A project report for partial fulfillment of the degree of Bachelor of Technology In Electronics and Communication Engineering on

“Tyre Pressure & Temperature Monitoring System”

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CERTIFICATE

This is to certify that Uday Narayan Khanra, Ayush Paul, Soumodip Bhattacharjee, Arpan Roy and Sagnik Acharya of the Department of Electronics and Communication Engineering have successfully completed a mini project on "Tyre Pressure & Temperature Monitoring System" during their 6th Semester in B. Tech, AY 2022-2023 (under Maulana Abul Kalam Azad University of Technology) under my supervision.

22/05/23

Prof. (Dr) Manabendra Maiti

Head of the Dept.

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Project Guide

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ACKNOWLEDGMENT

It has been a great privilege to work, right from the conceptualization of the topic of the report work of this project, under the guidance of our respected guide *Prof. Dr. Manabendra Maiti*, Head of the Department, Electronics & Communication Engineering Department.

We feel very much elevated in preparing the project report on “TYRE PRESSURE AND TEMPERATURE MONITORING SYSTEM". Despite our best efforts it is possible that some errors and mistakes may have gone unnoticed. We shall be great to the faculty who will kindly bring these mistakes to our notice. Suggestions from the faculties are most welcomed. We would also like to thank the staff Members of Electronics & Communication Engineering Department, for their support during the work schedule.

Finally & most importantly, we would like to thank our friends and families for their continuous support throughout all our endeavors.

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ABSTRACT

In this project we will show you how to easily build a Tyre Pressure and temperature monitoring system. For communication between the sender (here the tyre) and the receiver (here the driver) will take place through bluetooth module HC05**.** But due to costing issue, as college students we can not afford that much budget we used cheaper pressure and temperature sensor. As a result the range of the sensors also decreased that is why we can not use it on tyres so we are replacing tyre with balloon in this project. We used HX710B (Pressure Sensor) and BMP180 (Temperature Sensor). LCD Display using I2C used to display the pressure/ temperature status . Also LED and Buzzer are also used to alert the driver in sudden increase cases.

INTRODUCTION

The tire monitoring system project aims to develop a comprehensive solution for monitoring and managing tire conditions in vehicles. The project recognizes the importance of maintaining proper tire pressure and temperature for enhanced safety, fuel efficiency, and prolonged tire life. By implementing a tire monitoring system, vehicle owners can proactively monitor tire conditions and take necessary actions to ensure optimal performance.

The project will involve the integration of sensors, data processing algorithms, and user interfaces to provide real-time tire pressure and temperature information. The system will continuously monitor the tire conditions, alerting the driver to any deviations from the recommended levels. Additionally, it will facilitate data logging and analysis for performance evaluation and predictive maintenance.

The primary objectives of the tire monitoring system project are as follows:

Enhancing Safety: The project aims to improve vehicle safety by alerting drivers to potential tire issues, such as underinflation or overinflation, which can lead to accidents and blowouts. By providing real-time monitoring and alerts, the system will empower drivers to take immediate corrective actions.

Improving Fuel Efficiency: Properly inflated tires contribute to better fuel efficiency. The tire monitoring system will assist drivers in maintaining the recommended tire pressure, minimizing rolling resistance, and maximizing fuel economy. This will help reduce fuel consumption and carbon emissions.

Extending Tire Life: The project recognizes that irregular tire wear due to incorrect tire pressure can lead to premature tire replacement. By continuously monitoring tire conditions and providing alerts, the system will assist drivers in maintaining optimal tire pressure and

minimizing uneven wear, thereby extending tire life and reducing replacement costs.

Providing User-Friendly Interface: The tire monitoring system project will focus on developing an intuitive user interface that is easy to understand and operate. The interface will display tire pressure and temperature information in a clear and accessible manner, ensuring that users can monitor their tire conditions effectively.

Enabling Predictive Maintenance: By collecting and analyzing tire performance data, the system will enable predictive maintenance. It will track tire wear patterns, provide maintenance recommendations based on usage and environmental factors, and alert users to potential issues before they become critical.

The successful implementation of the tire monitoring system project will result in an innovative solution that promotes safer driving, better fuel efficiency, and extended tire life. Vehicle owners will benefit from real-time tire monitoring, improved maintenance practices, and overall cost savings.

PROBLEMS

Underinflation: Underinflated tires were a prevalent problem before tire monitoring systems became widespread. Drivers often failed to regularly check tire pressure, leading to tires running below the recommended inflation levels. Underinflation can cause increased tire wear, reduced fuel efficiency, and compromised handling and braking performance.

