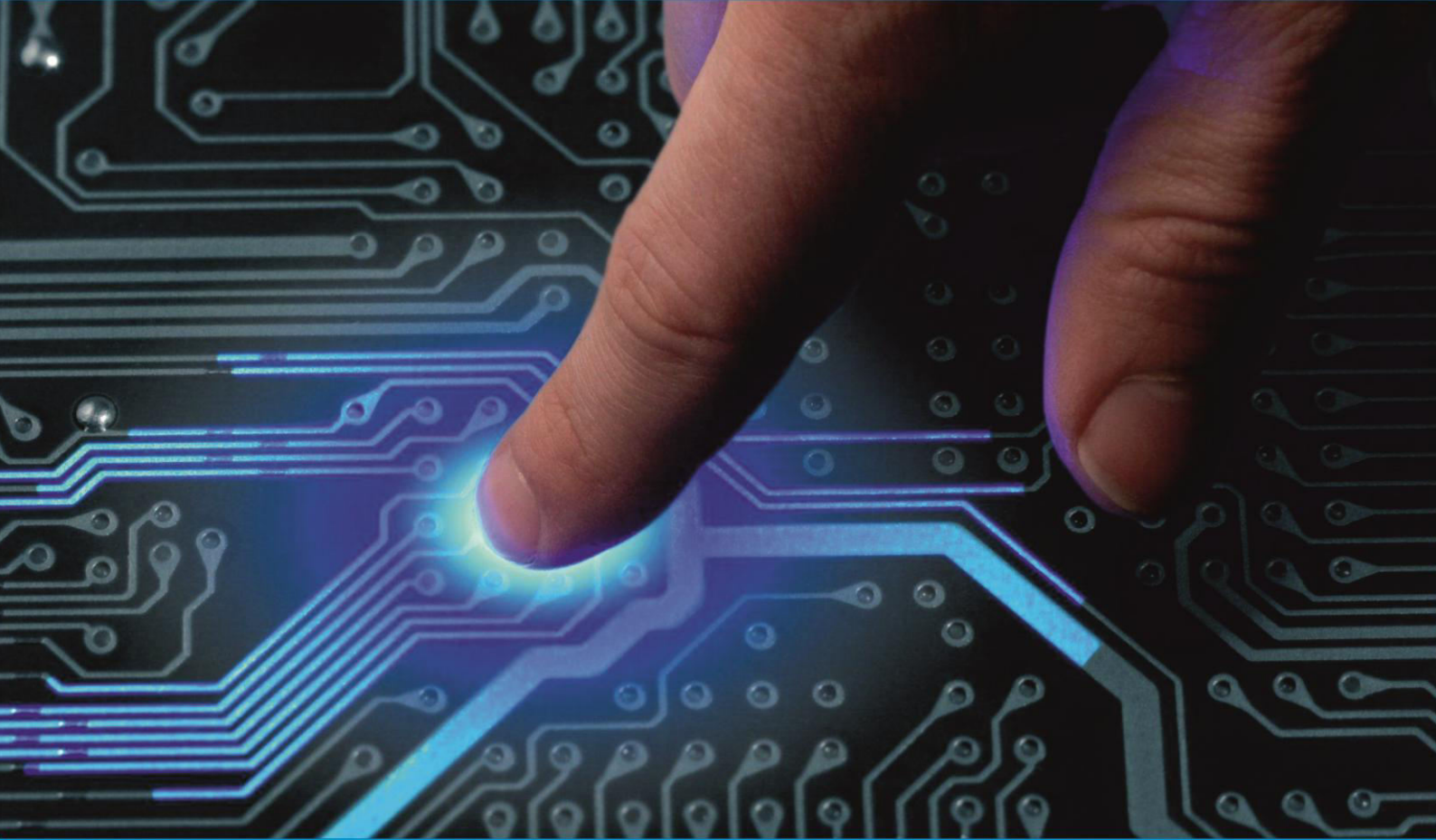




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Tyre Pressure Monitoring System for Vehicle Safety

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ABSTRACT: After Visiting the Bus Depo, we come to know tyres are undoubtedly one of the most critical safety components of a vehicle. Whenever the vehicle tyre comes in contact with the road, it affects traction, handling, steering, stability and breaking. Because of this, a sudden tyre failure can have serious consequences especially if it occurs when the vehicle is operating at highway speeds. The level of apathy and ignorance amongst Bus Drivers causes fatal accidents. Thus, to avoid such disastrous consequences, proper tyre pressure should be maintained. Therefore, we came up with an idea and successfully developed a Tyre Pressure Monitoring system, which could effectively meet this demand. The proposed TPMS has an electronic device unit directly attached to a tyre's valve. This unit includes Pressure sensor, ESP 32 BLE module, Latium Battery.

