Department of ICT

MIT, Manipal

EasyPark

Embedded Systems Lab Mini Project

IVth Sem B.Tech (IT)

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ABSTRACT

EasyPark is a smart car parking assistance system designed to make parking safer and more efficient using ultrasonic distance measurement. The system is built around the HC-SR04 ultrasonic sensor and the LPC1768 ARM Cortex-M3 microcontroller, which together enable precise detection of obstacles by calculating the time taken for ultrasonic waves to reflect off nearby objects.

Using the principle of echo-based distance calculation, EasyPark determines how far a vehicle is from a wall or obstruction. The system provides visual cues:

- Blinking Red LED activates when the distance becomes critically short (< 20 cm), providing a strong visual alert

In addition to the LED indications, a 16x2 LCD Display shows real-time distance readings in centimeters, offering clear feedback to the driver. This ensures that the driver can gauge proximity with high accuracy, minimizing the risk of collision.

EasyPark not only simplifies reverse parking but also has potential use cases in vehicle safety systems, robotic navigation, and smart occupancy detection in parking lots. The project highlights how embedded systems can be used to solve real-world challenges by combining efficient sensing technology, intuitive feedback, and user-focused design.

Keywords: EasyPark, LPC1768, Ultrasonic Sensor, Embedded System, LCD Display, Blinking LED, Parking Assistance.

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INTRODUCTION

The EasyPark project leverages ultrasonic sensor technology to develop a distance detection system. It integrates the HC-SR04 Ultrasonic Distance Sensor with the ARM Cortex-M3 LPC1768 microcontroller to accurately detect objects and measure distances in real time, achieving an accuracy of up to 3 millimeters.

The HC-SR04 sensor is selected for its reliability and precision. Operating at an ultrasonic frequency of 40 kHz, it can measure distances ranging from 2 centimeters to 4 meters, making it suitable for diverse applications.

The LPC1768 microcontroller works in conjunction with the HC-SR04 sensor by emitting ultrasonic pulses and measuring the time taken for the echoes to return. The system calculates the distance based on the speed of sound in air (~343 meters per second).

The HC-SR04 sensor consists of essential components that enable accurate distance measurement and object detection. It comprises a transmitter (which emits ultrasonic waves), a receiver (which captures reflected echoes), and a control circuit (responsible for timing and noise filtering). The sensor has **four key pins**:

1. VCC (power supply)
2. TRIG (triggering pulses)
3. ECHO (receiving echoes)
4. GND (grounding).

Working Principle:
The sensor emits ultrasonic waves, which reflect off objects and return as echoes. By measuring the time interval between emission and reception, the system determines the distance. The HC-SR04 requires a precise trigger pulse to initiate 40 kHz ultrasound emission.

Due to its precision and versatility, ultrasonic sensing is widely used in fields such as robotics, automation, and industrial applications.

METHODOLOGY

a. Components Required

- **LPC 1768 Microcontroller**: The ARM Cortex-M3-based LPC 1768 microcontroller acts as the central controller, managing all aspects of the EasyPark distance detection system, sensor activation, lighting up LEDs, and triggering the buzzer. It efficiently processes data from connected sensors, and controls outputs to ensure fast and reliable operation.
- **HCSR04 Ultrasonic Sensor**: This sensor is responsible for detecting the presence and distance of objects when the system enters alert mode. It activates after three consecutive incorrect password attempts, scanning for intruders within a specified range and sending data to the microcontroller for analysis.
- **LED**: The LEDs are turned on depending on the distance of the object from the Ultrasonic Sensor.
- **Buzzer**: The buzzer is activated by the microcontroller upon detecting an object in close proximity to the vehicle, emitting a loud sound to alert the user. Its sharp, clear sound serves as an effective warning, preventing collisions while parking in reverse gear.
- **LCD Display**: The LCD provides real-time feedback by displaying the measured distance from the ultrasonic sensor and indicating the proximity of objects. It shows system messages such as “Object Detected,” “Safe Distance,” or “Warning: Too Close,” depending on how near the object is. This visual output helps users understand the environment around the sensor, especially in features like parking assist, obstacle detection, and traffic monitoring simulations.
- **Connecting Cables (FRC, Data and Jumper Cables)**: Flat ribbon and data cables connect the components to the LPC 1768 microcontroller, jumper cables are used to connect the ultrasonic sensor and buzzer, ensuring stable communication and power flow across the system. These cables help maintain an organised and reliable setup for smooth operation.

