

Android-Based Car Tire Pressure Monitoring System

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Abstract

Inadequate tire pressure is a significant factor that accelerates tire damage and increases the risk of traffic accidents. This often occurs because tire pressure checking is still done manually with simple tools, which is not only inefficient but also prone to measurement errors. Therefore, a system capable of monitoring vehicle tire pressure automatically and in real-time is needed. This research aims to design and implement an Android-based car tire pressure monitoring system. Research data was obtained through field research and literature review. At the same time, system requirements analysis was conducted using the PIECES method (Performance, Information/Data, Economic, Control/Security, Efficiency, and Service) to ensure the quality, effectiveness, and safety of the resulting system. The results show that the developed system is capable of detecting tire pressure with high accuracy and displaying this information directly through an Android application. This feature allows users to take preventative action more quickly when abnormal pressure is detected, thereby reducing the risk of accidents and tire damage. Furthermore, the implementation of this system has been proven to improve vehicle maintenance efficiency by eliminating the need for routine manual checks. This innovation offers significant benefits not only to middle-class vehicle users but also to the upper class, who require practical and modern solutions for maintaining safe driving. Therefore, this research has a tangible impact in supporting transportation safety, reducing maintenance costs, and contributing to the development of future Internet of Things (IoT)-based automotive technology.

Keywords: Monitoring; PIECES; Tire Pressure; Android

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Introduction

Tires are a crucial component of land vehicles, playing a key role in maintaining vehicle stability during irregularities in the road surface, enhancing acceleration, and facilitating vehicle movement. Tires are a vital component for vehicles, particularly in four-wheeled vehicles, where they are a key factor in many road accidents. Tires are designed to hold air, as part of their structure. Tires designed to withstand air pressure have a predetermined pressure, so riders need a tire measuring device to manually check the air pressure in the tire. Non-standard tire pressure can affect tire life. The existence of tires sometimes goes unnoticed by the owner when driving (Hacker, 2019). Many people feel too lazy to check tire pressure intensively before driving, especially when traveling far in their vehicle. The hassle of manually checking tire pressure with a tire pressure measuring instrument is often due to the driver's laziness in taking tire pressure measurements. Improper air pressure can cause rapid damage and wear to the vehicle's tires, which can trigger accidents, (Pearlman et al., 2000).

Each tire manufacturer has set the exact tire pressure standard for each vehicle. The size of tire pressure is usually set in Pounds per Square Inch (Psi). The problem of human negligence in carrying out periodic checks cannot be separated from the availability of tire pressure monitoring devices that are not widely known and used by the public. Tire air pressure must always be considered and checked periodically to stay at a good pressure so that the tire can function optimally. Each tire manufacturer has set the exact tire pressure standard for each vehicle. The size of tire pressure is usually set in Pounds per Square Inch (Psi). The problem of human negligence in carrying out periodic checks cannot be separated from the availability of tire pressure monitoring devices that are not widely known and used by the public.

From the Computer Systems Study Program, Faculty of Computer Science, Narotama University of East Java Computer Systems Study Program, Faculty of Computer Science, Narotama University of East Java (Wuryaningrat et al., 2018) In his journal, Tire Air Pressure Detection on Motor Vehicles for Safe Riding. The study discussed the reading of air pressure on tires. Vehicles are able to display to motorists the condition of two-wheeled vehicle tires, so that in the

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future, air pressure gauges on four-wheeled vehicle tires can overcome the risk of accidents and save the lives of vehicle tires (Elfasakhany, 2019). By using the sensor as an air pressure reader, the results of the tire air pressure measurement will be sent through Bluetooth to the microcontroller, which will then be processed and displayed on the LCD display (Silalahi et al., 2019).

Method

The method used to analyze this system is by using the PIECES (Performance, Information/data, Economic, Control/Security, Efficiency, and Service) methods, the reason researchers use the PIECES method in this study is because by analyzing the weaknesses, needs and feasibility of the system, this analysis activity starts from understanding and identifying the problems of the system that is running, It is agreed to decide if the current system is problematic or not (Li et al., 2020). It works well, and the results of its analysis are used as a basis for improving the system. The analysis method also serves as a determinant of the goals that must be obtained to meet the needs of the user, as the comparison analysis of the old system and the new system can be seen in the following table.

Table 1. Comparison Analysis of Old Systems and New Systems.