Overinflation: Overinflation of tires was another issue. Some drivers mistakenly believed that overinflating their tires would improve fuel efficiency or provide better handling. However, overinflated tires can lead to a harsh ride, increased susceptibility to road hazards, and uneven tire wear.

Blowouts: Tire blowouts were a significant safety concern before the implementation of tire monitoring systems. Sudden loss of tire pressure due to underinflation, overloading, or damage could result in blowouts, leading to accidents, loss of vehicle control, and potential injuries.

Uneven Tire Wear: Without tire monitoring systems, drivers often failed to notice uneven tire wear patterns. Incorrect tire pressure and alignment issues could cause tires to wear unevenly, reducing their lifespan and necessitating premature replacement.

Fuel Inefficiency: Inadequate tire pressure management resulted in reduced fuel efficiency. Underinflated or overinflated tires create increased rolling resistance, leading to higher fuel consumption and unnecessary costs.

Lack of Awareness: Before the advent of tire monitoring systems, many drivers were simply unaware of the importance of maintaining proper tire pressure and the potential consequences of neglecting tire maintenance. This lack of awareness contributed to the persistence of tire-related problems.

Other than this, Many heavy vehicles like trucks, buses, etc develops a huge pressure/temperature through constant running. As a result the tyre bursts in many cases leading to disbalance of the vehicle which leads to huge accidents.

This accidents not only damage the vehicle or the driver but also can damage the surrounding vehicles or places and can lead to a huge number of deaths or injuries.

Also the same problem arises when the pressure of the tyre becomes low, if we say in easy language that is the tyre punctures.

SOLUTION

Yes, there is a solution possible, the answer is our project. Using Bluetooth Modules, sensors and LCD display we can constantly alert the driver about tyre pressure/temperature status i.e. (HIgh/ Normal/ Low).

If the LCD shows Normal, all is well.

But if the LCD shows high/ low the driver can immediately stop the vehicle and can take necessary actions to increase/ decrease the tyre pressure/temperature.

Also we can always monitor tyre conditions using this.

PROJECT PLANNING

Here in this project we will use 2 bluetooth modules (one master and one slave).

The master bluetooth module or the transmitter bluetooth module will be connected to the Arduino along with the temperature and pressure sensors. This is the unit which will be actually connected in the tyre of the vehicle.

And the other bluetooth module i.e. the slave or the receiver will be connected with a LCD screen which is connected with the I2C module. Along with them there will be one LED and one buzzer that will act as an emergency alarm mechanism . This is the unit which will notify the driver and warn him/her.

EQUIPMENTS

Breadboard 840 Tie Points Solderless

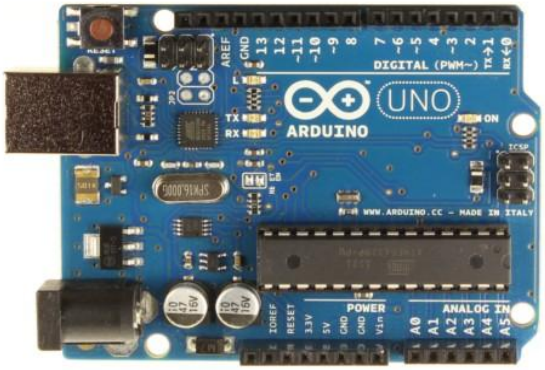
Breadboard GL-12 840 Tie Points is a construction base for prototyping of electronics. The term "breadboard" is commonly used to refer to a solder less breadboard.

Features of Breadboard (Full Size):

- Size is typically 0.1 in (2.54 mm).
- Integrated circuits (ICs) in dual in-line packages (DIPs) can be inserted to straddle the centerline of the block.
- Interconnecting wires and the leads of discrete components (such as capacitors, resistors, and inductors) can be inserted into the remaining free holes to complete the circuit.
- Where ICs are not used, discrete components and connecting wires may use any of the holes.
- Typically the spring clips are rated for 1 ampere at 5 volts and 0.333 amperes at 15 volts (5 watts).

