A Project Report

on

Smart Vehicle Management System Using LPC1768 ARM microcontroller.

Submitted by:-

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➢ Abstract

This paper introduces an advanced Smart Vehicle System powered by the LPC1768 microcontroller, integrating Automatic Breaking System (ABS), Battery Level Indication, Seat Belt Warning, Bluetooth Car Door Unlock, and Steering Rotation-Dependent Turn Indicators. The ABS enhances emergency braking, while real-time battery monitoring aids proactive maintenance. Seat Belt Warning ensures occupant safety and an innovative Bluetooth system enables secure car door unlocking. Additionally, turn indicators are automatically activated based on steering rotation, determined by an embedded potentiometer. The LPC1768 microcontroller provides a reliable and scalable platform, offering a holistic approach to vehicle safety, efficiency, and convenience in the era of smart automotive technology.

Keywords: LPC1768, Automatic Breaking System (ABS), Battery Management System (BMS), LCD, Seat Belt Alert System.

➢ Introduction

In the ever-evolving landscape of automotive technology, the integration of smart systems has become imperative to enhance vehicle safety, efficiency, and user experience. This paper introduces a cutting-edge Smart Vehicle System driven by the LPC1768 microcontroller, showcasing a harmonious fusion of innovative features. The system incorporates an Automatic Breaking System (ABS) for heightened safety during emergencies, Battery Level Indication for proactive maintenance, and a Seat Belt Warning System to promote occupant safety. Furthermore, it introduces Bluetooth-enabled Car Door Unlocking for enhanced security and Steering Rotation.

Dependent Turn Indicators using a potentiometer for a seamless and intuitive driving experience. The LPC1768 microcontroller serves as the robust backbone, ensuring reliability and scalability for these intelligent functionalities.

The integration of these features results in a Smart Vehicle System that not only prioritizes safety through advanced obstacle detection and braking but also enhances the overall vehicle performance through temperature regulation and intelligent battery management.

This paper delves into the details of these integrated features and their collective impact on transforming conventional vehicles into smart, responsive, and secure modes of transportation.

➢ Hardware & Software Requirements

Hardware:

- LPC1768 ARM Cortex-M3 Microcontroller: The central processing unit responsible for executing the embedded software and interfacing with various components.
- LCD 16x2 Display: A two-line, 16-character per-line display for providing visual feedback and information to the user.
- 4x4 Keypad: An input device for user interaction, enabling data input and system control.
- ADC (Analog-to-Digital Converter): Facilitates the conversion of analog signals (e.g., sensor readings) into digital values for processing by the microcontroller.

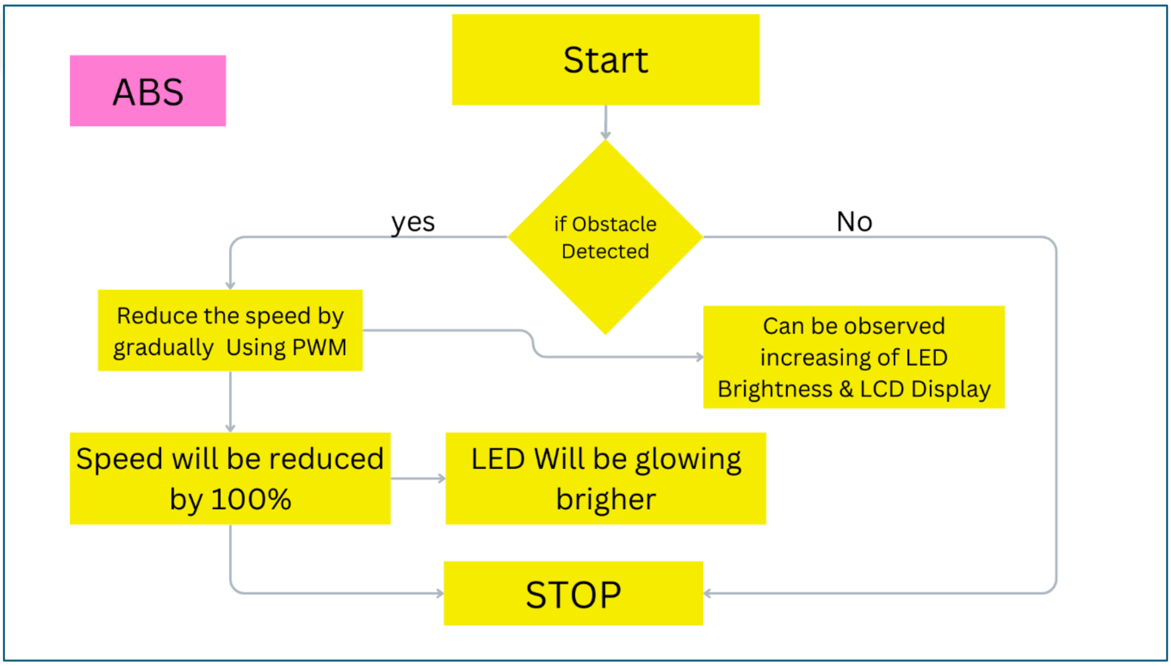
- Buzzer: An audio output device used for generating alerts and notifications.
- Pulse Width Modulation (PWM) Module: Enables control of motor speed, LED brightness, and other applications requiring variable output.

Software:

Keil Software: An integrated development environment (IDE) used for writing, compiling, and debugging the embedded software code for the LPC1768 microcontroller.