No	PIECES	Old System	New System
1	Performance	The current system is still less effective because it can monitor tire pressure using manual tools to monitor tire pressure.	The current system is effective because it can monitor tire pressure using Bluetooth communication that connects Android phones. to monitor tire pressure
2	Information	In the current system is still not optimal because it uses on the Liquid Crystal Display (LCD) screen. to display tire pressure results	On the current system using Bluetooth that connects Android phones. to monitor tire pressure
3	Economy	When viewed from the current system is still less economical because it is still using cable media and to monitor tire pressure.	When viewed from the current system is more economical because it is still utilizing Using Bluetooth that connects Android phones. to monitor tire pressure
4	Control	The current running system is less than optimal because it has not utilized Bluetooth technology.and Android Mobile monitors tire pressure	the current running system k optimal because it utilizes Bluetooth technology.and Android Mobile monitors tire pressure
5	Efficiency	When viewed in terms of efficiency, the current running system is still less efficient because the system has not optimal process long enough. For example, in the collection of tire pressure data	When viewed in terms of efficiency, the current running system is efficient because the system uses Bluetooth technology.and Mobile Android monitors tire pressure.
6	Services	When viewed in terms of service, the current system still uses cable media in reading tire pressure.	when viewed in terms of service, the system has used technology

Results and Discussion

Result

The monitoring to be developed focuses on car tire pressure. The learning design will be implemented with the aim of devices and sensors that take wind pressure data on tires connected to smartphones or Android phones, which aim to enable four-wheelers to monitor tire pressure with smartphone devices, so that drivers can know, monitor, and maintain the stability of air pressure on the tire to drive safely and comfortably. features that will be created in the development of Android-based tire pressure monitoring(Nguyen et al., 2020)(Patil et al., 2018).

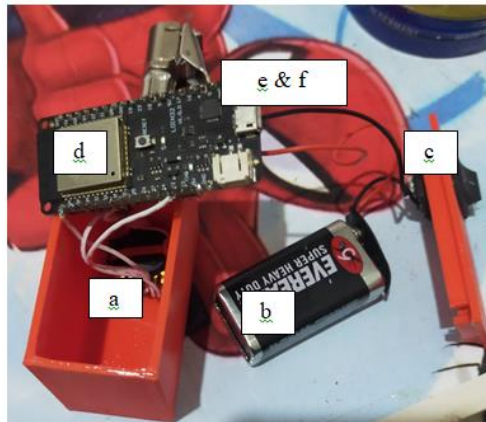


Figure 1. Hardware Design Results

In figure 1 shows a picture of an android-based tire pressure monitoring system tool, as for the explanation as follows:

1. **MPX 5700 AP Pressure Sensor:** Mpx 5700 AP pressure sensor is a function to measure air pressure on the tire, used for Microprocessors or Microcontroler Mpx5700 sensor pin configuration consists of 6 pins and used only 3 pins, namely pin one as the output voltage, pin two as ground while pin three as input from supohkunjhynm2qply voltage of 5 volts, while the other 3 pins NC (not connects).
2. **Battery:** An energy source that can convert the chemical energy it stores into electrical energy that emits a voltage of 9 Volts.
3. **Switch:** A switch is a device used to disconnect a power grid or to connect it.
4. **IC regulator 2596 mini:** An IC regulator is an electronic component used to regulate voltage in an electronic circuit. Named as IC or Integrated Circuit because this voltage regulator is composed of tens to hundreds of transistors, capacitors, diodes, and resistors, which integrate into each other so as to form regulatory IC components. This voltage regulator is widely found in various types of adapters that are useful for providing DC voltage for laptops, mobile phones, notebooks, and so on. In addition, in some electronic devices whose power supply is integrated with the series, such as Televisions, DVD players, and Desktop PCs. The function of a voltage regulator is to maintain or regulate the voltage at a certain level (according to the value on the regulator IC) automatically. This can be interpreted as the DC output voltage in the voltage regulator will be stable and not affected by the change in input voltage. This study raises the IC regulator 2596 mini, which will issue an output of 5V.
5. **Mikrokontroller ESP32:** ESP32 microcontroller whose function is the main control or controller on the circuit and sends data to Android phones via Bluetooth.



Figure 2. Results of Installation of Tools on Car Tires

Figure 2 shows an image of the installation of an Android-based tire pressure monitoring system on the tire by installing a tool on the car tire, tire, and connecting with the Android smartphone with an application that has been made using the Inventor app. After assembling and installing tools on the Toyota Dyna 130 tank car using Birghstone Might Rib N750 16 14PR car tires, we need to test whether it meets the planned specifications and withstands some engineering conditions that may occur during its development. Tire pressure testing when the tank water is empty by measuring the front and rear tires with a time of 45 (forty-five) minutes, with fixed test results, produces the same approval.

Table 2. System Test Results on empty water tanks

Test Cast Ban	Measurement Time	Initial Pressure Psi	Measurement Time	Final pressure Psi	Result
Front	08:00 WITA	61.30 Psi	08:45 WITA	61:30 Psi	The same pressure
Back	16:30 WITA	80.52 Psi	17:15 WITA	80:52 Psi	The same pressure

Table 2 shows that the test item measures tire pressure when the water tank in the car is filled. Each type of vehicle has different tire pressures according to its shape, size, weight, and function. Therefore, in addition to maintaining the vehicle's optimal performance, measuring tire pressure is an important ritual that should not be ignored because it has a significant impact on driving safety and comfort.