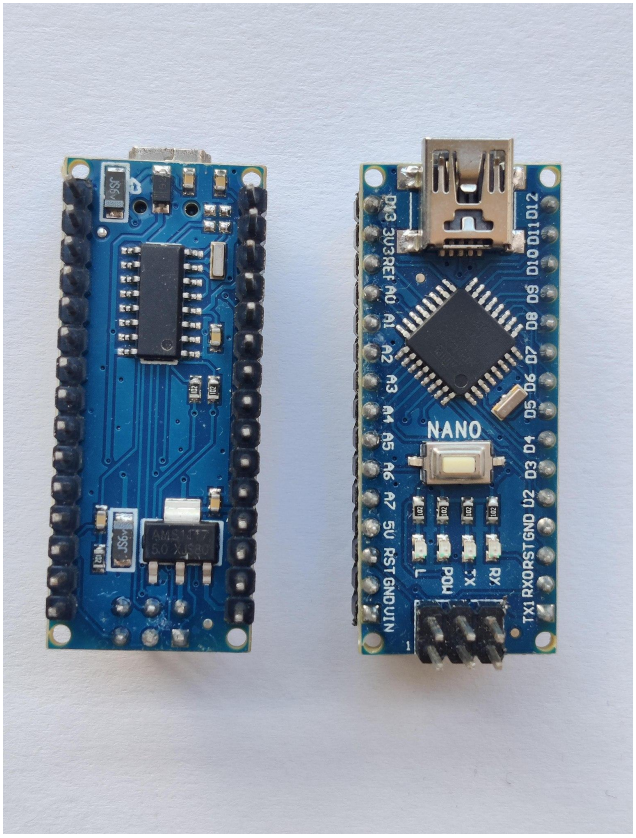
Arduino UNO

The Arduino Uno R3 Compatible board is an electronic hardware device used to build and program electronic circuits and projects. The board is based on the ATmega328P microcontroller and is designed to be compatible with the Arduino Uno R3 board, which means that it can be programmed using the Arduino software and libraries. The board features 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, and an ICSP header. The digital pins can be used as input or output pins and can be easily controlled using the Arduino programming language. The analog inputs allow the board to read analog signals, such as those from sensors, and convert them into digital signals for processing. The board also features a power regulator that can accept a range of input voltages, from 7 to 20 volts, and regulate it to a 5-volt output that is used to power the microcontroller and other components on the board. Additionally, the board includes a reset button, which can be used to restart the program running on the board, as well as an LED indicator that can be used for debugging and status monitoring. The board is compatible with a wide range of sensors, actuators, and other components, making it ideal for a wide range of applications, including robotics, automation, data logging, and more.



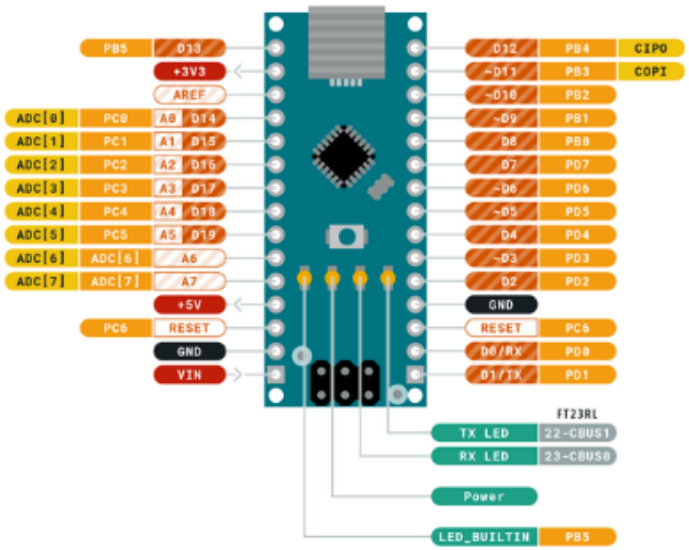
Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality as the Arduino Duemilanove but in a different package. It lacks only a DC power jack and works with a Mini-B USB cable instead of a standard one.



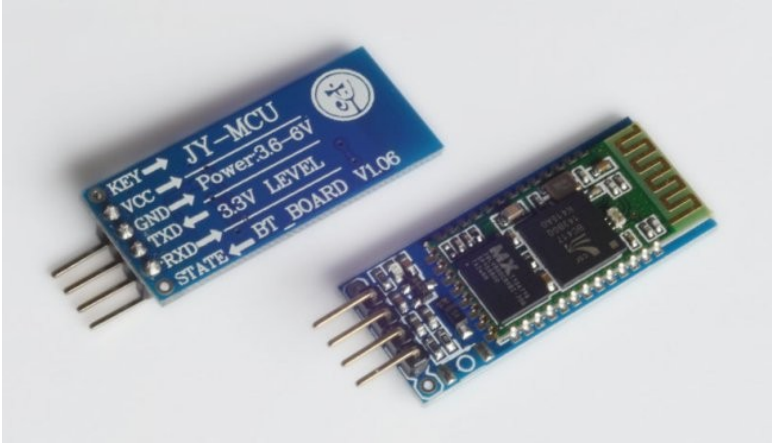
Specifications:

