Automatic PUC Detection System

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ABSTRACT
PUC System (Pollution Under Control)System is intended to check emission from in-use vehicles. The Society of Indian Automobile Manufacturers (SIAM) proposes an innovative Automatic PUC Detection System to enhance accountability and reduce false passes in the emission checking process in India. The system aims to minimize human involvement, thereby mitigating malpractices inherent in the current Pollution Under Control (PUC) system. The testing procedure continues to rely on idle tests, with the proposed computerized system incorporating advanced technologies for improved efficiency.

INTRODUCTION

The Pollution Under Control (PUC) System is designed to monitor emissions from in-use vehicles, preventing incomplete fuel combustion and environmental pollution. Neglecting regular PUC tests can lead to unsatisfactory roadworthiness, increased exhaust emissions, and higher road accidents. This paper addresses the need for an improved inspection and maintenance system in India, emphasizing the gaps and potential for enhancements in the existing process.
The invention introduces a novel approach to pollution control by integrating the ESP32 Microcontroller with CO and sound sensors. This system aims to improve the accuracy of emission monitoring and address challenges associated with conventional PUC systems.

Need of Project

Air pollution has emerged as a significant environmental concern, adversely affecting ecosystems, human health, and the overall quality of life. One of the primary contributors to air pollution is vehicular emissions, characterized by the release of pollutants such as carbon monoxide (CO) into the atmosphere. The detrimental impact of these emissions has led to the implementation of stringent regulations and emission standards worldwide. In the context of India, where rapid urbanization and industrialization contribute to elevated pollution levels, addressing vehicular emissions has become a critical imperative.
Moreover, our system stands out as an add-on solution that does not require any changes to the engine configuration.

The Pollution Under Control (PUC) certification has been established regulatory mechanism to ensure that vehicles conform to prescribed emission norms. This certification not only signifies compliance with environmental standards but also serves as a practical measure to mitigate the adverse effects of vehicular pollution.

However, the existing PUC testing process has inherent challenges related to manpower, physical presence, and the efficiency of the testing infrastructure. Recognizing these challenges, our invention seeks to revolutionize the PUC testing system by introducing an automated, technology-driven approach.

- The test procedures currently used do not represent typical driving conditions, and hence the emissions levels measurement cannot be used to generate an emission profile of in-use vehicles.
- PUC center operators are not sufficiently trained.
- No auditing and quality assurance is carried out at the test centers and as a result the measurements are not reproducible from center to center.
- Scope for false passes exists in this system.

Over here we are trying to implement a new concept whereby we will be implementing the CO sensor in the vehicle itself and whenever the CO emission goes above a certain level an SMS will be directly sent to the RTO department and a fine will be levied.

LITERATURE REVIEW

The Pollution Under Control (PUC) certification has been established as a regulatory mechanism to ensure that vehicles conform to prescribed emission norms. This certification not only signifies compliance with environmental standards but also serves as a practical measure to mitigate the adverse effects of vehicular pollution. However, the existing PUC testing process has inherent challenges related to manpower, physical presence, and the efficiency of the testing

infrastructure. Recognizing these challenges, our invention seeks to revolutionize the PUC testing system by introducing an automated.

Testing Layout: Employing an ESP32 microcontroller to automate the monitoring and processing of emission data.
Utilizing a CO sensor module for real-time detection of carbon monoxide levels.
Implementing GSM technology for transmitting emission data to regulatory authorities.
Enhancing the efficiency and accuracy of the PUC testing process through automation.