b. Flow Diagram

Hardware Components Used

- **Power Supply**
  Provides regulated power (typically 5V) to the LPC1768 microcontroller and all connected components such as the ultrasonic sensor, LCD, LEDs, and buzzer.

- **LPC1768 Microcontroller**
  Acts as the central control unit of the system. It interfaces with all input/output components, processes the distance data from the ultrasonic sensor, and generates appropriate responses such as visual alerts on the LCD and LEDs or audio alerts through the buzzer.

- **Input Block:**
  - Ultrasonic Sensor (HC-SR04)
    This sensor is connected with Trigger on P0.15 and Echo on P0.16. It sends and receives ultrasonic pulses to measure the distance of nearby objects. The microcontroller uses this data to determine how close an object is and whether to activate alerts.
- **Output Blocks:**
  - **LCD Display (16x2**)
    Displays real-time distance measurements and system status messages. It helps the user understand how close the object is and whether any alert has been triggered.
  - **LEDs (Connected from P0.4 to P0.11 on Connector CNA1)**
    Serve as a visual distance indicator. As the object moves closer to the sensor, LEDs are turned on one by one to represent the reduction in distance. This provides an intuitive visual cue for the user.
  - **Buzzer**
    Emits a warning sound when an object is detected within a critical distance range. This audio alert warns the user of potential danger or intrusion, especially useful in collision warning or intruder detection scenarios

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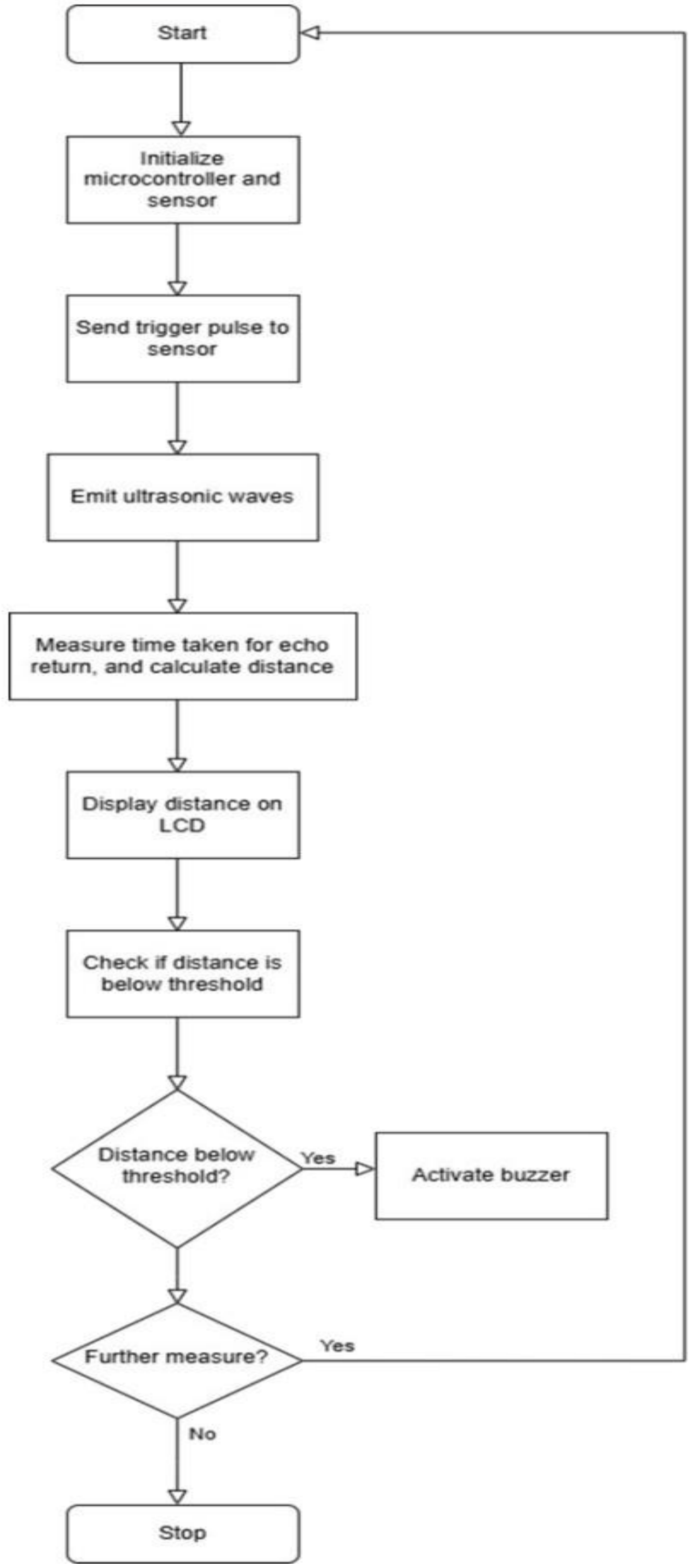