- ATmega328P Microcontroller is from 8-bit AVR family
- Operating voltage is 5V
- Input voltage (Vin) is 7V to 12V
- Input/Output Pins are 22
- Analog i/p pins are 6 from A0 to A5
- Digital pins are 14
- Power consumption is 19 mA
- I/O pins DC Current is 40 mA
- Flash memory is 32 KB
- SRAM is 2 KB
- EEPROM is 1 KB
- CLK speed is 16 MHz
- Weight-7g
- Size of the printed circuit board is 18 X 45mm
- Supports three communications like SPI, IIC, & USART



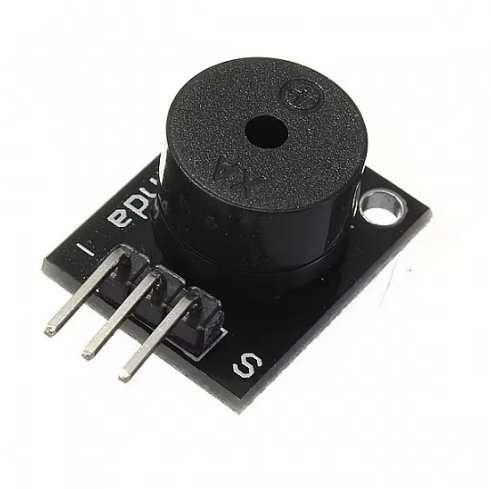
HC-05 Bluetooth Wireless UART Module

HC-05 is a Bluetooth Transceiver Module and has TTL Output. HC-05 6 Pin Wireless Serial Bluetooth Module is a Bluetooth module for use with any microcontroller. It uses the UART protocol to make it easy to send and receive data wirelessly. This Bluetooth module is a completely qualified Bluetooth V2+Enhanced Data Rate (EDR). It is 3Mbps Module with 2.4GHz radio transceiver and baseband. It has CSR Bluecore 04, an external single-chip Bluetooth system with CMOS technology and AFH, Adaptive Frequency Hopping, feature. The HC-06 module is a slave only device. This means that it can connect to most phones and computers with Bluetooth but it cannot connect to another slave-only device such as keyboards and other HC-06 modules. To connect with other slave devices a master module would be necessary such as the HC-05 version which can do both master and slave.



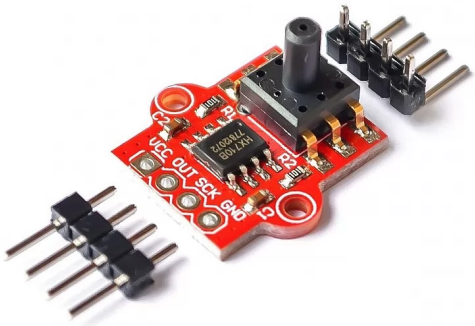
Standard Active Buzzer Module

A Standard Active Alarm Module for Arduino is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. This PCB Mounted Active Buzzer Module can produce a range of sound tones depending on the input frequency, i.e it can generate tones between 1.5 to 2.5 kHz by switching it on and off at different frequencies either using delays or PWM. An active buzzer rings out as long as it is electrified. Compared with a passive buzzer, it is a bit expensive but easier to control. Typical uses of buzzers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke. This module is ideally suited to adding noise to your project and is compatible with a pin pitch of 2.54mm while functioning with microcontrollers such as the Arduino. This module lets you respond to programmatic changes with a lovely annoying buzzer that can be altered over a range of frequencies to ensure maximum irritation. To operate the I/O pin must receive a square wave to trigger the buzzer.



HX710B Air Pressure Sensor Module

HX710B Air Pressure Sensor Module adopts a high-precision AD sampling chip. It has a 0-40KPa air pressure sensor. Pressure Sensors measure fluctuations in the pressure exerted by the atmosphere. It can connect a 2.5mm hose and also can detect water level and other air pressure. It is used for control and monitoring in thousands of everyday applications.