➢ Block Diagrams:

1)



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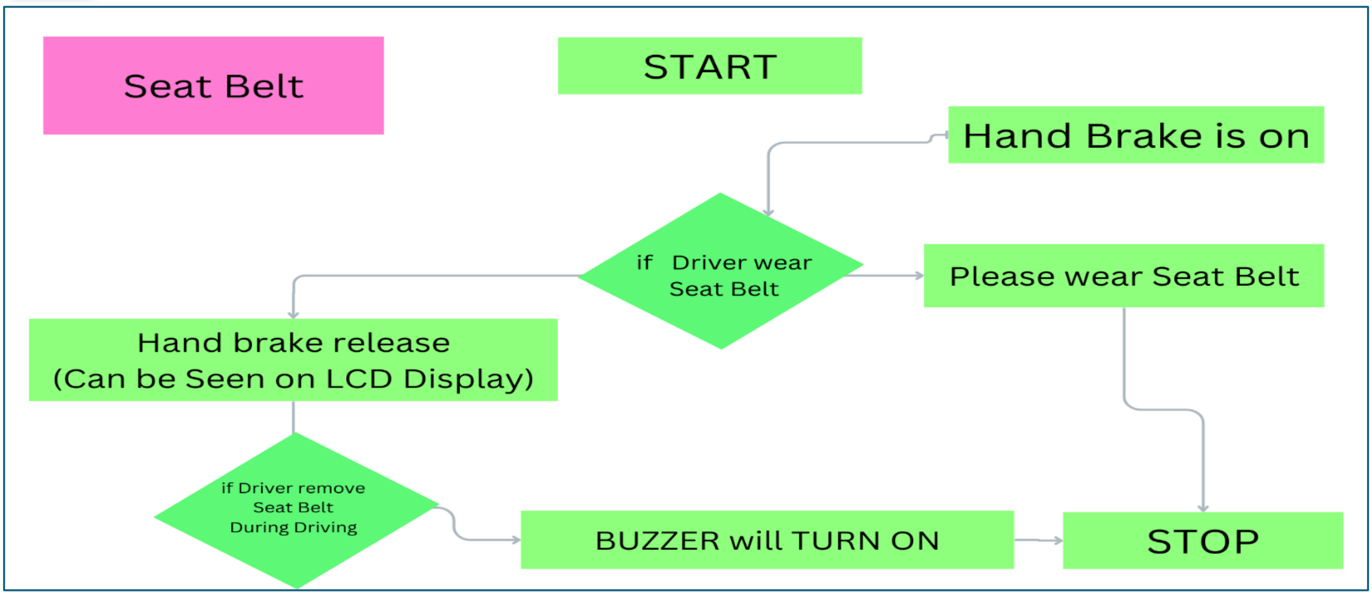

