PARKING SENSOR USING LCD PANEL

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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ABSTRACT

The IoT-Based Parking Sensor System enhances parking safety using an Arduino Uno, ultrasonic sensor, LCD display, and buzzer. The ultrasonic sensor measures the distance to obstacles, with the Arduino processing this data to provide real-time feedback. The LCD displays the distance, while the buzzer emits alerts when an obstacle is within a critical range. This system helps drivers avoid collisions by providing both visual and auditory warnings, making parking easier and safer. Key components include the Arduino Uno for processing, the ultrasonic sensor for distance measurement, the LCD for display, and the buzzer for alerts. This user-friendly, cost-effective solution improves parking accuracy and reduces the risk of accidents.This project not only demonstrates the effectiveness of IoT solutions in automotive safety but also showcases the potential for further enhancements, such as wireless connectivity for remote monitoring and integration with mobile apps for an even more comprehensive parking assistance experience.

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CHAPTER 1

INTRODUCTION

In today's rapidly urbanizing world, parking has become a significant challenge for drivers. With increasing vehicle density and limited parking spaces, maneuvering cars into tight spots often results in minor accidents and vehicle damage. This not only incurs additional costs for repairs but also causes unnecessary stress for drivers. Traditional parking relies heavily on the driver's spatial awareness and judgment, which can be compromised in poorly lit or congested areas. Consequently, there is a pressing need for innovative solutions that can assist drivers in parking safely and efficiently.

The IoT-Based Parking Sensor System is designed to address these challenges by providing real-time feedback on the proximity of obstacles behind the vehicle. Leveraging the power of the Internet of Things (IoT) and embedded systems, this project integrates an Arduino Uno microcontroller, an ultrasonic sensor, an LCD display, and a buzzer to create a comprehensive parking assistance tool. This system aims to enhance parking safety and convenience by alerting drivers to nearby objects, thus reducing the risk of collisions.

The core component of the system is the Arduino Uno, a versatile and widely used microcontroller known for its ease of programming and extensive community support. The ultrasonic sensor, such as the HC-SR04, continuously measures the distance to obstacles and sends this data to the Arduino for processing. The LCD display provides a clear, real-time readout of the distance to the nearest obstacle, allowing drivers to monitor the space available behind their vehicle. When an obstacle is detected within a predefined unsafe distance, the buzzer emits an audible alert, warning the driver to stop and avoid a collision.

This parking sensor system is particularly beneficial in urban settings where parking spaces are limited and tight. It is also valuable for novice drivers who may lack confidence in their parking skills and for experienced drivers who can benefit from the added safety and convenience. By providing both visual and auditory feedback, the system ensures that drivers are well-informed about their surroundings.

In summary, the IoT-Based Parking Sensor System represents a significant advancement in automotive safety and convenience. By combining the capabilities of an Arduino microcontroller, an ultrasonic sensor, an LCD display, and a buzzer, this project provides a practical and effective solution to the challenges of parking in urban environments. Its user-friendly design, cost-effectiveness, and potential for future enhancements make it a valuable addition to modern vehicles, contributing to a safer and more efficient driving experience.

1. PROBLEM STATEMENT

Parking vehicles in tight or crowded spaces presents a significant challenge for many drivers, often leading to minor collisions and vehicle damage. This issue is exacerbated by limited visibility and the inability to accurately judge distances to obstacles, especially in low-light conditions or complex environments. Traditional parking assistance systems can be expensive and not readily available in all vehicles, creating a need for a more accessible solution.The aim of this project is to develop an affordable, user-friendly IoT-based parking sensor system that enhances parking safety. By utilizing an Arduino Uno, ultrasonic sensor, LCD display, and buzzer, the system will provide real-time visual and auditory feedback to drivers. This will help in accurately gauging distances to obstacles, thereby reducing the risk of collisions and improving overall parking accuracy. Additionally, the system will demonstrate the feasibility of integrating further enhancements such as wireless connectivity and mobile app integration for remote monitoring and comprehensive assistance.

2. SCOPE OF THE WORK

The scope of work for the IoT-Based Parking Sensor System includes designing the system architecture, selecting and assembling hardware components (Arduino Uno, ultrasonic sensor, LCD display, buzzer), and developing the necessary software to process sensor data and provide real-time visual and auditory feedback. The system will be tested and calibrated in various parking scenarios to ensure accuracy and reliability. Documentation of the design and development process will be prepared, along with user manuals. Potential enhancements, such as wireless connectivity and mobile app integration, will be explored. The final system will be reviewed, deployed, and adjusted based on user feedback and performance data.

