ParkSafe Distance Monitor

Project Synopsis Submitted to

MANIPAL ACADEMY OF HIGHER EDUCATION

For Partial Fulfillment of the Requirement for the Award of the Degree

Of
Bachelor of Technology

in
Information Technology

by

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1. ABSTRACT

Our “ParkSafe Distance Meter” uses state-of-the-art technology to increase parking safety. The parking distance measurement system is built using an ARM microcontroller kit and an ultrasonic sensor. This project aims to provide a reliable and accessible way to guarantee safe parking in congested areas. Some of the main purposes of "ParkSafe Distance Monitor" are to measure the accurate distance between parked cars using ultrasonic sensors. Using a smart notification system with LED lights for distances less than 10 meters, an intuitive design and user interface that provides real-time notifications. Time feedback to users The device has been thoroughly tested and calibrated to demonstrate its durability and utility in a variety of parking situations. “Sustainable cities and communities” can have safer and more sustainable urban environments thanks to “safe distance measurement in parks,” which is in line with Sustainable Development Goal 11 by promoting the use of space. Efficient parking reduces traffic and improves overall safety. In urban environments by promoting safe parking practices in crowded places and developing safer parking options that reduce the likelihood of vehicle damage in the area would be beneficial. To everyone This is in line with the objective of building resilient and sustainable cities.

2. INTRODUCTION

Scope:

This project aims to develop a parking distance tracking system using ultrasonic sensors. It is designed to display real-time distance information on the LCD screen and activate the built-in LED warning system when the distance between vehicles is less than 10 meters, ensuring public safety in crowded parking lots. Proper parking spaces and guidelines will be enforced.

Project Description:

"ParkSafe Distance Monitor" is a sophisticated parking system designed to enhance the parking experience in demanding environments. By using advanced ultrasonic sensors This makes it possible to accurately and in real time measure the distance between parked cars. It is instantly displayed on the LCD screen for easy feedback on parking distance... The system has an intelligent notification mechanism, with LED lights and a buzzer that activates when the distance drops below a safe threshold of ten meters. To promote safe parking practices. This continuous monitoring system is suitable for a variety of applications. This includes commercial, public parking, garages and residential buildings. can be adjusted By optimizing space use and ensuring vehicles are parked at a safe distance. The "Safe Parking Distance Detector" will increase the safety and convenience of parking. Reduces minor vehicle damage. And helps make the parking experience more efficient and flexible.

Problem Statement:

Develop a "ParkSafe Distance Monitor" which has an ultrasonic sensor to measure parking distance in real time. Displayed on the LCD screen, it incorporates an LED alert system and a buzzer that is activated when the distance between vehicles is less than 10 meters, helping to ensure safe parking and reduce the risk of vehicle damage in conditions. Surrounded by dense people...

Objective:

The main objective of the "ParkSafe Distance Monitor" project is to create a reliable and easy-to-use parking distance monitoring system. The system uses ultrasonic sensors to accurately measure the distance between vehicles in real time. Collected data is instantly displayed on the ARM microcontroller kit's LCD screen to provide immediate feedback from the user. The system is also equipped with a smart notification mechanism: The LED lights and audible alarm are activated whenever the distance falls below the recommended safety threshold of ten meters. By seamlessly integrating advanced technology with safety features, ParkSafe Distance Monitor promotes safe parking practices. safe and increases the overall comfort and safety of parking in crowded environments

3. SYSTEM REQUIREMENTS

Hardware Requirements:

- **ARM Cortex-M3 Development Board (ALS-SDA-ARMCTXM3-01)**: Serves as the central microcontroller for processing and controlling the entire ParkSafe Distance Monitor system, handling input data from sensors and managing output alerts.
- **Power Supply (+5V)**: Provides the necessary voltage to power the ARM Cortex-M3 board and its associated components, ensuring stable and reliable operation.
- **HC-SR04 Ultrasonic Distance Sensor**: This ultrasonic sensor is responsible for precise, non-contact distance measurements, with an operational range of 2 cm to 400 cm and an accuracy of up to 0.5 cm, making it ideal for parking distance monitoring.
- **Cross-cable**: Facilitates programming and serial communication between devices, assisting in software uploads and data transfer between the host computer and the ARM Cortex-M3 board.
- **USB to B-type Cable**: Ensures connectivity between the ARM Cortex-M3 board and other peripherals or the host computer system, enabling smooth data transfer and programming.
- **10-core FRC Cables (8-inch length)**: Used for internal wiring within the system, these cables ensure efficient and secure signal transmission between components of the ParkSafe Distance Monitor.
- **LED Indicators:** LEDs (red, yellow, green) to signal safe, caution, and danger zones visually.
- **Buzzer:** Small piezoelectric or active buzzer for audible alerts when objects are within unsafe proximity.
- **Breadboard:** Breadboard for initial prototyping and permanent setup.