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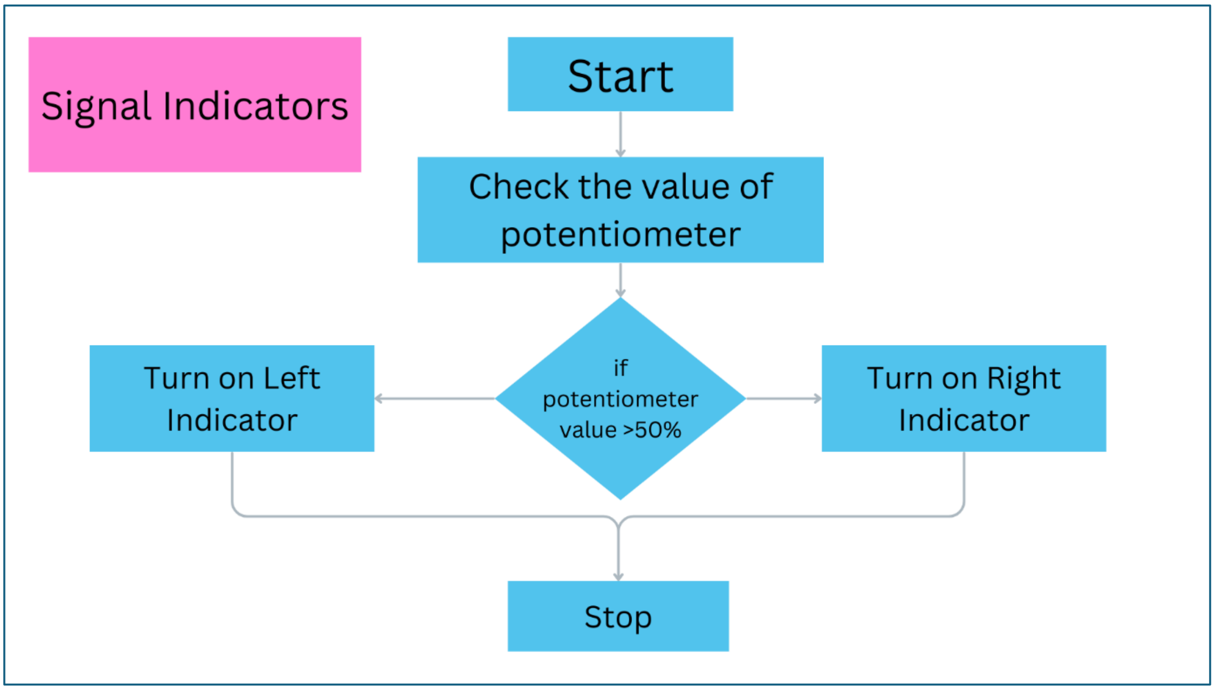
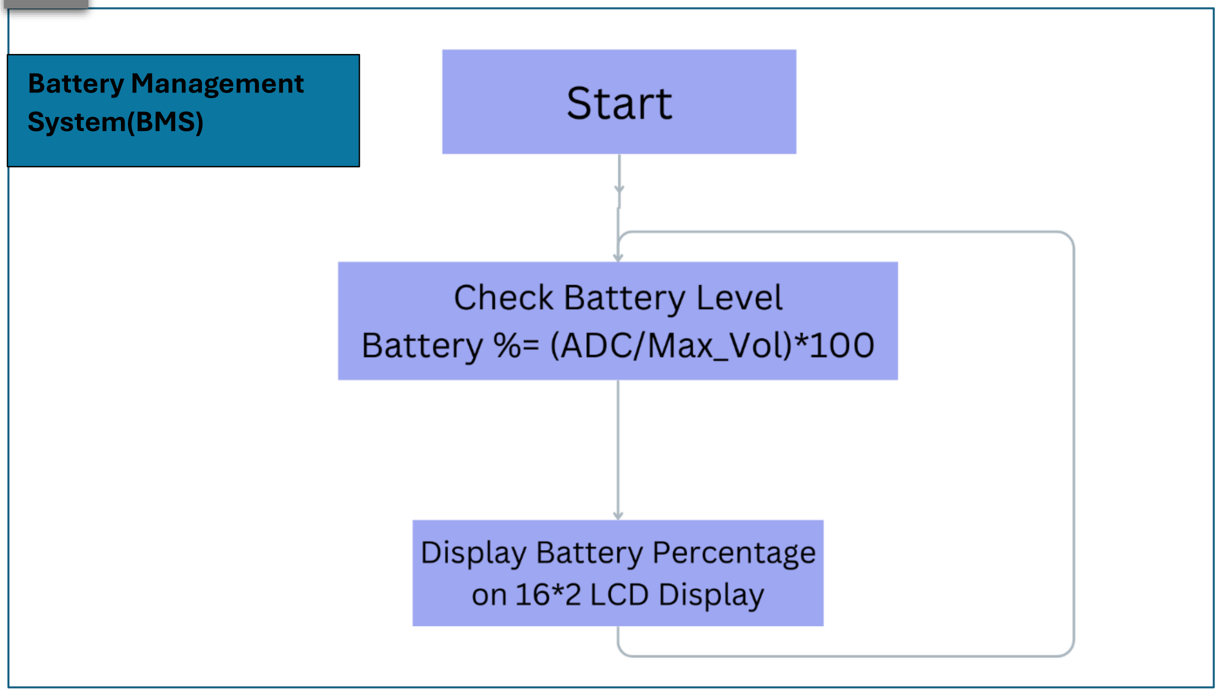
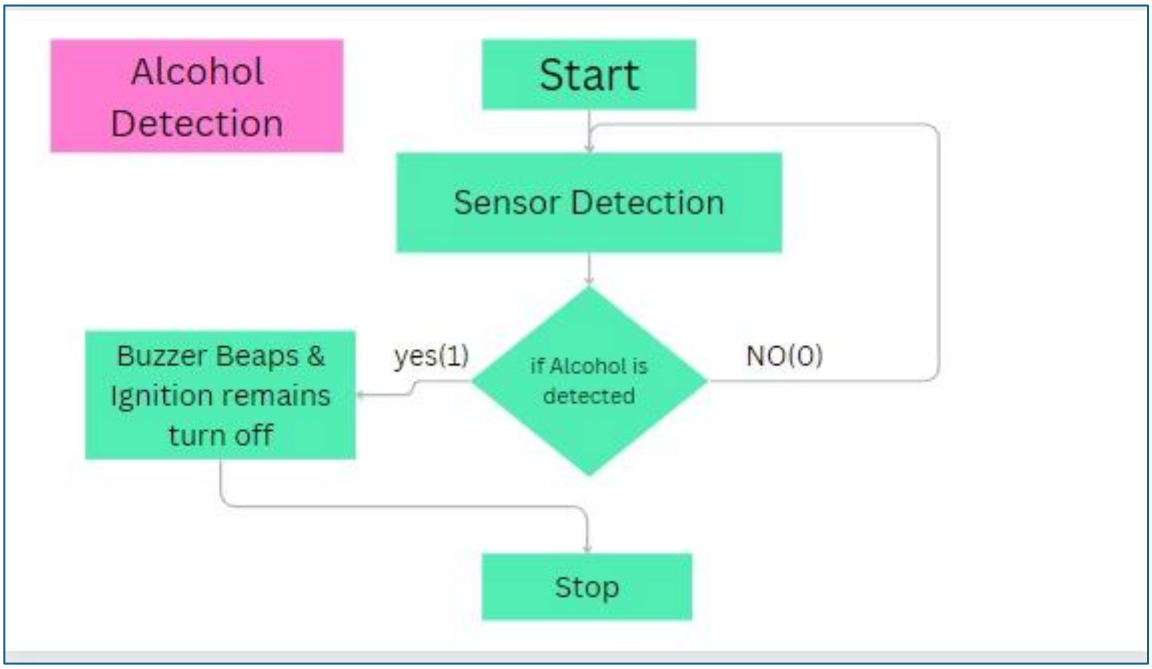

Signal Indicators
Start
Check the value of potentiometer
if potentiometer value >50%
Turn on Left Indicator
Turn on Right Indicator
Stop

4)


Battery Management System(BMS)
Start
Check Battery Level
Battery %= (ADC/Max_Vol)*100
Display Battery Percentage on 16*2 LCD Display

5)



➢ Methodology

Anti-Lock Braking System (ABS) using PWM:

- Implement PWM (Pulse Width Modulation) to gradually slow down the vehicle's wheels.
- Apply PWM signals in increments (20%, 40%, 60%, 80%, 100%) for controlled deceleration.
- Once 100% PWM is reached, the wheel comes to a complete stop.
- Cycle back to the normal state to allow the wheel to resume normal operation.

Seat Belt Alert System with Automatic Handbrake Activation:

- Interface a switch to detect the state of the seat belt (worn or not).
- If the seat belt is not worn, automatically activate the handbrake for enhanced safety.
- Indicate the activated state to the driver through visual or audible alerts.
- When the seat belt is fastened, release the handbrake to its normal state.

Battery Charge Level Indication using ADC:

- Utilize an ADC to measure the voltage, representing the battery charge level.
- Map ADC voltage values to corresponding battery charge levels for real-time indication.
- Display the battery charge level on the 16x2 LCD, providing users with actionable information.

Automatic Turn Light Indicators using Potentiometer:

- Employ a variable resistor (potentiometer) to detect steering wheel rotation.
- Determine the minimum, mid, and maximum values of the potentiometer to establish reference points.
- Mount the potentiometer on the steering wheel, fixing it at mid-value.

- When the steering wheel rotates left (value less than mid), it automatically activates the left turn indicator.
- Similarly, when the steering wheel rotates right (value greater than mid), it activates the right turn indicator.