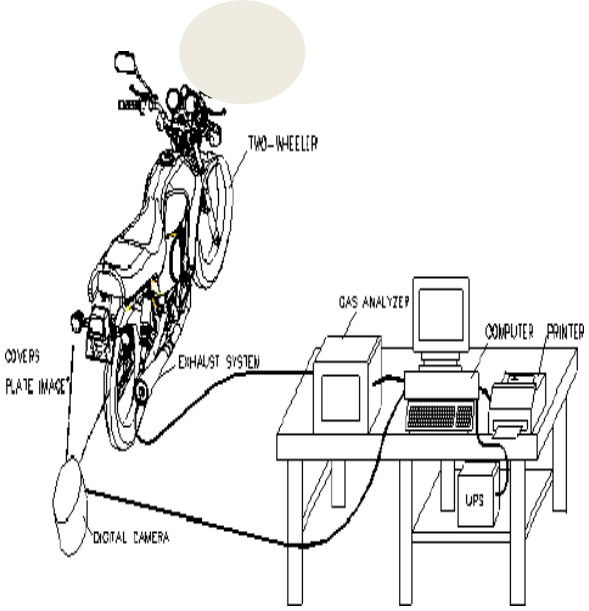


Fig 1: General Layout of the Computerized Testing System

- A method for scalable emissions monitoring, comprising:

Employing an ESP32 microcontroller for continuous and scalable data acquisition. Incorporating a CO sensor module to detect carbon monoxide levels in real-time. Utilizing GSM technology for efficient transmission of emission data to regulatory bodies. Facilitating scalable and adaptable emissions monitoring across diverse geographical settings.

- A system for intelligent vehicular emission testing, comprising:

Integration of an ESP32 microcontroller with CO sensor technology for intelligent data processing. Implementation of GSM technology for secure and efficient communication with regulatory authorities. Continuous monitoring of carbon monoxide emissions to ensure compliance with emission standards. Real-time reporting capabilities for effective and intelligent vehicular emission testing.

- A method for proactive emissions management, comprising:

Continuous monitoring of vehicular emissions using an ESP32 microcontroller. Employing a CO sensor module for the detection of carbon monoxide levels.

- Utilizing GSM technology to transmit real-time emission data to regulatory authorities. Enhancing regulatory compliance and contributing to sustainable emissions management.

Block Diagram:

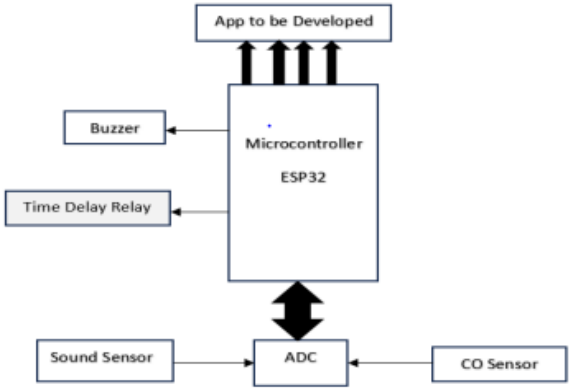


Fig 2: Block Diagram of Automatic PUC Detection System

Block diagram description :

1) ESP32 Microcontroller :-

A single-core 32-bit RISC-V CPU with WiFi and Bluetooth connectivity.specifications of the ESP32 include: Microprocessor with a clock frequency of up to 240 MHz. 520 KB of SRAM, 448 KB of ROM, and 16 KB of RTC SRAM. Supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 150 Mbps. Compatible with Classic Bluetooth v4.2 and BLE specifications. 34 programmable GPIOs for versatile interfacing. Up to 18 channels of 12-bit SAR ADC and 2 channels of 8-bit DAC. Multiple serial connectivity options: 4 x SPI, 2

x I2C, 2 x I2S, 3 x UART. Ethernet MAC for physical LAN communication (external PHY required). Host controller for SD/SDIO/MMC and a slave controller for SDIO/SPI. Motor PWM and support for up to 16 channels of LED PWM.

2) Sound Sensor :-

Monitors noise levels from the vehicle exhaust for pollution control.

3) Time Delay Relay :–

Controls vehicle shutdown after surpassing noise and CO emission limits. Timing element for intentional delay in switching ON/OFF. Built-in time delay function to wait for a fixed amount of time. Applicable in scenarios where delays are required, such as security systems and industrial automation. relays feature a shock absorber system connected to the armature to avoid complete movement upon coil activation or deactivation.