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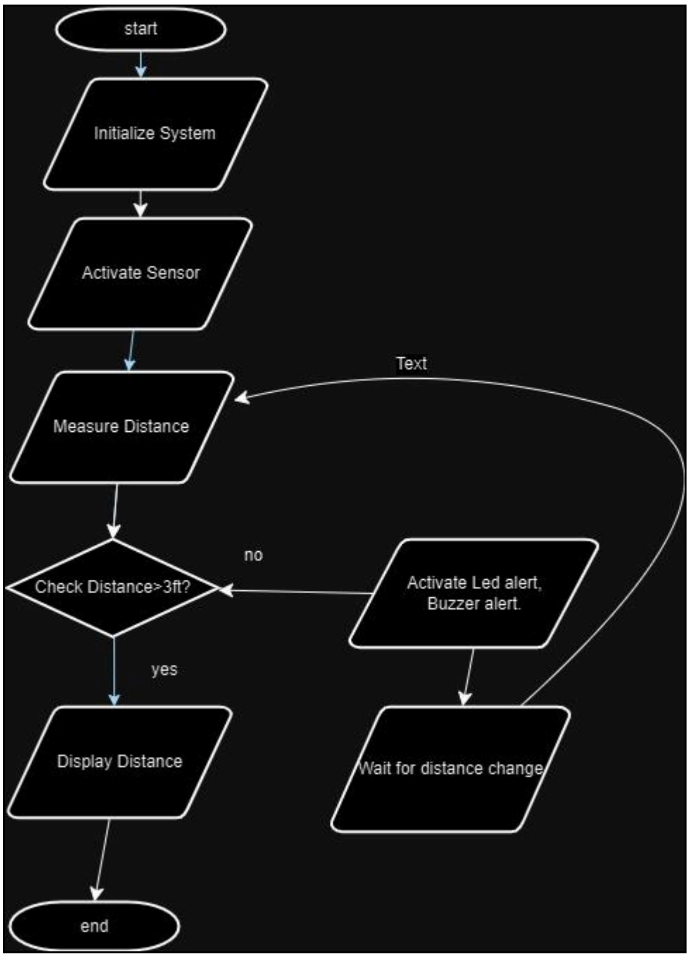
- **IDE: Keil MicroVision**: Used to develop and debug the embedded C code for the ParkSafe Distance Monitor, ensuring smooth and efficient software development.
- **Language: Embedded C**: The programming language used to write the code that controls the microcontroller and the overall functionality of the ParkSafe Distance Monitor.
- **Application: Flash Magic**: Utilized to program the microcontroller with the "ParkSafe Distance Monitor" firmware, enabling the system's operation.

Methodology Diagram



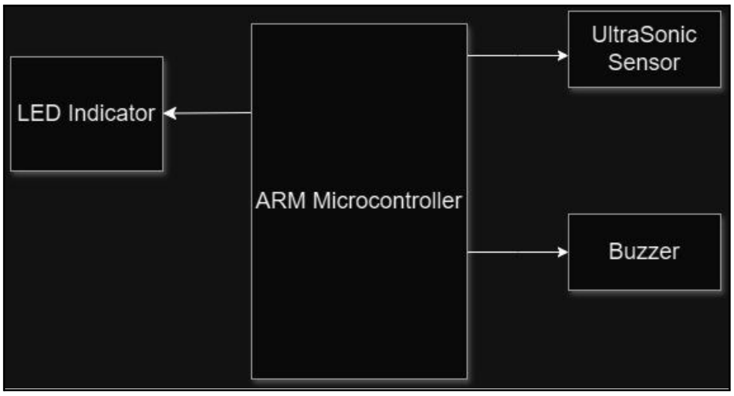


Fig 2: Block Diagram of the project

Fig 1: Flowchart of activities of the project

Based on the activities performed by the application the flow diagram to be made should look like this. This flowchart outlines the basic steps of the system, including initialization, sensor activation, distance measurement, checking if the distance is less than 3 feet, displaying distance, activating the LED alert if necessary, and waiting for a change in distance before looping back to measure the distance again

4. WORKING PRINCIPLE

The HC-SR04 Ultrasonic Distance/Range Sensor uses ultrasound to measure the distance from an object. Ultrasound, whose frequencies exceed the audible range (> 20 kHz), is the basis of its work. With a detection range from 2 centimeters to 4 meters, the HCSR04 module uses a 40 kHz ultrasound signal to measure the distance between itself and any object within the field.

Pinout: In terms of pinout, the module features four pins: VCC (+5V), TRIG, ECHO, and GND. Like SONAR, the ultrasonic sensor incorporates two transducers—one for transmitting ultrasound and the other for receiving the echo. Distance calculation relies on the speed of sound in the air, set at 343 m/s.