  Alcohol Detection System:-

  The Alcohol Detection System integrates an alcohol sensor module with the LPC1768 microcontroller to detect alcohol presence in the vicinity of the vehicle. Upon surpassing a predefined threshold concentration level, the system triggers a buzzer (connected to P1.27) to produce an audible alert while simultaneously turning off an LED to indicate ignition off status. An algorithm continuously monitors alcohol concentration readings, ensuring prompt response to intoxication detection. Thorough testing and calibration validate system accuracy and reliability, with safety mechanisms implemented to provide driver intervention options. Integration with the vehicle's ignition system ensures seamless operation, while compliance with regulations and standards ensures adherence to safety protocols.

➢ Design and Implementation

The designed **Anti-lock Braking System** employs an Ultrasonic Sensor and PWM control for intelligent and gradual braking in response to detected obstacles. The system's functionality is rooted in the LPC1768 Microcontroller, which integrates an Ultrasonic Sensor for real-time distance measurements. PWM signals, generated by the microcontroller, progressively decrease their duty cycles (20%, 40%, 60%, 80%) based on distance readings from the sensor. But in our project demonstration, we used A 4x4 keypad to facilitate system activation, with a designated switch, such as switch key[0][0], signaling obstacle detection and initiating the PWM-controlled braking sequence. For a visual demonstration, an LED connected to PORT1.21 reflects the varying brightness to simulate the gradual reduction in vehicle speed.

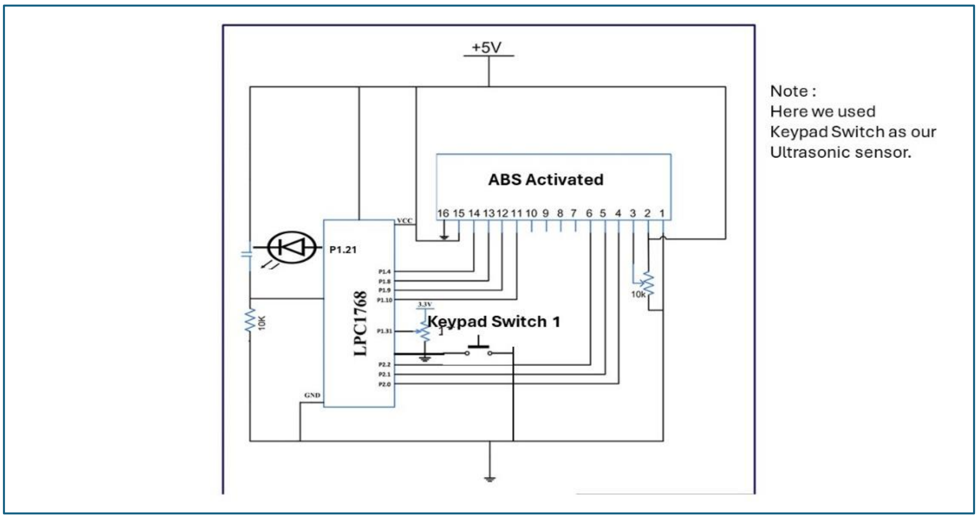


Figure 1 ABS System Circuit.

The safety system prioritizes the driver's well-being through a combination of **seatbelt monitoring**, handbrake engagement, and a buzzer alert. Upon starting the car, the system checks if the seatbelt is fastened; if not, the handbrake is automatically applied until the seatbelt is worn. During driving, any attempt to remove the seatbelt triggers a buzzer alert, prompting the driver to keep it fastened.

Controlled by a master LPC1768 microcontroller, this system serves as a proactive measure to enhance driver safety and promote responsible driving habits.

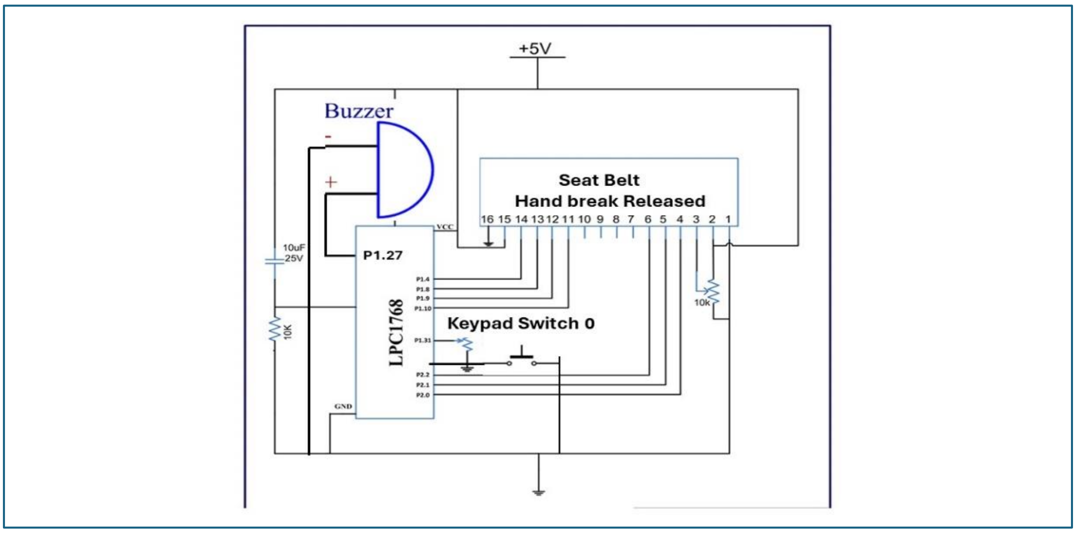


Figure 2 Seat Belt system Circuit.

The Battery Management System real-time monitoring of the car's battery status, displaying the remaining percentage of battery charge on an LCD screen. Utilizing an ADC converter, it reads analog data from the battery and processes it through the LPC1768 microcontroller. This allows the system to accurately calculate and display the battery's remaining charge. Not only does this feature aid users in determining when to recharge the car, but it also offers invaluable insight into battery usage patterns, empowering users to optimize their driving habits for efficiency and longevity of the battery.