4) Co Sensor:-

The CO Sensor is used to sense the amount of carbon mon-oxide emission of vehicle. It is kept in the exhaust pipe of the vehicle. The MQ-9 Carbon Monoxide, Methane, and LPG Gas Sensor Module is utilized to sense carbon monoxide and methane gas emissions from vehicle exhaust. Key features of the MQ-9 sensor include:

i. Dual-panel design with power and TTL signal output indicators.

ii. DO switch signal (TTL) output and AO analog signal output.

iii. TTL output signal is valid when low.

iv. 0 ~ 5V analog output voltage proportional to gas concentration.

v. High sensitivity to carbon monoxide, methane, and liquefied gas.

vi. Compact dimensions: 32 (L) * 20 (W) * 22 (H) mm.

5) Buzzer:-

A buzzer is employed to provide an audible alert when carbon monoxide levels exceed predetermined thresholds, ensuring the vehicle driver is aware of emission issues. Activates when CO levels surpass predetermined thresholds.

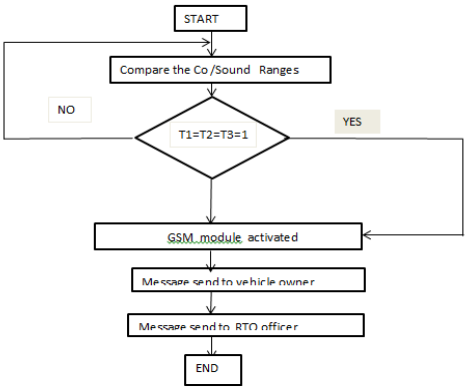
6) GSM module:-

GSM module SIM 300 is used for cellular communication i.e. in this case it is used for sending SMS to the master number.

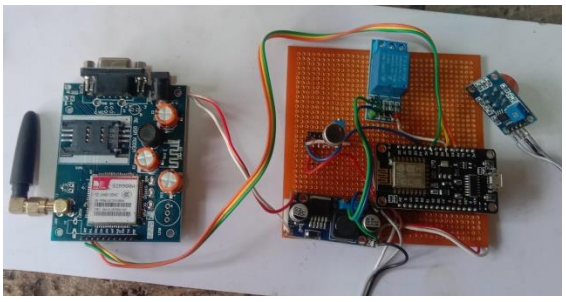
Software Description :-

In our project we use the C language for programming and develop the code ,to fulfill all the conditions which we required in this Automatic PUC Detection system .

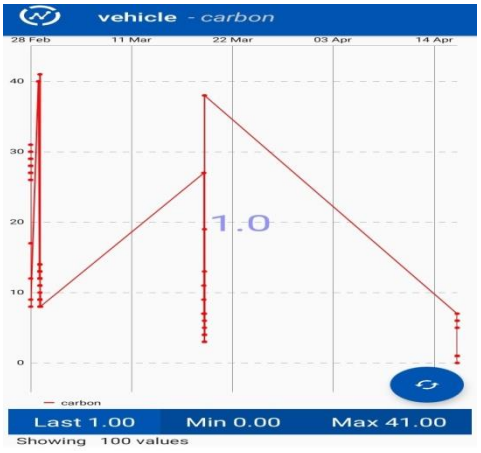
- **FLOWCHART:**



ACTUAL HARDWARE DESIGN :



RESULT AND OUTPUT :



Conclusion :-

The Pollution Under Control (PUC) certification serves as a crucial indicator of a vehicle's compliance with established emission standards, ensuring that its environmental impact remains within acceptable norms.
The mandatory possession of a valid certificate for all vehicles on Indian roads emphasizes the significance of maintaining emissions at environmentally friendly levels.
The motivation behind our initiative is rooted in the necessity to streamline and modernize the PUC testing process. By focusing on reducing manpower requirements and minimizing physical presence during testing, we aim to enhance the efficiency and reliability of the entire system.

Reference :

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