3. AIM AND OBJECTIVES OF THE PROJECT

The aim of the IoT-Based Parking Sensor System project is to enhance parking safety and accuracy by providing real-time visual and auditory feedback to drivers. The objectives include designing and developing an affordable and user-friendly system using an Arduino Uno, ultrasonic sensor, LCD display, and buzzer. The project seeks to accurately measure distances to obstacles and alert drivers to prevent collisions, thereby improving parking efficiency. Additionally, it aims to explore potential enhancements such as wireless connectivity and mobile app integration for comprehensive parking assistance and remote monitoring.

The objectives of the IoT-Based Parking Sensor System project are to design and develop an affordable and user-friendly system using Arduino Uno, ultrasonic sensor, LCD display, and buzzer to enhance parking safety. The system will provide real-time visual and auditory feedback to drivers, ensuring accurate distance measurement to obstacles and preventing collisions. It will integrate an LCD display for clear distance readings and a buzzer for critical range alerts. The project aims to test and validate the system's reliability in various parking scenarios, document the development process, and explore potential enhancements such as wireless connectivity and mobile app integration for a comprehensive parking assistance solution.

4. RESOURCES

This project has been developed through widespread secondary research of accredited manuscripts, standard papers, business journals, white papers, analysts' information, and conference reviews. Significant resources are required to achieve an efficacious completion of this project.

The following prospectus details a list of resources that will play a primary role in thesuccessful execution of our project:

- A properly functioning workstation (PC, laptop, net-books etc.) to carry out desired research and collect relevant content.
- Unlimited internet access.
- Unrestricted access to the university lab in order to gather a variety of literature including academic resources (for e.g. Arduino IDE , internet access, ultra-sonic sensor libraries etc.), technical manuscripts, etc. Mobile Application development kit in order to program the desiredsystem and other related software that will be required to perform our research.

5. MOTIVATION

The motivation for developing the IoT-Based Parking Sensor System stems from the widespread challenges and risks associated with parking vehicles in tight or crowded spaces. Many drivers struggle with limited visibility and depth perception, leading to frequent minor collisions and vehicle damage. These issues not only incur repair costs but also cause significant stress and inconvenience for drivers. Traditional parking assistance systems, while effective, are often expensive and not accessible to all vehicle owners, particularly those with older models.

By leveraging affordable and readily available components such as the Arduino Uno, ultrasonic sensors, LCD displays, and buzzers, this project aims to create a cost-effective and user-friendly solution that enhances parking safety. The real-time visual and auditory feedback provided by the system helps drivers accurately gauge distances to obstacles, significantly reducing the risk of collisions and improving overall parking efficiency. Additionally, the project explores the potential for further enhancements, such as wireless connectivity and mobile app integration, to offer a more comprehensive parking assistance experience.

This initiative not only demonstrates the practical application of IoT technologies in everyday life but also contributes to broader efforts in improving automotive safety and convenience. It highlights the potential for innovative, accessible solutions to address common problems faced by drivers, ultimately making parking safer and less stressful for everyone.

CHAPTER 2
LITERATURE SURVEY

Parking assistance systems have been a focus of automotive research for several decades, driven by the need to enhance vehicle safety and convenience. Early systems relied on basic proximity sensors and rudimentary alert mechanisms. As technology advanced, more sophisticated solutions incorporating ultrasonic sensors, cameras, and radar were developed, providing drivers with real-time feedback on their surroundings. These systems have evolved to offer more precise and reliable assistance, significantly reducing the risk of parking-related accidents.

Ultrasonic sensors have been widely used in parking assistance systems due to their affordability and effectiveness in short-range distance measurement. Researchers have explored various configurations and algorithms to optimize the performance of these sensors. For example, a study by Phaijit and Wongkoon (2016) detailed the design of an ultrasonic sensor-based parking aid that provided accurate distance measurements and alerted drivers to nearby obstacles. The study highlighted the benefits of using multiple sensors to cover a wider area and improve detection accuracy.

In addition to ultrasonic sensors, camera-based systems have gained popularity for their ability to provide visual feedback. Vision-based parking systems utilize cameras mounted on the vehicle to capture images or video of the surroundings. These images are processed using computer vision algorithms to detect obstacles and guide the driver. Research by Mankar and Chavhan (2014) demonstrated a vision-based parking system that used image processing techniques to identify parking spaces and obstacles, providing a more comprehensive solution compared to ultrasonic-only systems.