Fig. 1: Flow Diagram

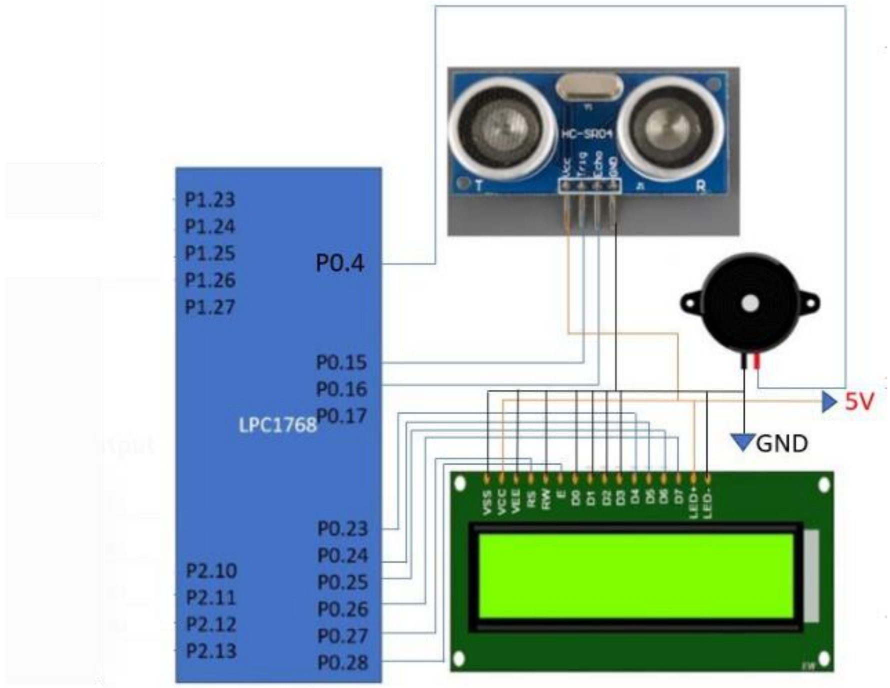
c. Connection Description

- **LCD Display:** The 16x2 LCD display is connected to the LPC1768 for real-time visual feedback. The Register Select (RS) pin is connected to P0.27, allowing the microcontroller to switch between command and data modes. The Enable (E) pin is connected to P0.28, triggering data latching on the display. Data lines D4 through D7 are connected to P0.23, P0.24, P0.25, and P0.26, respectively, for sending 4-bit parallel data from the microcontroller. The display, backlight, and control signals are powered via 5V and grounded via GND to complete the circuit.