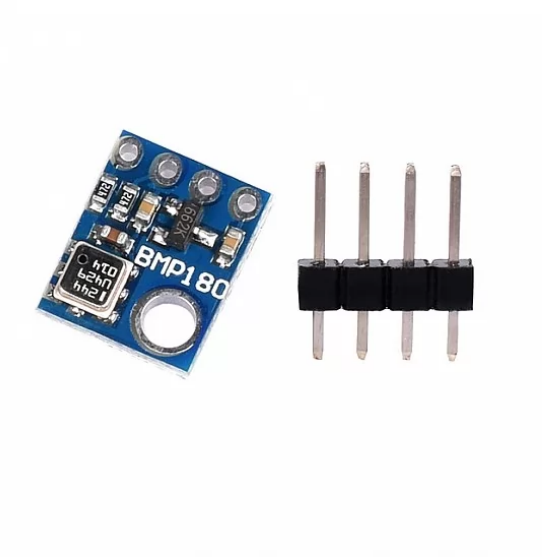


Features:

- Pressure: 0 - 40KPa
- It is compact in size and easy to install.
- Adopt a 5K ohm resistor bridge sensor

BMP 180

BMP180 Digital Barometric Pressure Sensor Module is used for measuring barometric pressure and altitude. It also has a temperature sensor for temperature compensation of pressure measurements. It uses push sensors for the BMP180. It offers a pressure measuring range of 300 to 1100 hPa with a relative pressure error of 0.12 hPa. BMP 180 is a barometric pressure sensor with an I2C interface. Barometric pressure sensors measure the absolute pressure of the air around them. This pressure varies with both the weather and altitude.



Features :

- I2C interface.
- Max I2C Speed: 3.4Mhz
- Pressure conversion time: 5msec
- Fully calibrated.
- Small and easy to use.
- Voltage supply: 1.8 ~ 3.6 V
- Current supply: 5µA at 1Hz
- Peak current: 1000µA
- Very low noise: up to 0.02hPa (17cm)
- Pressure Range: 300hPa to 1100hPa (+9000m to -500m)

LCD Display Module Screen For Arduino(16X2)

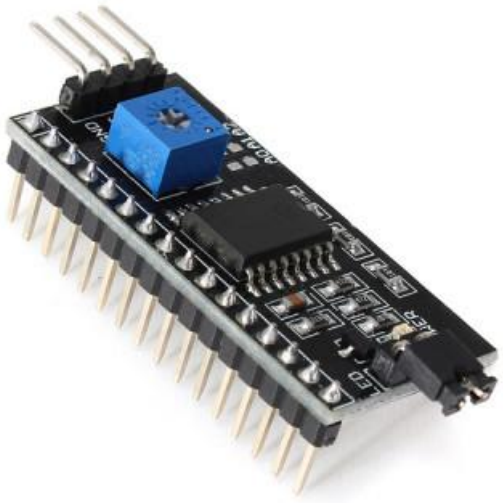
If you want to add some visual output to your Arduino projects, you'll need a display. If you need only a little to display, the LCD1602 Parallel LCD Display is a quite good solution. This is LCD1602 Parallel LCD Display that provides a simple and cost-effective solution for adding a 16×2 White on RGB Liquid Crystal Display into your project. The display is 16 character by 2 line display has a very clear and high contrast.

Features:

- Green backlight 4-bit or 8-bit MPU interface enabled
- 80 X 8-bit display RAM (80 characters max.)
- Working Voltage: 5V
- Standard Type
- Works with almost any Microcontroller
- Compact size, lightweight, and easy to interface

I2C Module for 16x2 LCD

I2C Module has a inbuilt PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display. These modules are currently supplied with a default I2C address of either 0x27 or 0x3F. To determine which version you have check the black I2C adaptor board on the underside of the module. If there a 3 sets of pads labelled A0, A1, & A2 then the default address will be 0x3F. If there are no pads the default address will be 0x27.



Features:-

- Operating Voltage: 5V
- Backlight and Contrast is adjusted by potentiometer
- Serial I2C control of LCD display using PCF8574
- Come with 2 IIC interface, which can be connected by Dupont Line or IIC dedicated cable
- Compatible for 16x2 LCD
- This is another great IIC/I2C/TWI/SPI Serial Interface
- With this I2C interface module, you will be able to realize data display via only 2 wires.