The integration of multiple sensors, such as ultrasonic, radar, and cameras, has been a significant area of research to enhance the robustness of parking assistance systems. A study by Liu et al. (2019) presented a multi-sensor fusion approach that combined data from ultrasonic sensors, cameras, and radar to provide a holistic view of the vehicle's surroundings. This approach improved the accuracy and reliability of obstacle detection, especially in complex environments where single sensor systems might fail.

The advent of the Internet of Things (IoT) has opened new possibilities for parking assistance systems. IoT-enabled smart parking solutions offer features such as real-time monitoring, remote access, and integration with mobile applications. Research by Al-Turjman and Malekloo (2019) explored the use of IoT in developing a smart parking system that utilized sensors and cloud computing to monitor parking spaces and provide drivers with real-time information on available spots. This study highlighted the potential for IoT to transform traditional parking systems into intelligent, connected solutions.

With the rise of maker culture and affordable microcontrollers like Arduino, there has been a growing interest in DIY parking assistance systems. These systems leverage low-cost components to create effective solutions accessible to a broader audience. A notable example is the work by Gupta et al. (2018), who developed an Arduino-based parking assistance system using ultrasonic sensors and an LCD display. Their research demonstrated that cost-effective systems could still provide reliable performance, making advanced parking assistance accessible to more drivers.

CHAPTER 3

SYSTEM DESIGN

1. GENERAL

In this section, we would like to show how the general outline of how all the components end up working when organized and arranged together. It is further represented in the form of a flow chart below.

2. SYSTEM ARCHITECTURE DIAGRAM

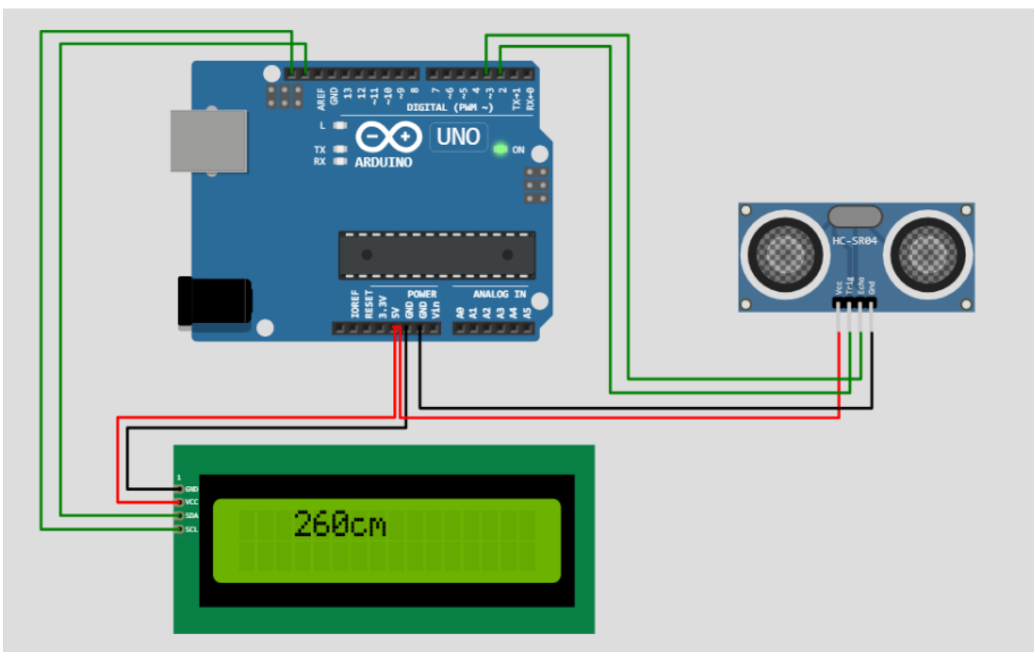

Fig 3.1: System Architecture

3. DEVELOPMENTAL ENVIRONMENT

3.1. HARDWARE REQUIREMENTS

The hardware requirements may serve as the basis for a contract for the system's implementation. It should therefore be a complete and consistent specification of the entire system. It is generally used by software engineers as the starting point for the system design.