- **Ultrasonic Sensor:** The ultrasonic sensor is connected to the LPC1768 for distance measurement. The Trigger (T) pin, responsible for sending ultrasonic pulses,connected to P0.15, while the Echo (R) pin, which captures the returning pulse, is connected to P0.16. When activated, the sensor receives power through a 5V connection and GND. By measuring the time delay between sending and receiving the pulse, the microcontroller can calculate the distance to any object within the sensor's range, useful for intruder detection.

- **LED**:The LED system is connected to the LPC1768 for visual indication and pattern display. A total of eight LEDs are used, each connected to GPIO pins P0.4 to P0.11 through the CNA1 connector. These GPIOs are configured as outputs to control the ON/OFF state of each LED.The LEDs receive power via a regulated 5V supply (depending on the board and LED configuration) and are grounded through the LPC1768 or the common ground rail. Each LED is connected in series with a current-limiting resistor (typically 220Ω–330Ω) to prevent excess current draw.

- **Buzzer:** The buzzer is connected to the LPC1768 to provide audio alerts. Its negative terminal is connected to P0.17, which the microcontroller uses to control sound activation. The positive terminal is connected to a 5V power source. When the microcontroller signals P0.17, the buzzer emits a sound to alert of an intrusion or security breach, effectively notifying anyone nearby of unauthorised access.



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d. Method

- **System Startup and Component Setup**
  At system power-up, the LPC1768 microcontroller initializes all essential peripherals including the LCD, ultrasonic sensor, LEDs, and buzzer. The system prompts the user to set a secure password via the keypad, which is temporarily shown on the LCD. Once confirmed, the LCD requests password re-entry to authenticate the user. This secure startup routine ensures the device is accessed only by authorized users and that all modules are properly configured for real-time operation.

- **Distance-Based Parking Assistance Simulation**
  This module demonstrates how parking assistance works using the ultrasonic sensor. The sensor, connected to P0.15 (Trigger) and P0.16 (Echo), measures distance to nearby objects. If an object is too close, the LCD shows the exact distance and the buzzer sounds a warning. This simulates how modern vehicles alert drivers to obstacles while parking, enhancing safety in tight spaces.

- **Rear Detection and Alert System**
  In this feature, the system mimics blind spot or reverse detection. When simulating reverse motion, the ultrasonic sensor scans for objects behind the vehicle. If an obstacle is detected within a predefined range, the LPC1768 activates an LED and buzzer, providing a visual and auditory alert. This replicates how drivers are warned of hidden obstacles, preventing potential accidents.

- **Simulated Traffic Flow Analysis and Counting**
  Our project replicates a basic traffic monitoring setup. The ultrasonic sensor is placed overhead to detect moving objects (vehicles). Each detection is counted by the microcontroller and updated on the LCD. This setup demonstrates how vehicle flow can be monitored in real-time, data which can be used to adjust traffic signals or analyze road usage patterns.

- **Obstacle Prevention in Forward Motion**
  This function showcases a collision avoidance concept. As the system detects an object directly in front of it (within danger range), the buzzer is instantly activated to alert the user. This simulates how autonomous vehicles sense obstacles and issue early warnings to prevent crashes or trigger emergency stops.

- **Smart Speed Bump Violation Alert**
  This simulation recreates a smart city speed bump scenario. If a vehicle passes over the bump too quickly (detected by rapid sensor trigger), the system considers it a speed violation. The buzzer is turned on to issue a warning. This models how real-time speed monitoring can be used for safe driving enforcement and traffic violation alerts.