Male to Male Jumper wire

Female to Male Jumper wire

2.5 mm Hose Pipe

Specifications :

- Pipe OD – 4mm (OD- Outside Diameter)
- Pipe ID – 2.5mm (ID- Inner Diameter)
- 3 Feet length
- Material : Polyurethane (PU) | Air Tube Hose Pipe | Heavy Duty
- Working Pressure : 13 Bar

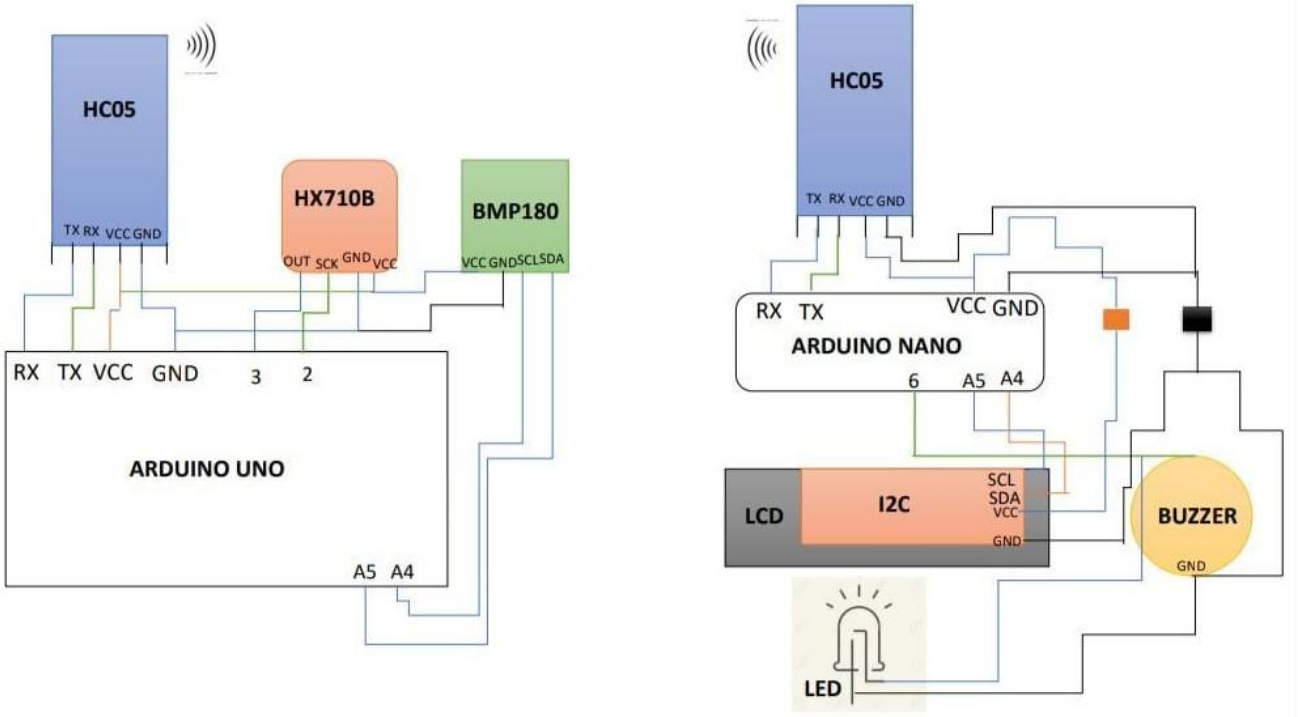
LED LIGHT

Features and Specifications :

- Product : LED Diode (Light Emitting Diode)
- Light Colour : Varying
- LED Type : 5mm

Balloons for prototype testing in place of tyre

CIRCUIT DIAGRAM



This Figure represents the circuit diagram of our project which is well explained and marked in the figure.

WORKING

Sensor Installation: The system requires sensors to be installed on each tire. These sensors are responsible for measuring tire pressure and temperature. They may utilize various technologies such as pressure transducers and temperature sensors to gather the required data.

Data Collection: The sensors continuously monitor the tire pressure and temperature. They transmit this information wirelessly to a central control unit or receiver, typically located inside the vehicle. The control unit acts as a hub for receiving and processing data from all the sensors.

Data Processing and Analysis: The control unit receives the tire pressure and temperature data from the sensors. It processes and analyzes this data using algorithms to determine if the tire conditions are within the recommended range. These algorithms can compare the measured values against predefined thresholds or use more sophisticated methods to detect anomalies or trends.