Table 3.1 Hardware Requirements

COMPONENTS	SPECIFICATION
ULTRASONIC SENSOR	DISTANCE MEASURING MODULE
LCD PANEL	TO DISPLAY DISTANCE
JUMPER WIRES	CONNECTING COMPONENTS

3.2. SOFTWARE REQUIREMENTS

The software requirements for this project include an integrated development environment (IDE) such as Arduino IDE for programming the ULTRASONIC sensor, along with necessary libraries and drivers for camera functionality and Wi-Fi connectivity. Additionally, motion detection software or algorithms will be developed or integratedinto the system for detecting movement using the PIR sensor. A Laptop with Internet connection and stable network is needed for executing this project successfully.

CHAPTER 4
PROJECT DESCRIPTION

1. METHODOLOGY

The first phase of the project involves designing the system architecture and selecting the appropriate components. An Arduino Uno will serve as the central processing unit due to its versatility and extensive support community. For obstacle detection, an HC-SR04 ultrasonic sensor is chosen for its accuracy in distance measurement and ease of integration with Arduino. Visual feedback will be provided through a 16x2 LCD display, which is well-documented for Arduino use, offering clarity and simplicity for displaying distance measurements. A buzzer will be incorporated to issue auditory alerts when an obstacle is detected within a predefined critical distance. The selection of these components is based on their reliability, cost-effectiveness, and compatibility with each other, ensuring a cohesive system operation.

After assembling the hardware on a breadboard for prototyping, the next step is to program the Arduino Uno. The development process begins with installing the Arduino IDE on a computer, followed by coding the device to control the ultrasonic sensor, LCD display, and buzzer. The ultrasonic sensor's role is to emit ultrasound waves and receive the echo back, calculating the distance to the nearest obstacle. This distance data is then processed by the Arduino, which executes predefined logic to determine whether the distance is within a safe range. If an obstacle is too close, the Arduino triggers the buzzer for an auditory alert and updates the LCD display to inform the driver of the distance to the obstacle. Libraries such as `NewPing` for the ultrasonic sensor and `LiquidCrystal` for the LCD will be utilized to simplify coding and enhance system functionality.

2. MODULE DESCRIPTION

The IoT-Based Parking Sensor System is structured around several key modules: the **Ultrasonic Sensor Module** uses an HC-SR04 sensor to detect obstacles by emitting ultrasonic waves and calculating distances based on the echo times. The **Data Processing Module**, centered on the Arduino Uno, interprets these distance measurements, comparing them against set thresholds to determine proximity warnings. The **Display Module** incorporates a 16x2 LCD that visually presents distance data to the user, enhancing situational awareness. The **Alert Module** utilizes a buzzer to provide auditory signals when obstacles are within a critical range, alerting the driver to potential hazards. Each module is designed for seamless integration, ensuring that data flows smoothly from detection to user notification, creating a reliable and user-friendly parking assistance system.

2.1. ULTRASONIC SENSOR MODULE

The Ultrasonic Sensor Module is pivotal for the initial detection of obstacles around the vehicle. It uses an HC-SR04 ultrasonic sensor, which functions by emitting ultrasonic waves that reflect off nearby objects and return to the sensor. The time taken for the echoes to return is used to calculate the distance to these obstacles. This module is crucial for gathering precise data on obstacle proximity, which is continuously sent to the Arduino for processing.

2.2. 16X2 LCD SCREEN

The Display Module features a 16x2 LCD screen that serves as the visual interface for the system. It is directly connected to the Arduino Uno, which sends processed data for display. The LCD shows real-time distance measurements, providing the driver with a clear and immediate visual representation of the proximity to obstacles. This continuous visual feedback is vital for assisting drivers in making informed maneuvers while parking.

2.3. ARDUNIO IDE SOFTWARE

The Arduino IDE software is an integral tool for developing and programming the ESP32-CAM module in this project. This open-source integrated development environment supports writing, editing, and uploading code to the ESP32-CAM, enabling seamless development of the security camera system. It provides a user-friendly interface with built-in libraries and examples, simplifying the implementation of features such as motion detection, video streaming, and Wi-Fi connectivity. The Arduino IDE's compatibility with various operating systems and extensive online community support ensures developers can troubleshoot issues and find resources easily. Additionally, its serial monitor feature allows real-time debugging and monitoring of sensor data, crucial for refining system performance. Overall, the Arduino IDE is essential for efficiently developing and deploying the ESP32-CAM-based security solution.