RESULTS AND DISCUSSION

a. Photographs of the system

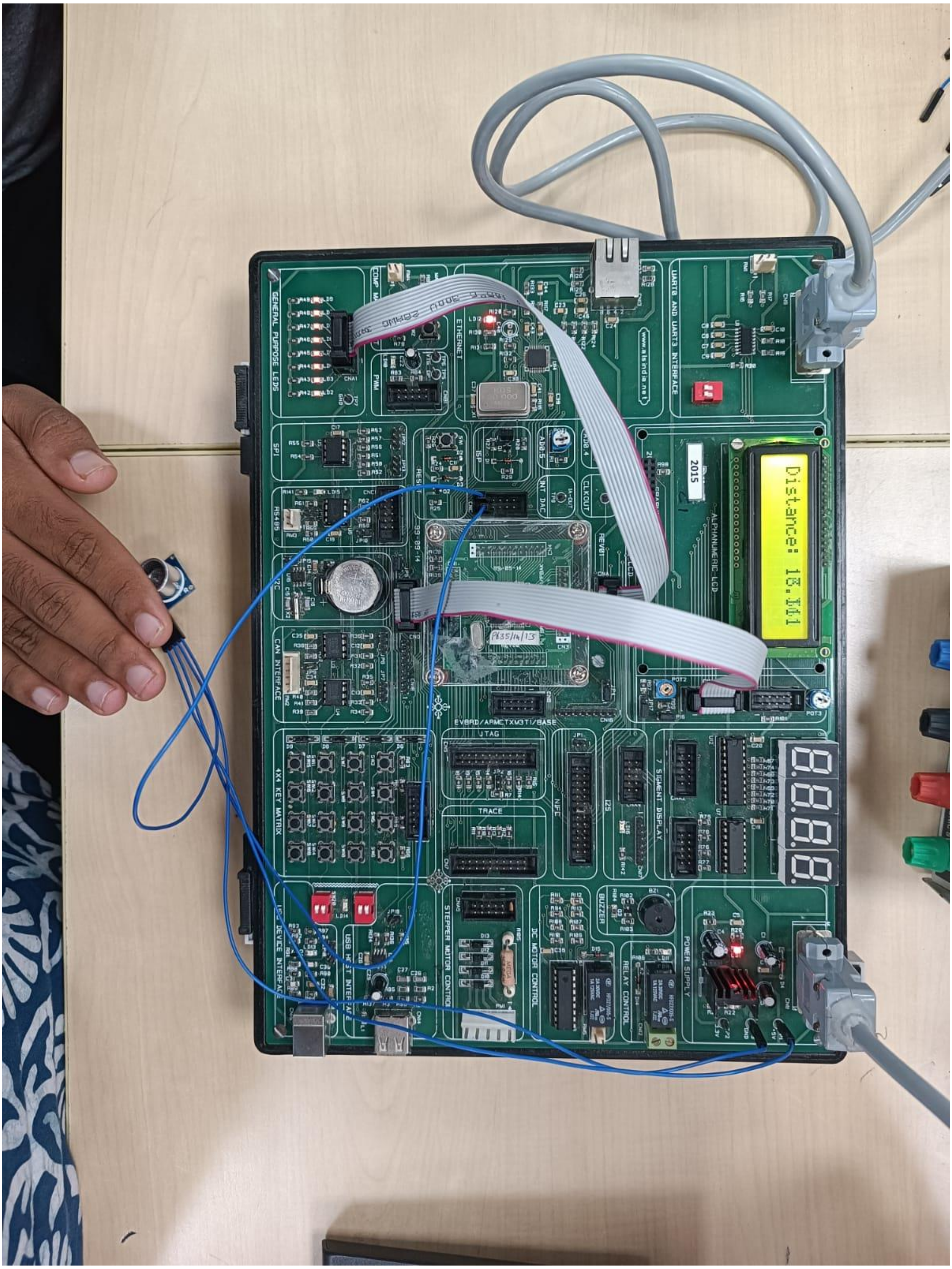

Fig. 4: Photographs of the System

b. Working and relevance of the system

Ultrasonic sensors play a vital role in modern automotive and smart traffic systems due to their ability to accurately detect objects and measure distances in real time. In Automatic Parking Assist Systems, ultrasonic sensors are mounted on vehicle bumpers to detect nearby obstacles, assisting drivers in parking safely. When an object is too close, the system can trigger a buzzer or visual display to alert the driver, reducing the risk of collisions in tight spaces. Similarly, in a Blind Spot Detection System, these sensors monitor areas around the vehicle that the driver cannot easily see, such as the rear or sides.