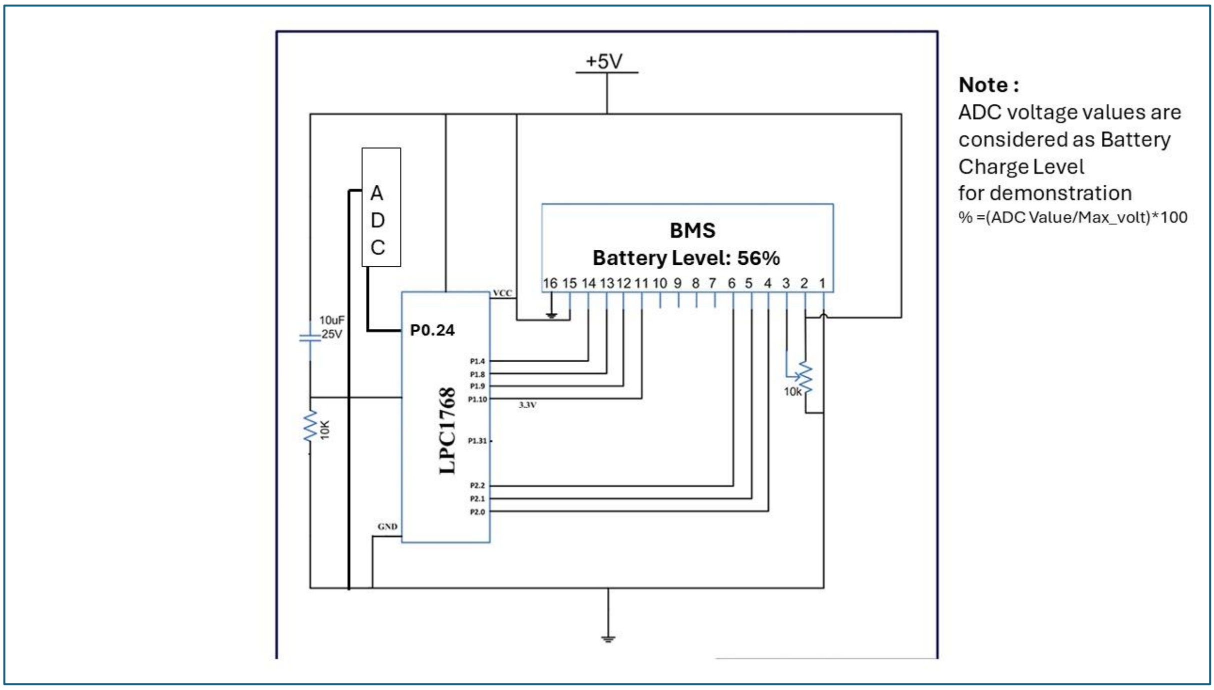


Figure 3 Battery Management System Circuit.

The **Alcohol Detection System** to prevent accidents caused by driving under the influence of alcohol, a serious violation of traffic laws. Employing a Miq3 sensor, it detects the presence of ethanol in the air within the car. This data is transmitted to the master LPC1768 microcontroller, which promptly triggers an indication on the LCD display and halts the car's engine, effectively preventing the driver from operating the vehicle while under the influence.

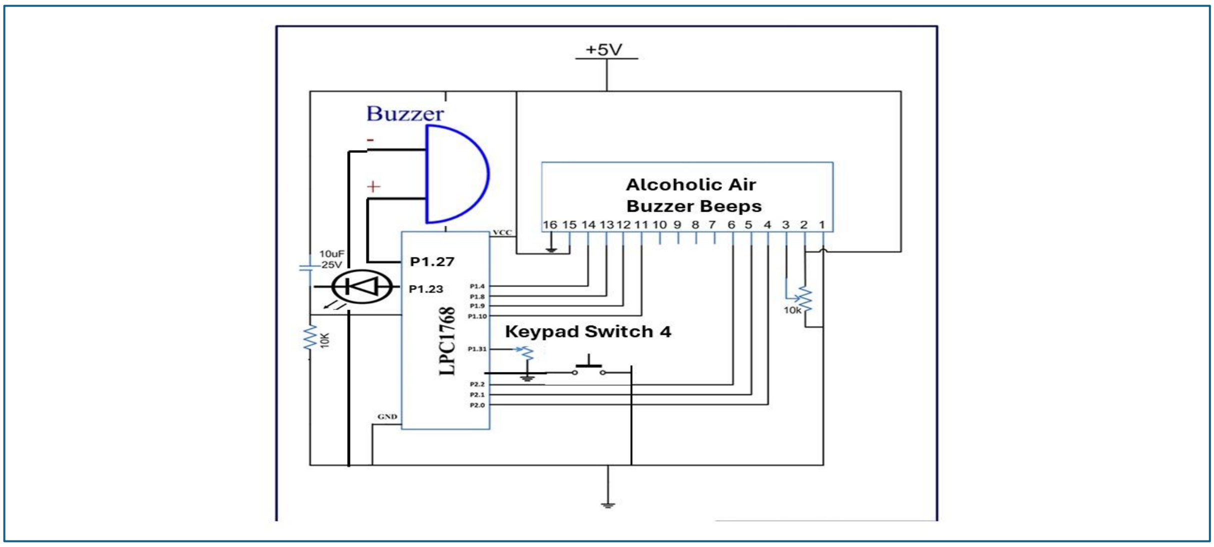


Figure 4 Alcohol detection System Circuit.

By employing **automatic side indicators**, it enhances road safety by utilizing a potentiometer calibrated with the vehicle's steering or handle. As the driver initiates a turn, the potentiometer detects the change in voltage corresponding to the steering movement, transmitting this data to the master LPC1768 microcontroller. Through precise processing of ADC values and comparison with reference thresholds for left or right turns, the system autonomously activates the indicators, ensuring accurate signalling without the need for manual intervention.