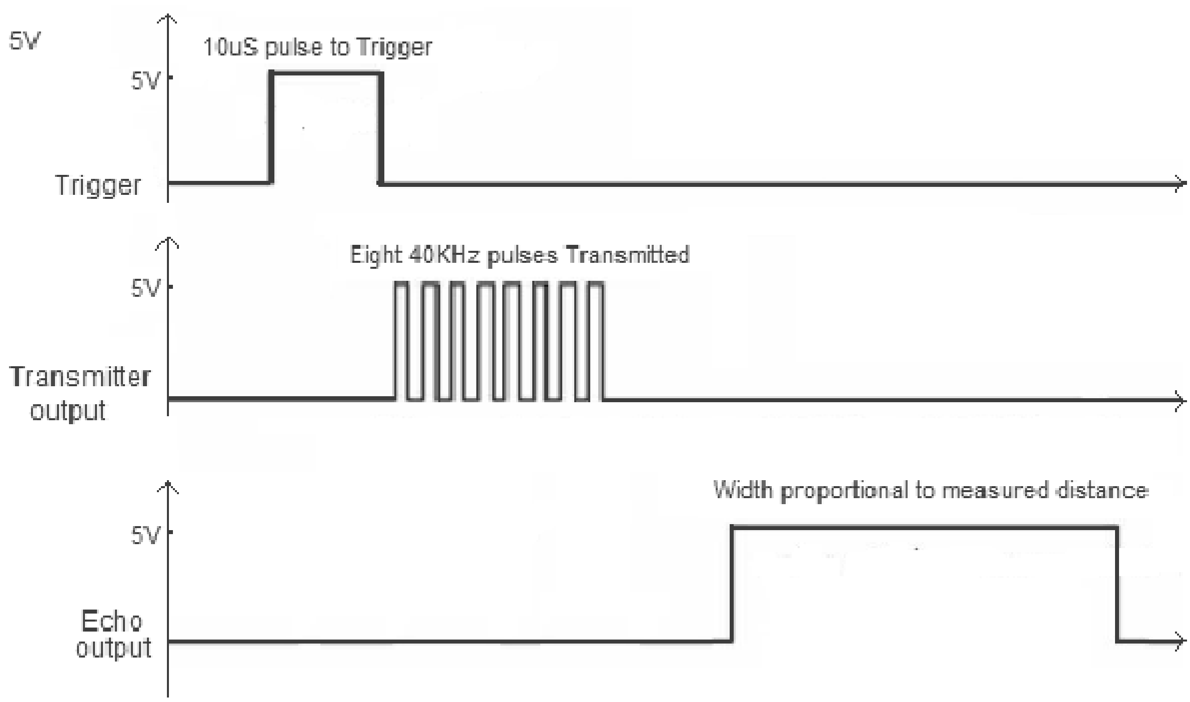


Fig 2: HC SR04 timing diagram

Interfacing HC-SR04:

- The trigger pin is given a short pulse of 10us.
- Upon receiving a trigger pulse, the HC-SR04 Module emits a burst of eight ultrasonic pulses at 40 kHz.
- Then, it outputs a HIGH for the time the sound waves take to reach back.
- The duration of the high pulse is measured and subsequently utilized to determine the distance

Distance Measurement Calculations:

To calculate the distance a sound wave travels, given its speed in air (343 m/s), we use the formula:

$$D = 0.0343 \times \frac{T}{2}$$

where T is the time in microseconds and D is the one-way distance in centimeters. This formula calculates the round trip motion of sound waves. It is suitable for fast distance measurement in centimeters. The time is in microseconds...