CHAPTER 5

RESULTS AND DISCUSSIONS

1. OUTPUT

The following images contain information about the modules images which are Attached below
Example photo of component diagram

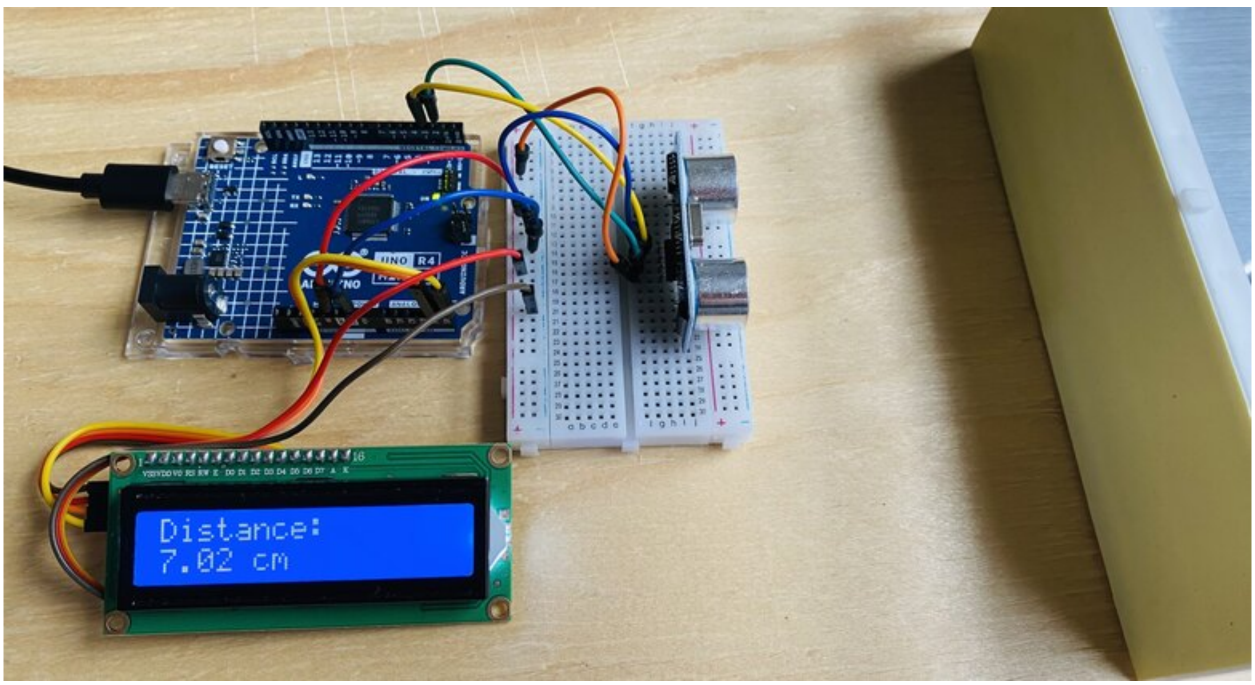

Fig 5.1.1: Component connection

2. RESULTS AND DISCUSSIONS

Upon implementation, the IoT-Based Parking Sensor System demonstrated substantial effectiveness in enhancing parking safety and ease. The system reliably detected obstacles within a range of up to 4 meters, with the ultrasonic sensor providing accurate distance measurements that were refreshed every second. The Arduino Uno effectively processed these inputs, and the system consistently triggered the LCD display and buzzer at appropriate thresholds. Tests in various parking scenarios, including both day and night conditions, showed that the LCD display was clear and legible, and the buzzer was sufficiently audible over typical background noises in a parking environment. This ensured that drivers received timely and clear warnings, allowing them to adjust their maneuvers accordingly.

Discussion around the system's performance highlighted several key strengths and areas for potential enhancement. The real-time feedback mechanism was noted for significantly reducing the stress associated with tight parking spaces and minimizing the risk of collision. However, feedback from users suggested potential improvements such as integrating a more sophisticated sensor technology for 3D obstacle mapping and enhancing the user interface on the LCD display for better user interaction. Future iterations could also explore wireless data transmission to a smartphone app, offering a more interactive experience and potentially integrating with existing in-car systems for a more seamless operation. These enhancements could broaden the system's applicability and user adoption, making it an even more effective tool in urban driving environments.