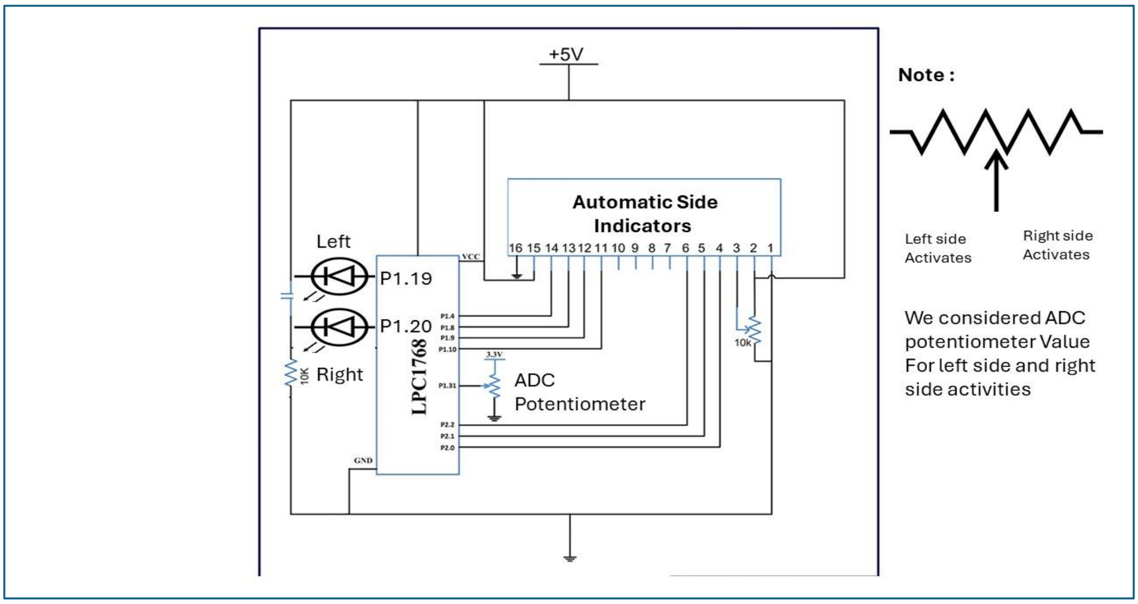


Figure 5 Automatic Turn Indicators Circuit

➢ Testing and Results: -

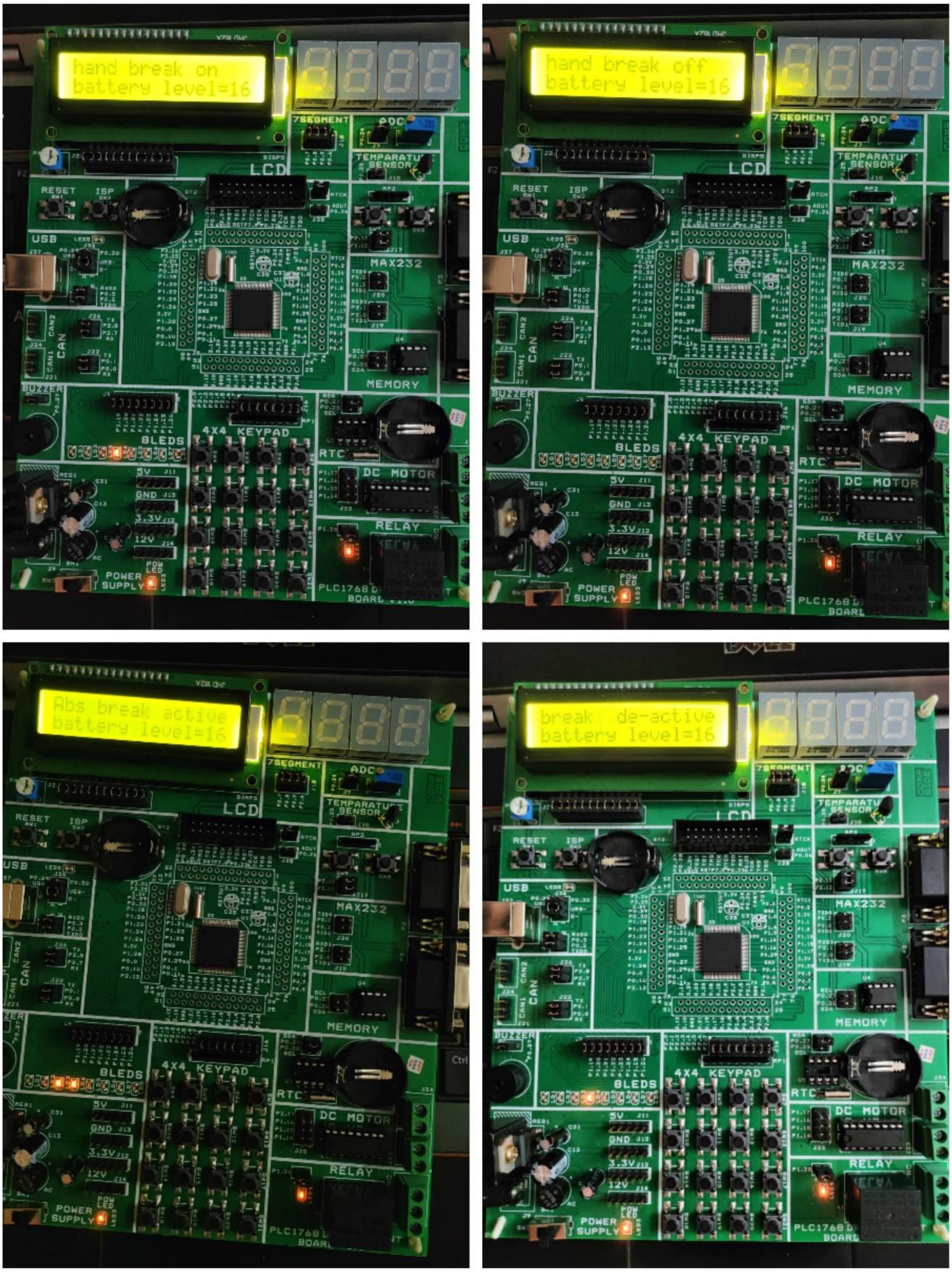


Figure 6 ABS and Seat belt detection and BMS.