KEYWORDS: Tyre Pressure Monitoring System, Pressure sensor, ESP 32 Model, Latium Battery, Tyres

I. INTRODUCTION

Maharashtra State Road Transport Corporation state has made many improvements in vehicle safety in the recent past. One such fast growing application is the Tyre Pressure Monitoring System (TPMS).

A tyre can lose about half of its air pressure without appearing to be under inflated. [3] Apart from causing a higher risk of accidents due to loss of control, improper pressure in tyre also leads to tyre damage and ultimately leads to faster replacement.

According to MSRTC more than 250 deaths occur on our country's roads every day and also 75% of vehicles run on incorrect tyre pressure. Apart from causing a higher risk of accidents due to loss of control, improper pressure in tyre also leads to tyre damage and ultimately leads to faster replacement. Additionally, under-inflated tyres have increased rolling resistance requiring more fuel to maintain the same speed thus affecting fuel efficiency.

TPMS is an electronic safety system that is used to monitor the air pressure inside the tyres of a vehicle and provide the driver with proper warning signal on the mobile application. Application is connected with the using Bluetooth. Thus, it can be referred as a Driver Assist System [3].

[4] The monitoring system is carried out to monitor all activities that occur at a time deemed important to be safeguarded. Therefore, it is necessary for to be informed about the tyre pressure to ensure the vehicle's safety performance at a high velocity. Motorized vehicle consists of a sensor module mounted on a vehicle's tyre valve and an attached receiver module. This sensor module is responsible for monitoring the pressure on tyre.

The tyre, afterwards, the tyre pressure data is sent to the receiver module wirelessly through Bluetooth. Meanwhile, the receiver module serves as the recipient of the data which are subsequently processed in order that it can be displayed on the mobile application to inform the user.

II. METHODOLOGY

A tyre-pressure monitoring system (TPMS) is an electronic system designed to monitor the air pressure inside the pneumatic tyres on various types of vehicles. [2] A TPMS reports real-time tyre-pressure information to the driver of the vehicle, either via a gauge, a pictogram display, or a simple low-pressure warning light.

TPMS directly measures tyre pressure using hardware sensors. In each wheel, most often on the inside of the valve, there is a battery-driven pressure sensor which transfers pressure information to a central control unit which reports it to the mobile application. Some units also measure and alert temperatures of the tyre as well.

These systems can identify under-inflation for each individual tyre. Although the systems vary in transmitting options, many TPMS products (both OEM and aftermarket) can display real-time, individual tyre pressures whether the vehicle is moving or parked.

TPMS sensor consists of the following main functions requiring only a few external components. Battery, housing, PCB to get the sensor module that is mounted to the valve stem inside the tyre:

- Pressure sensor CC2500
- Microcontroller Esp32 BLE module.
- Bluetooth transmitter.
- Voltage regulator (battery management).

Most originally fitted TPMS have the sensor mounted on the inside of the rim and the batteries are not exchangeable. A discharged battery means that the tyre must be dismantled in order to replace it, so long battery life is desirable.

To save energy and prolong battery life, many TPMS sensors do not transmit information when parked (which eliminates spare tyre monitoring) or apply a more expensive two-way communication which enables wake-up of the sensor. For OEM auto TPMS units to work properly, they need to recognize the sensor positions and must ignore the signals from other vehicles. Aftermarket dTPMS units not only transmit while vehicles are moving or parked, but also provide users with some advanced monitoring options including data logging, remote monitoring options and more. They are available for all types of vehicles, from Bus to heavy equipment, and can monitor up to 64 tyres at a time, which is important for commercial vehicles.