When reversing, the system detects obstacles behind the car and provides audio or LED-based alerts, helping avoid accidents. In the domain of traffic management, Traffic Monitoring and Vehicle Counting systems utilize overhead ultrasonic sensors to detect and count vehicles in each lane. This data is crucial for analyzing traffic density, adjusting signal timings, and optimizing flow at intersections. The system can even detect the presence or absence of waiting vehicles to determine if a green signal is needed.

In advanced automotive applications, Collision Avoidance Systems use ultrasonic sensors to constantly scan the vehicle's surroundings. If an object or vehicle is detected too close, the system can automatically slow down or stop the car, greatly enhancing safety in autonomous or semi-autonomous vehicles. Additionally, in smart city infrastructure, Speed Bump Monitoring Systems use these sensors to check if vehicles are slowing down when approaching a speed bump. If a vehicle fails to reduce speed, the system can trigger a warning or log a fine, promoting safer driving behavior. Collectively, these applications highlight the effectiveness and versatility of ultrasonic sensors in enhancing road safety, improving vehicle automation, and supporting intelligent traffic systems.

References:

1. LPC 1768 Microcontroller Documentation: https://www.nxp.com/docs/en/user-guide/UM10360.pdf
2. Keil uVision IDE: https://www.keil.com/mdk5/
3. Ultrasonic Sensor (HC-SR04) Working Principles: https://techatronic.com/hc-sr04-ultrasonic-sensor-working-and-explanation/
4. LCD Display Interfacing with LPC1768: https://www.bascom-tutorials.com/lcd-interfacing-with-lpc176