- In the integrated vehicle safety system, various features ensure driver and passenger safety. Upon driver entry, the handbrake defaults to the engaged state, visibly indicated on the LCD with the message "HAND BREAK IS ON." Upon fastening the seat belt, the handbrake releases, accompanied by an LCD notification stating "HAND BREAK DEACTIVE." However, if the driver removes the seat belt during the journey, a buzzer alerts them.
- The Automatic Braking System (ABS) engages upon obstacle detection, gradually reducing wheel speed via PWM control, showcased through LED brightness modulation. Upon activation, the LCD displays "ABS activated," releasing the brake upon reaching 100% duty cycle, as indicated on the LCD.
- Battery level indication utilizes ADC voltage values for accurate battery charge percentage, continually displayed on the LCD.
- Additionally, an Alcohol Detection feature activates upon alcohol consumption, detected by the sensor, subsequently halting ignition, visually represented by LED status and indicated on the LCD with the message "Alcohol detected." This comprehensive system ensures enhanced safety and security during vehicle operation.
- For the Automatic Left and Right Indicators, the system utilizes ADC voltage values, setting specific thresholds for left and right turns. When the ADC voltage surpasses the threshold for a left turn, the left indicator is activated, visually indicated on the LCD with the message "Left indicator on." Similarly, if the ADC voltage exceeds the threshold for a right turn, the right indicator is activated, and the LCD displays "Right indicator on." This functionality enhances driver communication and awareness, ensuring safer navigation on the road.

Note :

- For seat belt detection buzzer beeps (Port1.27)
- For the Breaking system you can observe by simulation as well as from the brightness of the LED (Port 1.21).
- For battery charge level indication you can observe the levs on LCD.
- Automatic Turn indicators are demonstrated by rotating the knob of the adc potentiometer you can observe the left led(Port 1.19) , and for right indicator(Port1.20)
- Now the alcohol detection is shown by beeping the buzzer(Port1.27) and the Ignition off position is shown with the help a lead (Port1.23).