Circuit Diagram

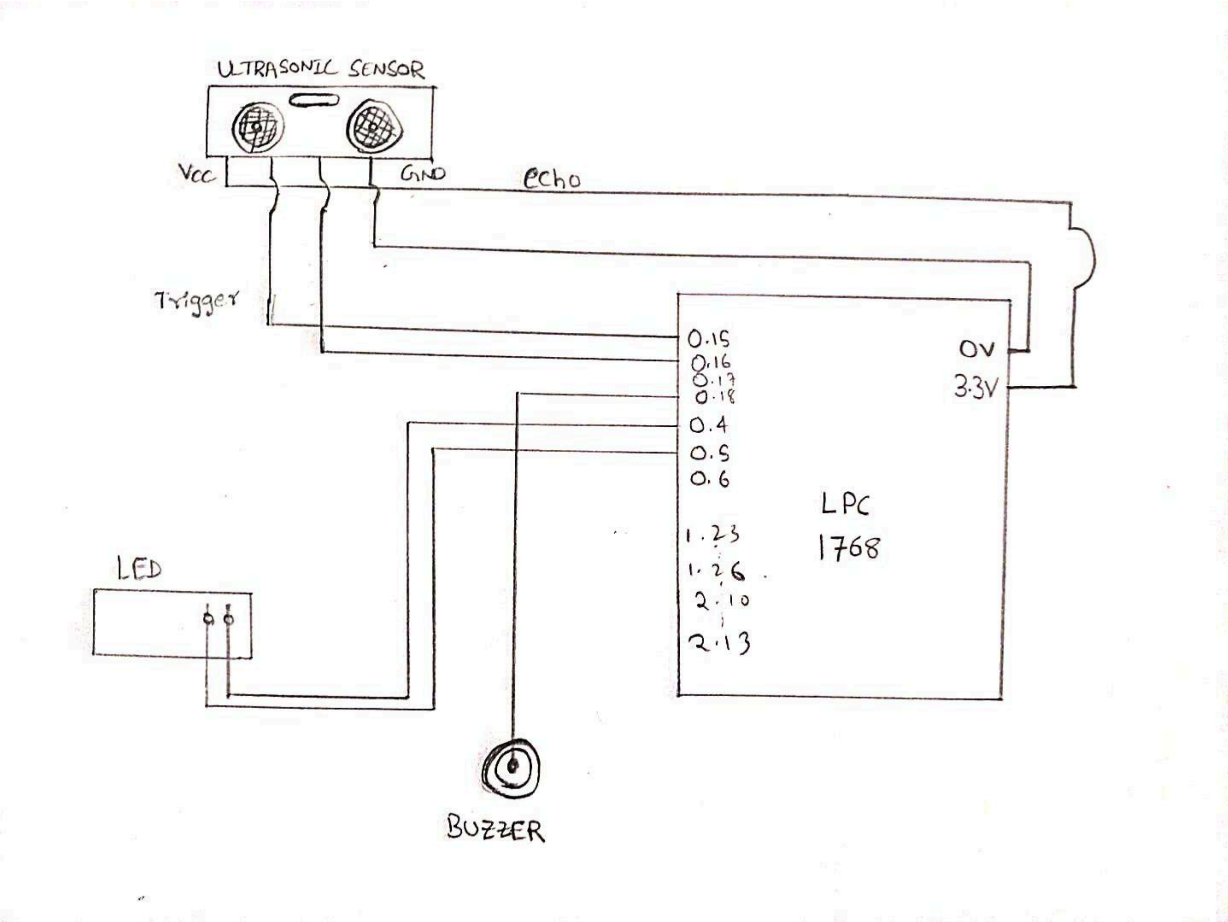


Fig 4: LPC1768 interfaced with HC-SR04 ultrasonic sensor, LEDs, LCD, and buzzer, displaying the respective pin configurations.

5. CODE

```
 LPC_GPIO0->FIOSET = 1 << 28;
 for (j = 0; j < 50; j++);
 LPC_GPIO0->FIOCLR = 1 << 28;
 for (j = 0; j < 10000; j++);
 }
 void lcd_write()
 {
temp2 = (temp1 >> 4) & 0xF;
 port_write();
 temp2 = temp1 & 0xF;
 port_write();
 }


 int main()
 {

 int ledflag=0;
 int command[] = {3, 3, 3, 2, 2, 0x01, 0x06, 0x0C, 0x80};
 char message1[] = "danger!";
 char message2[] = "safe ";
float rounded_down;
SystemInit();
SystemCoreClockUpdate();
initTimer0();
LPC_GPIO0->FIODIR |= BUZZER;
LPC_PINCON->PINSEL0 &= 0xfffff00f; // Interface LEDs P0.4-P0.11
LPC_PINCON->PINSEL0 &= 0x3fffffff; // Interface TRIG P0.15
LPC_PINCON->PINSEL1 &= 0xfffffff0; // Interface ECHO P0.16
LPC_GPIO0->FIODIR |= TRIG | 1<<17; // Direction for TRIGGER pin
 LPC_GPIO1->FIODIR |= 0 << 16; // Direction for ECHO PIN
LPC_GPIO0->FIODIR |= LED << 4; // Direction for LED
LPC_PINCON->PINSEL1 |= 0;
LPC_GPIO0->FIODIR |= 0XF << 23 | 1 << 27 | 1 << 28;
 flag1 = 0;
```

```
 for (i = 0; i < 9; i++)
{
temp1 = command[i];
lcd_write();
 for (j=0; j<100000; j++);
 }
flag1 = 1;
 i = 0;
 flag = 1;
LPC_GPIO0->FIOCLR |= TRIG;
 while (1)
 {
 LPC_GPIO0->FIOSET = 0x00000800;
 // Output 10us HIGH on TRIG pin
 LPC_GPIO0->FIOMASK = 0xFFFF7FFF;
 LPC_GPIO0->FIOPIN |= TRIG;
 delayUS(10);
 LPC_GPIO0->FIOCLR |= TRIG;
 LPC_GPIO0->FIOMASK = 0x0;
 while (! (LPC_GPIO0->FIOPIN & ECHO)) {// Wait for a HIGH on ECHO pin}
 startTimer0();
 //LPC_GPIO0->FIOSET = LED_Pinsel << 4;
 //echoTime--;
 while (LPC_GPIO0->FIOPIN & ECHO); // Wait for a LOW on ECHO pin
 echoTime = stopTimer0(); // Stop Counting
 //LPC_GPIO0->FIOCLR = LED_Pinsel << 4;
 distance = (0.0343 * echoTime) / 40;
 sprintf(ans, " D:%.2fcm", distance);
 delay(999999);
 flag1 = 1;
 i = 0;
 flag1 = 0;
 temp1 = 0x01;
 lcd_write();
 flag1 = 1;
 while (ans[i]!= '\0')
```

```
 {
temp1 = ans[i];
lcd_write();
for (j=0; j<100000;j++);
i++;
}
if(distance < 20 && distance > 15) {
LPC_GPIO0->FIOSET=LED<<4;
LPC_GPIO0->FIOSET=1<<17;
delay(9999);
}
if(distance < 15 && distance > 10){
LPC_GPIO0->FIOSET=LED<<4;
LPC_GPIO0->FIOSET=1<<17;
delay(9999);
}
if (distance < 10) {
LPC_GPIO0->FIOSET=LED<<4;
LPC_GPIO0->FIOSET=1<<17;
LPC_GPIO0->FIOSET = BUZZER;
delay(5555);
}
 else
 {
 LPC_GPIO0->FIOCLR=LED<<4;
 LPC_GPIO0->FIOCLR=1<<17;
 LPC_GPIO0->FIOCLR = BUZZER;
 delay(9999);
 }
 }
 }
```