Table 3. System Test Results on paved roads

Test Cast Ban	Time	Initial Pressure	Time	Final pressure	Result
Front	09:40 WITA	61.30 Psi	10:25 WITA	61:47 Psi	experienced a Tire pressure increase of 0.12 Psi
Back	10:30 WITA	80.52 Psi	11:15 WITA	80:82 Psi	experienced an increase in tire pressure of 0.22 Psi

Table 3 shows that the test item measures the pressure of the front tire running on the asphalt. Tire pressure that is too high or excessive can interfere with driving comfort because hard tire conditions are very sensitive to the condition of the road, both on paved roads and damaged roads, in addition to potentially causing damage to some parts of the vehicle due to vibrations that are too loud. In addition, it can also accelerate the occurrence of wear on the tire, especially in the middle.

Table 4. System Testing Results on the road berbeton

Test Cast Ban	Time	Initial Pressure	Time	Final pressure	Result
Front	13:30 WITA	61.35 Psi	13:55 WITA	61:59 Psi	experienced Tire pressure increase of 0.24 Psi
Back	14:00 WITA	80.60 Psi	14:45 WITA	80:92 Psi	experienced an increase in tire pressure of 0.32 Psi

Table 4 shows that the test item measures tire pressure on concrete roads.

Discussion

The problem of air pressure on car tires is often considered trivial; in fact, if the pressure of the car tire is either too low or too high, it will have an impact and once felt on the performance of the car on the track, this will undoubtedly affect comfort as well as safety in driving. This tool offers several advantages, as evidenced by the analysis results. Notably, it facilitates tire pressure measurements and utilizes microcontrollers with Bluetooth, allowing for easy operation via an Android smartphone to display tire pressure. There are also some shortcomings obtained in this study, namely, a handphone can only connect to Bluetooth with one tool(Masoudi et al., 2019). The ideal tire pressure is the wind pressure on the tires recommended by the car manufacturer. Usually, this perfect tire pressure is written/listed on the car dashboard and the car manual. In the description of the tire pressure, it actually also states information about the tire, the type of tire used, and its size(Caban et al., 2019).

Conclusions and Suggestions

Conclusions

Based on the design results and research results of "Android-Based Tire Pressure Monitoring System," the authors concluded. This tool is designed to use the ESP32 Microcontroller as the main device and is equipped with several other tools, namely Batteries, Switches, IC regulator 2596 mini, Bluetooth, and an Android smartphone. In terms of software, this tool uses Arduino IDE and APP Inventor.

Suggestion

In the manufacture of this tool, there are several obstacles faced, then for the next opportunity, so that the work of this tool is more maximal and perfect, then the next research on monitoring tire pressure with an Android smartphone can connect Bluetooth with the tool installed on 4 (four) car tires.

References

- Caban, J., Turski, A., Nieoczym, A., Tarkowski, S., & Jereb, B. (2019). Impact of specific factors on the state of the tire pressure value. *Archiwum Motoryzacji*, 85(3).
- Elfasakhany, A. (2019). Tire pressure checking framework: A review study. *Reliability Engineering and Resilience*, 1(1), 12–28.
- Hacker, K. L. (2019). *Preserving Privacy in Automotive Tire Pressure Monitoring Systems*.
- Li, L., Shao, Y., Song, D., Qiu, X., & Huang, X. (2020). Generating adversarial examples in chinese texts using sentence-pieces. *ArXiv Preprint ArXiv:2012.14769*.
- Masoudi, S., Esfahani, M. J., Jafarian, F., & Mirsoleimani, S. A. (2019). Comparison the effect of MQL, wet and dry turning on surface topography, cylindricity tolerance and sustainability. *International Journal of Precision Engineering and Manufacturing-Green Technology*, 1–13.
- Nguyen, T.-B., Nguyen, T.-H., & Chung, W.-Y. (2020). Battery-free and noninvasive estimation of food ph and co2 concentration for food monitoring based on pressure measurement. *Sensors*, 20(20), 5853.
- Patil, R., Bais, P., Baviskar, K., Shevate, S., & Kalyani, M. (2018). An Android Application for Driver Assistance and Event Alert System Using Ultrasonic Sensor and Heart Rate Sensor. *2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA)*, 1–4.
- Pearlman, M. D., Klinich, K. D., Schneider, L. W., Rupp, J., Moss, S., & Ashton-Miller, J. (2000). A comprehensive program to improve safety for pregnant women and fetuses in motor vehicle crashes: a preliminary report. *American Journal of Obstetrics and Gynecology*, 182(6), 1554–1564.
- Silalahi, L. M., Alaydrus, M., Rochendi, A. D., & Muhtar, M. (2019). Design of tire pressure monitoring system using a pressure sensor base. *Sinergi*, 23(1), 70–78.
- Wuryaningrat, N., Kindengan, P., Sendouw, G., Lumanouw, B., & others. (2018). *The development model of creativity industry innovation capabilities: The Lliterature Study*.