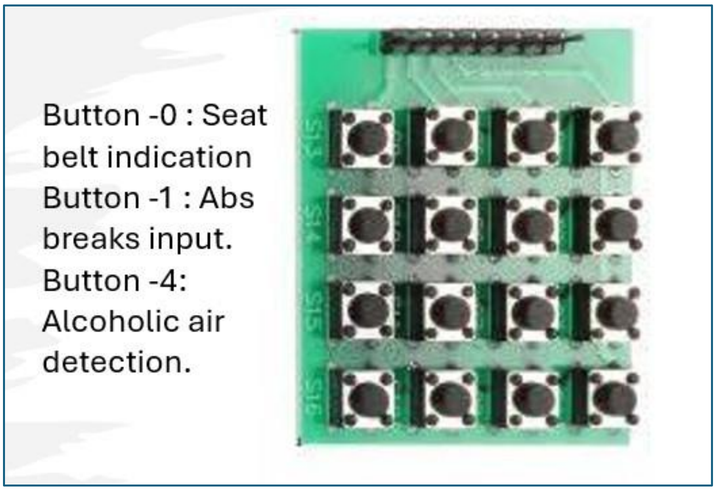


Figure 7 Key pad Indication

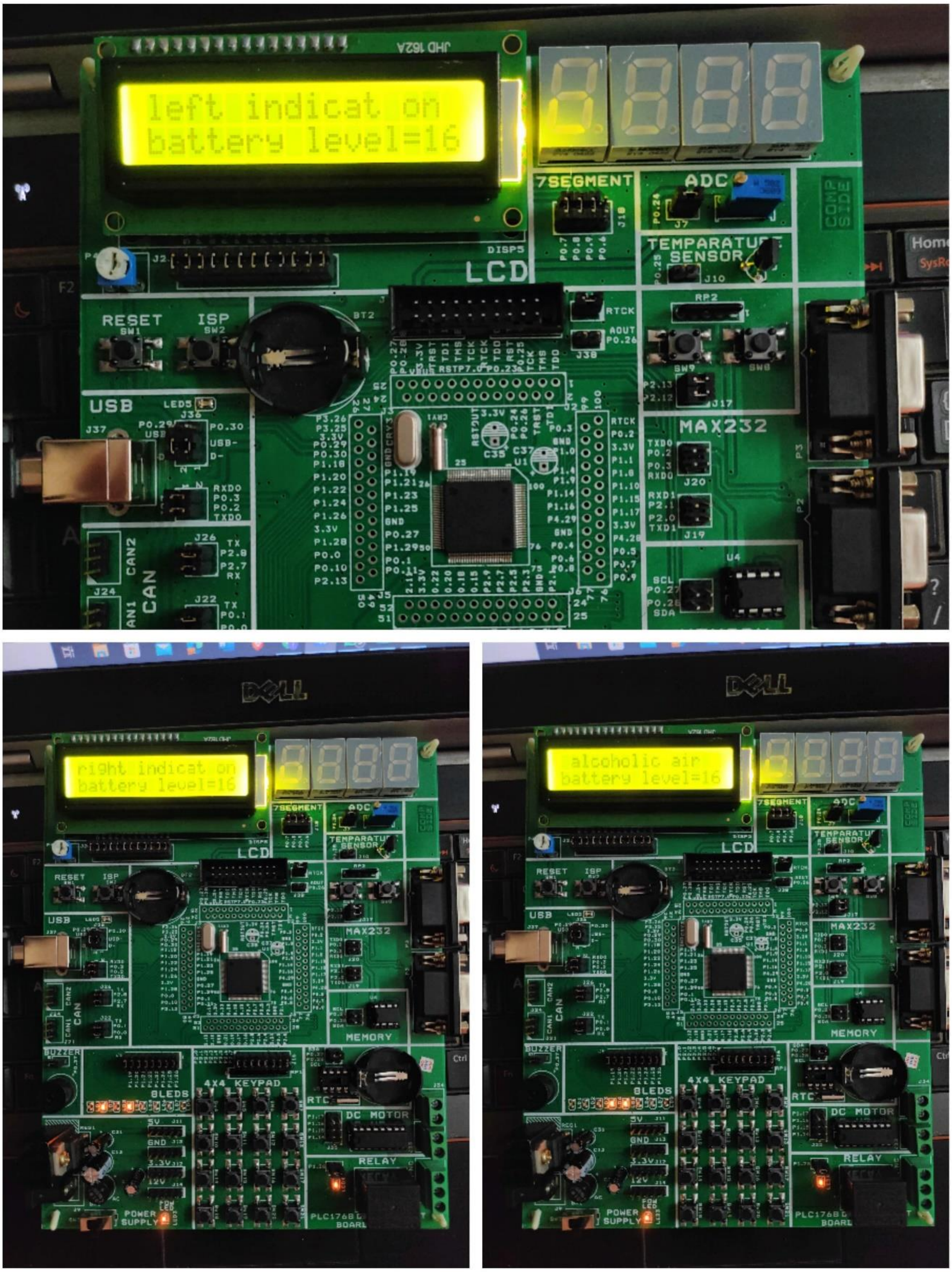


Figure 8: Automatic Turn Indicators and Alcohol Detection

➢ Applications:

- **<u>Anti-Lock Braking System (ABS):</u>**

  It is a safety feature that prevents the wheels from locking up when braking.
  ABS has the potential to avert fatal accidents that may result in loss of life.

- **<u>Seat Belt Alert System with Automatic Handbrake Activation:</u>**

  It alarms typically use audible and visual alerts to encourage seat belt usage.
  It thereby helps in enhancing road safety and compliance with seat belt laws.

- **<u>Automatic Turn Light Indicators using Potentiometer:</u>**

  It can decrease the chance of unexpected lane changes or turns that surprise other drivers.
  A driver uses these signaling devices to communicate what they intend to do to other road users.

- **<u>Alcohol Detection System:</u>**

  Alcohol detection and engine locking systems can help prevent accidents due to drunk driving.
  The system can send an emergency siren to alert other motors and prevent a crash.

- **<u>Battery Charge Level Indication using ADC:</u>**
  It can provide real-time and historical information on voltage, power consumption, temperature, and more.
  Battery monitoring can help predict the state of health and failure of each battery in a string.

➢ Future Scope:

The Automatic Braking System has promising future prospects, with several avenues for further development and enhancement:

- **Integration with Advanced Driver Assistance Systems (ADAS):** The system can be integrated with ADAS technologies to create a comprehensive safety suite, including features like lane departure warning, adaptive cruise control, and collision avoidance systems.
- **Enhanced Sensor Technologies:** Advancements in sensor technologies, such as LiDAR and radar, can further improve the system's accuracy and reliability in detecting obstacles and determining distances.
- **Artificial Intelligence and Machine Learning:** Implementing AI and ML algorithms can enable the system to learn and adapt to different driving conditions, improving its responsiveness and effectiveness.
- **Vehicle-to-Everything (V2X) Communication:** Integration with V2X communication systems can enable vehicles to exchange information with infrastructure and other vehicles, enhancing overall safety and efficiency on the road.

- **Regulatory Standards and Adoption:** With increasing emphasis on vehicle safety regulations worldwide, there is a growing demand for advanced safety systems like automatic braking. Future developments may focus on meeting and exceeding regulatory standards to ensure widespread adoption and acceptance in the automotive industry.
- Overall, the Automatic Braking System holds significant potential for continued innovation and deployment, contributing to safer and more efficient transportation systems in the future.

➢ References: -

1. https://pubs.aip.org/aip/acp/article-abstract/1952/1/020014/1008250/Anti-lock-braking-system-ABS-and-regenerative

2. https://ieeexplore.ieee.org/abstract/document/7916857

3. https://www.tandfonline.com/doi/abs/10.1080/00423111003706755

4. Junyi Shen, Alireza Khaligh, "Design and Real-Time Controller Implementation for a Battery-Ultracapacitor Hybrid Energy Storage System", IEEE Transactions On Industrial Informatics, Vol. 12, No. 5, pp. No: 1910–1918, October 2016.https://doi.org/10.1109/TII.2016.2575798

5. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=2b69e497dca433f4172a265005a560854d9084fe

6. Lee, S., & Lee, H. (2019). A Smart Car System Using Ultrasonic Sensors. 2019 International Conference on Electrical Engineering and Information Technology (ICEEIT). doi: 10.1109/ICEEIT.2019.8718801

7. Soni, S., & Singh, P. (2020). Design and Development of Automatic Braking System Based on Distance Measurement Using Ultrasonic Sensor. 2020 5th International Conference on Inventive Computation Technologies (ICICT). doi: 10.1109/INVENTIVE49393.2020.9198039

8. Biswal, S., Mishra, P., & Roul, B. (2018). Development of a Prototype Model of Automatic Braking System Using Ultrasonic Sensors. 2018 3rd International Conference on Computational Systems and Information Technology for Sustainable Solutions (CSITSS). doi: 10.1109/CSITSS.2018.8672913

9. Chowdhury, A., Islam, M., & Rahman, M. (2017). Automatic Braking System for Autonomous Vehicles Using Ultrasonic Sensor. 2017 4th International Conference on Advances in Electrical Engineering (ICAEE). doi: 10.1109/ICAEE.2017.8250221

10. Natarajan, A., & Vimala, A. (2019). Implementation of Automatic Braking System Using Ultrasonic Sensor. 2019 2nd International Conference on Advanced Computational and Communication Paradigms (ICACCP). doi: 10.1109/ICACCP.2019.8885657