6. RESULTS

1. Distance > 20 cm

- Safe Distance
- LED: OFF
- Buzzer: OFF

2. 15 cm < Distance ≤ 20 cm

- Caution Zone
- LED: ON
- Buzzer: OFF

3. 10 cm < Distance ≤ 15 cm

- Warning Zone
- LED: ON
- Buzzer: OFF

4. Distance ≤ 10 cm

- Danger Zone
- LED: ON
- Buzzer: ON (continuous beep)

When the "ParkSafe Distance Monitor" detects a distance of more than 20 cm, the LED lights will indicate the safe zone without any light or buzzer sound. When the distance is reduced from 15 cm to 20 cm, the LED lights will be activated to send a signal to the notification area. while the buzzer remains muted. If the distance is less than 10 cm to 15 cm, the LED will light to alert the user to the warning area. The doorbell is still off. Finally, if there is a distance of 10 cm, this indicates a danger zone. Both the LED lights and the buzzer are activated. The alarm will continuously beep to warn the user of nearby obstacles.

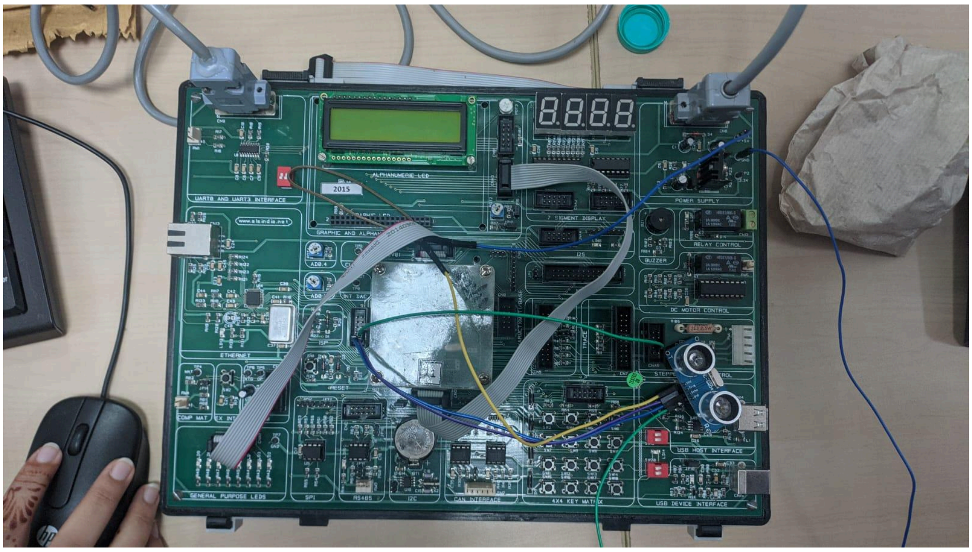


Fig 5: At distance =< 10 cm, both the LED and Buzzer are activated simultaneously

7. CONCLUSION

The "ParkSafe Distance Monitor" is a parking safety solution that uses ARM microcontrollers and ultrasonic sensors to provide real-time distance monitoring, displayed on an LCD screen for user-friendly feedback. Equipped with LED and buzzer alerts for proximity below safe thresholds, it proactively prevents potential collisions and vehicle damage. Aligned with Sustainable Development Goal 11, this system enhances safety and optimizes parking space, contributing to secure, resilient, and sustainable urban environments.

FUTURE SCOPES

- **Integration with smart city infrastructure:** Future developments may include integration of systems with smart city platforms. Enabling data sharing with traffic management systems To optimize traffic flow and real-time parking availability.
- **Mobile Application Connectivity:** Create a mobile application that connects to a remote monitor. and notify users Measuring distance and the availability of parking space Improved user experience and accessibility
- **Advanced Sensor technologies:** Using advanced sensors such as LiDAR or infrared sensors. It can improve the accuracy and distance of object detection. Make the system more reliable in a variety of environments and weather conditions…
- **Machine Learning Algorithms:** Incorporating machine learning can improve the system's ability to predict parking behavior, recognize patterns, and optimize notifications based on user preferences. or past information Improve the overall efficiency of the inspection system.
- **Expand to other applications:** This technology can be adapted to a wide range of applications beyond parking, such as remote monitoring in warehouses. construction site or public area It improves safety and operational efficiency in those environments.