Alert Generation: Based on the analysis, if the tire pressure or temperature deviates from the recommended range, the control unit generates alerts. These alerts can be visual, auditory, or both, and are typically displayed on a dashboard-mounted screen or communicated to the driver through other means, such as audio signals.

User Interface: The tire monitoring system provides a user interface that allows the driver to access the tire pressure and temperature information. This interface can be a dedicated display on the vehicle dashboard or integrated into existing infotainment systems. It shows real-time tire status, including pressure readings for each tire and warnings for any abnormal conditions.

Maintenance and Response: Upon receiving an alert, the driver can take appropriate actions to address the tire issue. This may involve checking the affected tire, inflating or deflating it as necessary, or seeking professional assistance if the problem persists. The tire monitoring system assists the driver in maintaining optimal tire conditions and provides valuable information for timely maintenance.

APPLICATIONS

1. Automotive Industry: TPMS is widely used in passenger cars, trucks, and commercial vehicles to enhance safety and performance. It continuously monitors tire pressure and alerts the driver if there is a significant deviation from the recommended pressure levels. Maintaining proper tire pressure can improve fuel efficiency, reduce tire wear, and prevent accidents caused by underinflated or overinflated tires.

2. Fleet Management: In the context of fleet management, tire monitoring systems can be highly beneficial. Fleet operators can remotely monitor the tire pressure and temperature of multiple vehicles in their fleet. This helps them ensure the safety and efficiency of their vehicles, optimize fuel consumption, and reduce maintenance costs.

3. Logistics and Transportation: Tire monitoring systems are particularly useful in logistics and transportation companies. By monitoring tire conditions in real-time, these systems help prevent potential tire failures, reduce downtime, and improve the overall efficiency of the fleet. They can also provide valuable data on tire performance, helping companies optimize their tire selection and maintenance schedules.

4. Industrial and Off-road Vehicles: Tire monitoring systems are also employed in heavy machinery and off-road vehicles used in construction, mining, agriculture, and other industries. These systems ensure that the tires are properly inflated and operating within safe temperature ranges, reducing the risk of accidents, improving traction, and prolonging tire life.

5. Motorcycles and Bicycles: Tire monitoring systems can be integrated into motorcycles and bicycles to provide riders with real-time information about tire pressure and temperature. This can enhance safety by alerting riders to any abnormalities and reducing the risk of accidents caused by tire-related issues.

6. Smart City Infrastructure: In the context of smart cities, tire monitoring systems can be used to monitor the condition of tires on public transportation vehicles, such as buses and trains. This helps improve safety, optimize vehicle maintenance, and reduce the risk of breakdowns that can disrupt public transportation services.

7. Sports and Performance Vehicles: Tire monitoring systems are also used in high-performance sports vehicles to monitor tire conditions during races or high-speed driving. This enables drivers to make informed decisions and optimize their vehicle's performance based on real-time tire data.

ADVANTAGES

Safety: One of the primary advantages of a tire monitoring system is enhanced safety. It can alert the driver if there is a sudden loss of tire pressure, which can help prevent accidents and blowouts. Maintaining the correct tire pressure improves vehicle stability, reduces the risk of skidding, and enhances overall road handling.

Fuel Efficiency: Properly inflated tires contribute to better fuel efficiency. A tire monitoring system helps ensure that the tires are inflated to the recommended pressure, which minimizes rolling resistance. This can lead to improved fuel economy and reduced carbon emissions.

Extended Tire Life: Underinflated or overinflated tires can wear unevenly and prematurely. By constantly monitoring tire pressure, a tire monitoring system helps prevent irregular tire wear, leading to longer tire life and reduced replacement costs.

Convenience: Checking tire pressure manually can be time-consuming and inconvenient. With a tire monitoring system, you receive real-time information about the tire pressure and temperature, eliminating the need for manual checks. It provides a convenient and efficient way to keep track of tire health.

DISADVANTAGES

Cost: Implementing a tire monitoring system can be costly, especially for older vehicles that do not have built-in sensors. The system typically requires sensors to be installed on each tire, and the initial investment and maintenance costs can be a deterrent for some vehicle owners.

Sensor Maintenance: Tire pressure monitoring systems rely on sensors, which can be susceptible to damage or malfunction. If a sensor fails, it may require replacement or recalibration, which can be an additional expense and inconvenience.

False Alarms: Occasionally, a tire monitoring system may trigger false alarms due to sensor errors or irregular readings. These false alarms can lead to unnecessary checks or tire replacements, causing inconvenience and added costs.