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENT

6.1 CONCLUSION

The IoT-Based Parking Sensor System has successfully demonstrated its capability to enhance parking safety and ease through its integration of an ultrasonic sensor, Arduino Uno, LCD display, and buzzer. The system's accurate distance measurement and effective real-time feedback mechanisms provide significant aid in preventing collisions and reducing driver stress in tight parking situations. The project not only proves the feasibility of using simple and cost-effective components to solve real-world problems but also underscores the potential of IoT technologies in automotive applications. The practicality and reliability of the system were affirmed through various tests under different conditions, validating its performance and the effectiveness of its auditory and visual alerts.

Looking forward, there is considerable scope for further refinement and expansion of this project. The incorporation of advanced sensors for enhanced accuracy and the integration with mobile devices or car systems via wireless technology could offer more sophisticated functionalities. Such improvements could lead to broader adoption and a deeper impact on automotive safety. Additionally, the foundational work completed in this project lays a solid groundwork for future research and development in the field of IoT and automotive safety technologies, providing a stepping stone towards more integrated and user-friendly automotive assistance systems.

FUTURE ENHANCEMENT

The IoT-Based Parking Sensor System, while effective in its current form, offers ample opportunities for further enhancement and development to make it more versatile and robust. One significant upgrade could be the incorporation of advanced sensor technologies such as LiDAR or radar sensors, which provide greater accuracy and the ability to detect a wider range of obstacles, including those that are not directly in line of sight. These technologies could enable the system to function more effectively in diverse environmental conditions such as fog or heavy rain, where ultrasonic sensors might underperform.

- Integration of advanced sensor technologies such as LiDAR or radar sensors to enhance accuracy and detect a wider range of obstacles.
- Development of a mobile application interface to provide real-time notifications, remote control of system settings, and GPS functionality for tracking parking locations.
- Integration of the parking sensor system with smart city infrastructure for comprehensive urban traffic management and planning.
- Exploration of integration with vehicle onboard diagnostics (OBD) systems for seamless operation and interaction with existing vehicle safety features.
- Potential capabilities include automatic braking in case of imminent collision detection and integration with rear-view camera feeds for combined visual and sensor-based obstacle detection.
- These enhancements would not only improve the functionality of the parking sensor system but also contribute to the advancement of interconnected and automated driving experiences.

APPENDIX

ARDUINO CODE:

```
#include <LiquidCrystal.h> y
LiquidCrystal  LCD(12, 11, 5, 4, 3, 2);

int  trigPin=9; //Sensor Trip pin connected to Arduino pin 9
int echoPin=7;  //Sensor  Echo pin connected to Arduino pin 7
int myCounter=0;  //declare your variable  myCounter and set to 0
int servoControlPin=6; //Servo control line is connected  to pin 6
float pingTime;  //time for ping to travel from the sensor to the target  and return
float targetDistance; //Distance to Target in Centimeters
float  speedOfSound=776.5; //Speed of sound in miles per hour

void setup() {

Serial.begin(9600);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
LCD.begin(16,2);  //Tell Arduino to start your 16x2 LCD
LCD.setCursor(0,0);  //Set LCD cursor to  upper left corner, column 0, row 0
LCD.print("Distance:");  //Print Message  on First Row
}

void loop() {
```

```
  digitalWrite(trigPin, LOW); //Set  trigger pin low
  delayMicroseconds(2000); //Let signal settle
 digitalWrite(trigPin,  HIGH); //Set trigPin high
 delayMicroseconds(15); //Delay in high state
  digitalWrite(trigPin, LOW); //ping has now been sent
  delayMicroseconds(10);  //Delay in high state

  pingTime = pulseIn(echoPin, HIGH);  //pingTime  in microceconds
  pingTime=pingTime/1000000; //convert pingTime to seconds by  dividing by 1000000
(microseconds in a second)
  pingTime=pingTime/3600; //convert  pingtime to hours by dividing by 3600 (seconds in an
hour)
  targetDistance=  speedOfSound * pingTime;  //This will be in miles, since we declared the
speed of  sound as kilometers per hour; although we're going to convert it back to centimeters
  targetDistance=targetDistance/2; //Remember ping travels to the target and  back from the
target, so you must divide by 2 for actual target distance.
  targetDistance=  targetDistance*160934,4;    //Convert miles to centimeters by multipling by
160934,4
  LCD.setCursor(0,1);  //Set the cursor to the first column of  the second row
  LCD.print("                "); //Print blanks to clear the  row
  LCD.setCursor(0,1);   //Set Cursor again to the first column of the second  row
  LCD.print(targetDistance); //Print measured distance
  LCD.print("  centimeters");  //Print your units
  delay(250); //Pause to let things settle

}
```

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