8. REFERENCES

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Referred on: 2nd October 2024

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Aditya P Sajjan	220953029	10	V (CCE)	A

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by Rebanta Mandal

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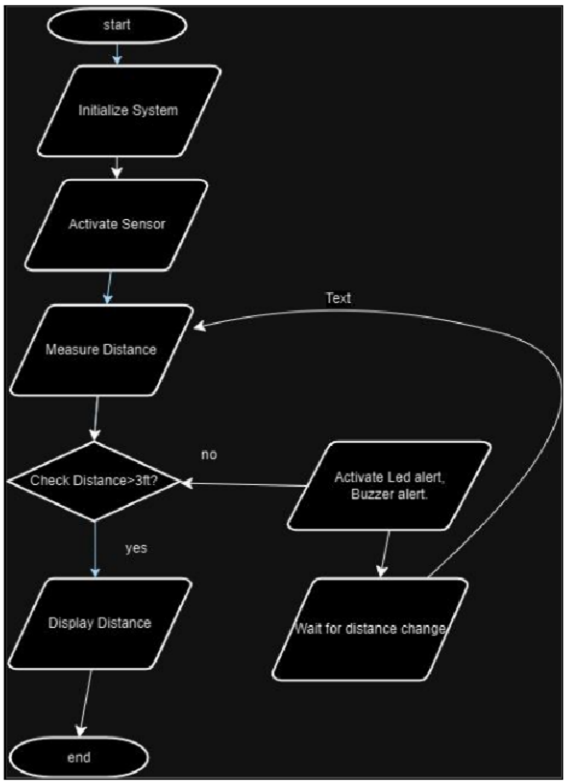

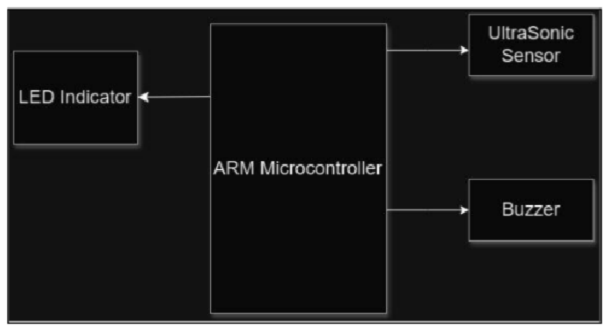

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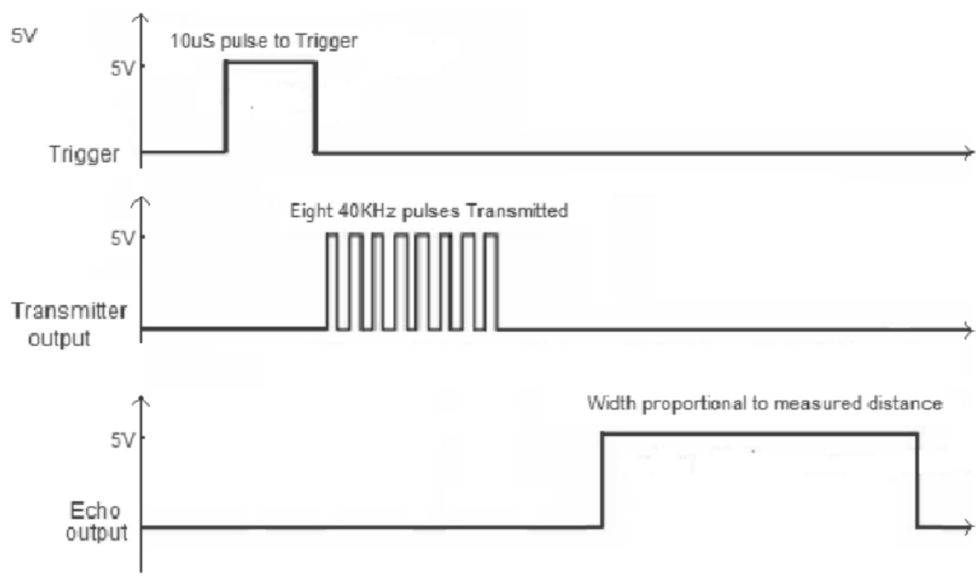

Fig 2: HC SR04 timing diagram

Interfacing HC-SR04:

- The trigger pin is given a short pulse of 10us.
- Upon receiving a trigger pulse, the HC-SR04 Module emits a burst of eight ultrasonic pulses at 40 kHz.
- Then, it outputs a HIGH for the time the sound waves take to reach back.
- The duration of the high pulse is measured and subsequently utilized to determine the distance

Distance Measurement Calculations:

To calculate the distance a sound wave travels, given its speed in air (343 m/s), we use the formula:

$$D = 0.0343 \times \frac{T}{2}$$

where T is the time in microseconds and D is the one-way distance in centimeters. This formula calculates the round trip motion of sound waves. It is suitable for fast distance measurement in centimeters. The time is in microseconds...