Fig -1: Transmitter on tyre rim [3]

❖ Software and Hardware Requirements

- Software Requirements:
 1. Flutter app developer
 2. Arduino IDE.
 3. ESP IDF.
 4. Python.
 5. GCP (Google cloud platform)
- Hardware Requirements:
 1. Pressure sensor CC2500
 2. ESP 32 BLE module
 3. Latium Battery

❖ Project Module

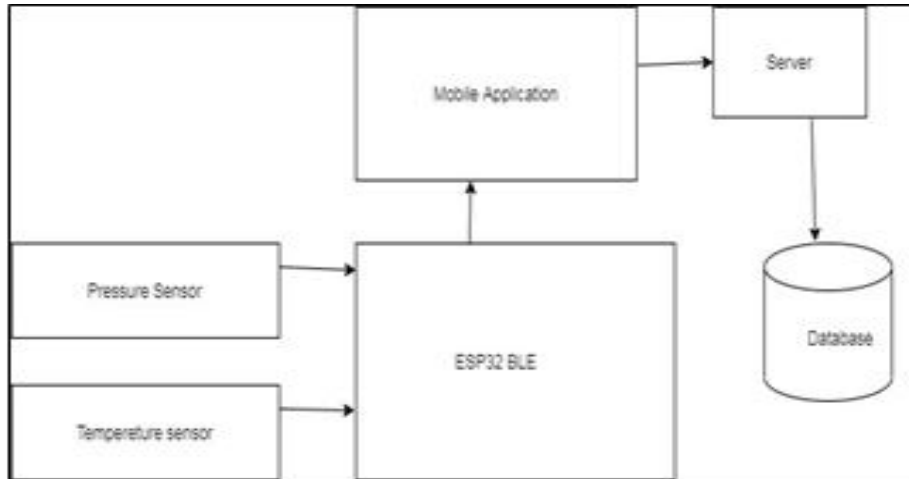


Fig -2: Project modules of TPMS

III. MODELING AND ANALYSIS

According to the dTPMS and Bluetooth technology each tyre having it separate Esp 32 board with it unique id set by the developer [1]. All this board are connected using the Bluetooth Network CAN communication protocol with the mobile application.

Using this application we are fetching the sensor data form the Esp32 module. This packet of data will be transmitted in the JSON format. When if tyre pressure is lower or high form the given threshold than it is should send Alert message will directly to driver’s mobile application. From mobile application it will be send to server room/office and store in GCP cloud All the tyre pressure data are storing in the GCP cloud (Google Cloud Platform) for the future reference.

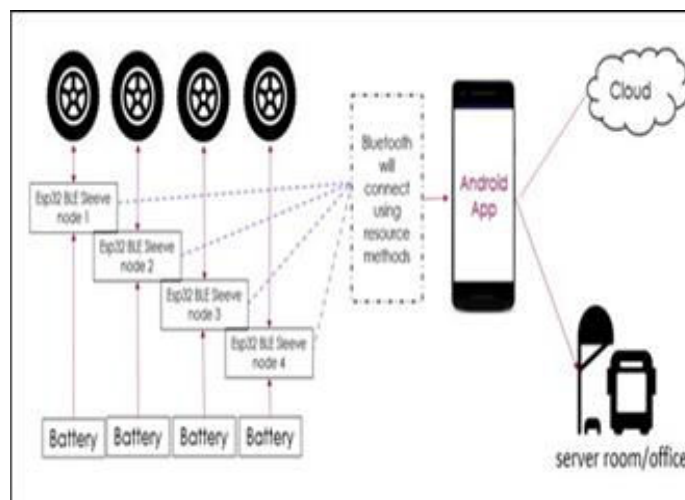


Fig-3: Block Diagram of TPMS



IV. CONCLUSION AND FUTURE WORK

The Tyre pressure monitoring system Integrated circuits along with its other components to measure a real time pressure of the Tyre and displays the values on the App. This system also alerts the driver and to MSRCT of the pressure when the pressure values reaches below 25% of the required accurate pressure on which the Tyre must operate. Tyre is an important and essential component of the vehicle and this must be made mandatory in all the vehicle. Also, this system has many benefits like prevention of road accidents, improves Tyre life, improves the handling of the vehicle and reduces fuel consumption.

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