Limited Features: Basic tire monitoring systems typically provide information about tire pressure and temperature. More advanced systems may offer additional features, such as individual tire position tracking or integration with vehicle information systems. However, these advanced features may not be available in all vehicles or come at a higher cost.

It's important to note that the advantages generally outweigh the disadvantages when it comes to tire monitoring systems. The safety and cost-saving benefits, along with the convenience they provide, make them a worthwhile investment for many vehicle owners.

FUTURE SCOPE

Advanced Sensor Technology: The development of more advanced sensor technology is expected. This includes the use of sensors that can provide even more accurate and precise measurements of tire pressure, temperature, and other relevant parameters. Additionally, the integration of additional sensors, such as tread wear sensors or road condition sensors, could further enhance the capabilities of tire monitoring systems.

Integration with Vehicle Systems: Future tire monitoring systems may be integrated with other vehicle systems, such as the vehicle's onboard computer or infotainment system. This integration would allow for more seamless monitoring and reporting of tire data, as well as providing real-time alerts and notifications to the driver. Integration with advanced driver-assistance systems (ADAS) could also enable proactive tire management and improved vehicle safety.

Wireless Connectivity and Data Analytics: Tire monitoring systems could leverage wireless connectivity and cloud-based data analytics to provide more comprehensive insights and predictive maintenance capabilities. By collecting and analyzing data from multiple vehicles, manufacturers and service providers could identify patterns and trends, optimize tire performance, and provide proactive maintenance recommendations.

Smart Tyres: The concept of smart tires is gaining attention in the industry. Smart tires would incorporate built-in sensors and technology to continuously monitor tire conditions and communicate with the vehicle's systems. They could provide real-time information about tire performance, road conditions, and even adjust tire pressure and tread patterns dynamically to optimize grip and fuel efficiency.

Autonomous Vehicles: As autonomous vehicles become more prevalent, tire monitoring systems will play a crucial role in ensuring their safe operation. Tire monitoring systems that can communicate directly with autonomous vehicle systems and make real-time adjustments based on road conditions, tire wear, and other factors will be important for maintaining optimal vehicle performance and safety.

Energy Harvesting: Future tire monitoring systems may explore energy harvesting techniques to power the sensors. Technologies like piezoelectric materials or kinetic energy recovery systems could be utilized to generate power from the tire's motion, eliminating the need for battery replacements or external power sources.

Data Security and Privacy: With the increasing connectivity of tire monitoring systems, data security and privacy will be paramount. Future developments should focus on robust encryption methods, secure data transmission, and adherence to privacy regulations to protect the sensitive information collected by the tire monitoring systems.

Overall, the future of tire monitoring systems holds tremendous potential for advancements in sensor technology, integration with vehicle systems, data analytics, smart tires, and the support of autonomous vehicles. These developments aim to enhance safety, optimize performance, and provide a more seamless and efficient driving experience for vehicle owners.

CONCLUSION

In conclusion, a tire monitoring system offers significant advantages in terms of safety, fuel efficiency, extended tire life, and convenience. By continuously monitoring tire pressure and temperature, it helps prevent accidents and blowouts, improves vehicle stability, and enhances road handling. Properly inflated tires also contribute to better fuel efficiency and reduced carbon emissions. The system provides real-time information, eliminating the need for manual tire pressure checks and ensuring timely maintenance. However, there are some disadvantages to consider, such as the initial cost of implementation, sensor maintenance, occasional false alarms, and limited features in basic systems. Despite these drawbacks, the overall benefits of a tire monitoring system make it a valuable investment for many vehicle owners, promoting safer and more efficient driving while reducing long-term costs associated with tire wear and replacements.

TOTAL COST ASSOCIATED

EQUIPMENT NAME	QUANTITY	PRICE
ARDUINO UNO	1	₹800
ARDUINO NANO	1	₹300
BREAD BOARD	2	₹120
HC05 BLUETOOTH SENSOR	2	₹400
HX710B PRESSURE SENSOR	1	₹300
BMP180 TEMPERATURE SENSOR	1	₹200
LCD 16x2 DISPLAY	1	₹300
I2C	1	₹200
JUMPER WIRES (MALE TO MALE & MALE TO FEMALE)	AS REQUIRED	₹20
LED	1	₹5
BUZZER	1	₹30
USB CONNECTORS	2	₹100
SOLDERING KIT	1	₹200
PACKET OF BALLOON	1	₹25

TOTAL PRICE :- ₹3000

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