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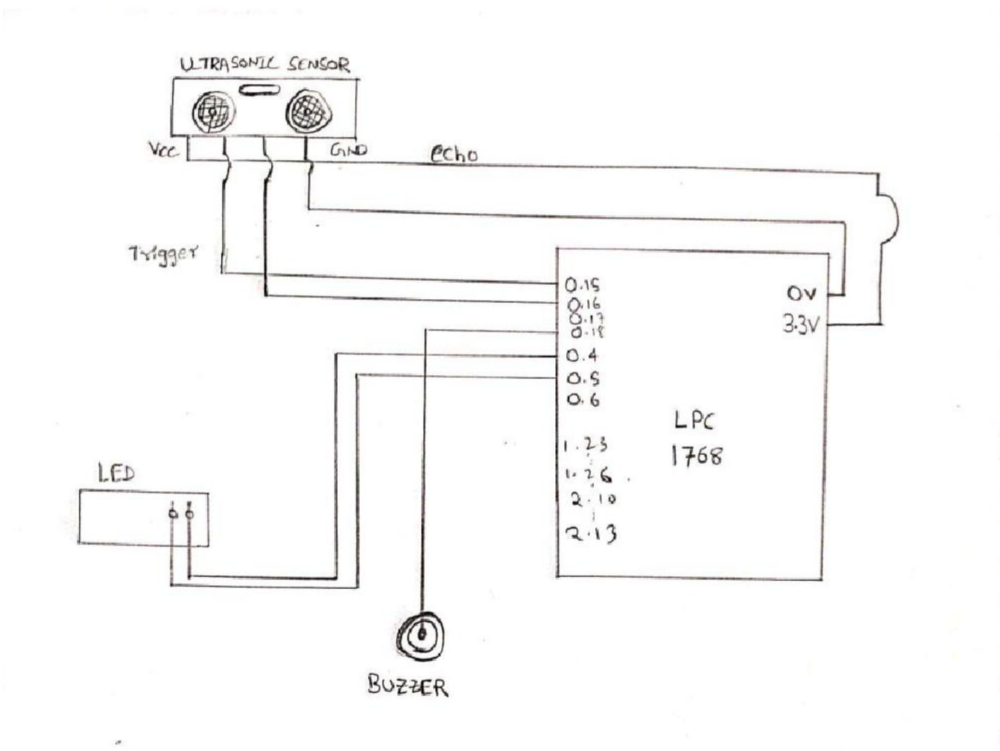

Fig 4: LPC1768 interfaced with HC-SR04 ultrasonic sensor, LEDs, LCD, and buzzer, displaying the respective pin configurations.

5. CODE

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for (j = 0; j < 50; j++);
LPC_GPIO0->FIOCLR = 1 << 28;
for (j = 0; j < 10000; j++);
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void lcd_write()
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temp2 = (temp1 >> 4) & 0xF;
port_write();
temp2 = temp1 & 0xF;
port_write();
}


int main()
{

int ledflag=0;
int command[] = {3, 3, 3, 2, 2, 0x01, 0x06, 0x0C, 0x80};
char message1[] = "danger!";
char message2[] = "safe ";
float rounded_down;
SystemInit();
SystemCoreClockUpdate();
initTimer0();
LPC_GPIO0->FIODIR |= BUZZER;
LPC_PINCON->PINSEL0 &= 0xfffff00f; // Interface LEDs P0.4-P0.11
LPC_PINCON->PINSEL0 &= 0x3fffffff; // Interface TRIG P0.15
LPC_PINCON->PINSEL1 &= 0xfffffff0; // Interface ECHO P0.16
LPC_GPIO0->FIODIR |= TRIG | 1<<17; // Direction for TRIGGER pin
LPC_GPIO1->FIODIR |= 0 << 16; // Direction for ECHO PIN
LPC_GPIO0->FIODIR |= LED << 4; // Direction for LED
LPC_PINCON->PINSEL1 |= 0;
LPC_GPIO0->FIODIR |= 0XF << 23 | 1 << 27 | 1 << 28;
flag1 = 0;
```

```
for (i = 0; i < 9; i++)
{
temp1 = command[i];
lcd_write();
for (j=0; j<100000; j++);
}
flag1 = 1;
i = 0;
flag = 1;
LPC_GPIO0->FIOCLR |= TRIG;
while (1)
{
LPC_GPIO0->FIOSET = 0x00000800;
// Output 10us HIGH on TRIG pin
LPC_GPIO0->FIOMASK = 0xFFFF7FFF;
LPC_GPIO0->FIOPIN |= TRIG;
delayUS(10);
LPC_GPIO0->FIOCLR |= TRIG;
LPC_GPIO0->FIOMASK = 0x0;
while (! (LPC_GPIO0->FIOPIN & ECHO)) {// Wait for a HIGH on ECHO pin}
startTimer0();
//LPC_GPIO0->FIOSET = LED_Pinsel << 4;
//echoTime--;
while (LPC_GPIO0->FIOPIN & ECHO); // Wait for a LOW on ECHO pin
echoTime = stopTimer0(); // Stop Counting
//LPC_GPIO0->FIOCLR = LED_Pinsel << 4;
distance = (0.0343 * echoTime) / 40;
sprintf(ans, " D:%.2fcm", distance);
delay(999999);
flag1 = 1;
i = 0;
flag1 = 0;
temp1 = 0x01;
lcd_write();
flag1 = 1;
while (ans[i]!= '\0')
```

```
{
temp1 = ans[i];
lcd_write();
for (j=0; j<100000;j++);
i++;
}
if(distance < 20 && distance > 15) {
LPC_GPIO0->FIOSET=LED<<4;
LPC_GPIO0->FIOSET=1<<17;
delay(9999);
}
if(distance < 15 && distance > 10){
LPC_GPIO0->FIOSET=LED<<4;
LPC_GPIO0->FIOSET=1<<17;
delay(9999);
}
if (distance < 10) {
LPC_GPIO0->FIOSET=LED<<4;
LPC_GPIO0->FIOSET=1<<17;
LPC_GPIO0->FIOSET = BUZZER;
delay(5555);
}
else
{
LPC_GPIO0->FIOCLR=LED<<4;
LPC_GPIO0->FIOCLR=1<<17;
LPC_GPIO0->FIOCLR = BUZZER;
delay(9999);
}
}
}
```

6. RESULTS

1. Distance > 20 cm

- Safe Distance
- LED: OFF
- Buzzer: OFF

2. 15 cm < Distance ≤ 20 cm

- Caution Zone
- LED: ON
- Buzzer: OFF

3. 10 cm < Distance ≤ 15 cm

- Warning Zone
- LED: ON
- Buzzer: OFF

4. Distance ≤ 10 cm

- Danger Zone
- LED: ON
- Buzzer: ON (continuous beep)

When the "ParkSafe Distance Monitor" detects a distance of more than 20 cm, the LED lights will indicate the safe zone without any light or buzzer sound. When the distance is reduced from 15 cm to 20 cm, the LED lights will be activated to send a signal to the notification area. while the buzzer remains muted. If the distance is less than 10 cm to 15 cm, the LED will light to alert the user to the warning area. The doorbell is still off. Finally, if there is a distance of 10 cm, this indicates a danger zone. Both the LED lights and the buzzer are activated. The alarm will continuously beep to warn the user of nearby obstacles.

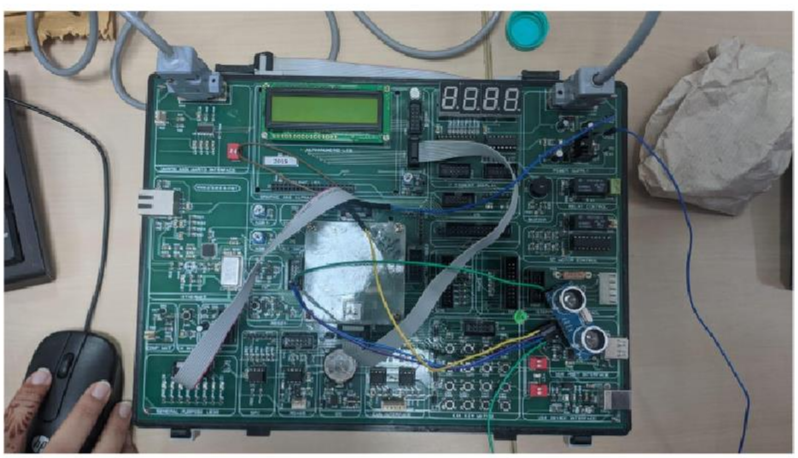

Fig 5: At distance =< 10 cm, both the LED and Buzzer are activated simultaneously

7. CONCLUSION

The "ParkSafe Distance Monitor" is a parking safety solution that uses ARM microcontrollers and ultrasonic sensors to provide real-time distance monitoring, displayed on an LCD screen for user-friendly feedback. Equipped with LED and buzzer alerts for proximity below safe thresholds, it proactively prevents potential collisions and vehicle damage. Aligned with Sustainable Development Goal 11, this system enhances safety and optimizes parking space, contributing to secure, resilient, and sustainable urban environments.

FUTURE SCOPES

- **Integration with smart city infrastructure:** Future developments may include integration of systems with smart city platforms. Enabling data sharing with traffic management systems To optimize traffic flow and real-time parking availability.
- **Mobile Application Connectivity:** Create a mobile application that connects to a remote monitor. and notify users Measuring distance and the availability of parking space Improved user experience and accessibility
- **Advanced Sensor technologies:** Using advanced sensors such as LiDAR or infrared sensors. It can improve the accuracy and distance of object detection. Make the system more reliable in a variety of environments and weather conditions…
- **Machine Learning Algorithms:** Incorporating machine learning can improve the system's ability to predict parking behavior, recognize patterns, and optimize notifications based on user preferences. or past information Improve the overall efficiency of the inspection system.
- **Expand to other applications:** This technology can be adapted to a wide range of applications beyond parking, such as remote monitoring in warehouses. construction site or public area It improves safety and operational efficiency in those environments.

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