C Code with Comments:

```
#include <stdio.h>
#include <LPC17xx.h>
#include <string.h>



#define LED_Pinsel 0xFF // P0.4-0.11 (LEDs)
#define TRIGGER_PIN (1 << 15) // P0.15 (Trigger Pin)
#define ECHO_PIN (1 << 16) // P0.16 (Echo Pin)



char ans[20] = "";
int temp, temp1, temp2 = 0;
int flag = 0, flag_command=0;
int i, j, k, l, r, echoTime = 5000;
float distance = 0;



void lcd_wr(void);
void port_wr(void);
void delay(int r1);
void timer_start(void);
float timer_stop();
void timer_init(void);
void delay_in_US(unsigned int microseconds);

void delay_in_US(unsigned int microseconds)
 {
        LPC_TIM0->TCR = 0x02;
        LPC_TIM0->PR = 0; // Set prescaler to the value of 0
        LPC_TIM0->MR0 = microseconds - 1; // Set match register for 10us
        LPC_TIM0->MCR = 0x01; // Interrupt on match
        LPC_TIM0->TCR = 0x01; // Enable timer
        while ((LPC_TIM0->IR & 0x01) == 0); // Wait for interrupt flag
        LPC_TIM0->TCR = 0x00; // Stop the timer
        LPC_TIM0->IR = 0x01; // Clear the interrupt flag
 }

 void timer_init(void)
 {
        // Timer for distance
        LPC_TIM0->CTCR = 0x0;
        LPC_TIM0->PR = 11999999; //To maintain 12Mhz as per specified for LPC 1768
        LPC_TIM0->TCR = 0x02; // Reset Timer
 }
```

```
void timer_start(void)
{
	LPC_TIM0->TCR = 0x02; // Reset Timer
	LPC_TIM0->TCR = 0x01; // Enable timer
}

float timer_stop()
{
	LPC_TIM0->TCR = 0x0;
	return LPC_TIM0->TC;
}


void delay(int r1)
{
	for (r = 0; r < r1; r++);
}


void port_wr()
{
	int j;
	LPC_GPIO0->FIOPIN = temp2 << 23;
	if (flag_command == 0){
		LPC_GPIO0->FIOCLR = 1 << 27;
	}
	else{
		LPC_GPIO0->FIOSET = 1 << 27;
	}
	LPC_GPIO0->FIOSET = 1 << 28;
	for (j = 0; j < 50; j++);		//delay(50);
	LPC_GPIO0->FIOCLR = 1 << 28;
	for (j = 0; j < 10000; j++);	//delay(10000);
}


void lcd_wr()
{
	temp2 = (temp1 >> 4) & 0xF;
	port_wr();
	temp2 = temp1 & 0xF;

	port_wr();
}
```

```
int main()
 {
        int command_init[] = {3, 3, 3, 2, 2, 0x01, 0x06, 0x0C, 0x80};
        SystemInit();
        SystemCoreClockUpdate();
        timer_init();



          LPC_PINCON->PINSEL0 &= 0xFFFFF00F; // LEDs P0.4-P0.11
          LPC_PINCON->PINSEL0 &= 0x3FFFFFFF; // TRIG P0.15
          LPC_PINCON->PINSEL1 &= 0xfffffff0; // ECHO P0.16



          LPC_GPIO0->FIODIR |= TRIGGER_PIN | 1 << 17; // Direction for TRIGGER pin

          LPC_GPIO1->FIODIR |= 0 << 16; // Direction for ECHO PIN
          LPC_GPIO0->FIODIR |= LED_Pinsel << 4; // Direction for LED
          LPC_PINCON->PINSEL1 |= 0;
          LPC_GPIO0->FIODIR |= 0XF << 23 | 1 << 27 | 1 << 28; // Direction For LCDs
          flag_command = 0;
          for (i = 0; i < 9; i++)
          {
              temp1 = command_init[i];
              lcd_wr();
              for (j = 0; j < 30000; j++);        //delay(30000);
          }



          i = 0;
          flag = 1;
          LPC_GPIO0->FIOCLR |= TRIGGER_PIN;
          while (1){
              LPC_GPIO0->FIOSET = 0x00000800;    // Output 10us high on TRIGGER pin
              LPC_GPIO0->FIOMASK = 0xFFFF7FFF;
              LPC_GPIO0->FIOPIN |= TRIGGER_PIN;
              delay_in_US(10);
              LPC_GPIO0->FIOCLR |= TRIGGER_PIN;
              LPC_GPIO0->FIOMASK = 0x0;
              while (!(LPC_GPIO0->FIOPIN & ECHO_PIN)){
                      // Wait till ECHO PIN becomes high
           }


           timer_start();
           while (LPC_GPIO0->FIOPIN & ECHO_PIN);   // Wait till ECHO becomes low
           echoTime = timer_stop(); // Store the time taken on stopping the timer
           distance = (0.00343 * echoTime) / 2; //Calculations of Distance in cm
           sprintf(ans, " Distance: %.3f", distance);
           flag_command = 1;
           i = 0;
           flag_command = 0;
           temp1 = 0x01;
           lcd_wr();
```

```
        flag_command = 1;
        while (ans[i] != '\0'){
                temp1 = ans[i];
                lcd_wr();
                for (j = 0; j < 30000; j++);
                i++;
        }


        if (distance < 20){
                LPC_GPIO0->FIOSET = LED_Pinsel << 4;
                LPC_GPIO0->FIOSET = 1 << 17;
        }
        else{
                LPC_GPIO0->FIOCLR = LED_Pinsel << 4;
                LPC_GPIO0->FIOCLR = 1 << 17;
        }
        delay(88000);
    }
}
```

Group9_ES.pdf

by Urvi Mapsenkar

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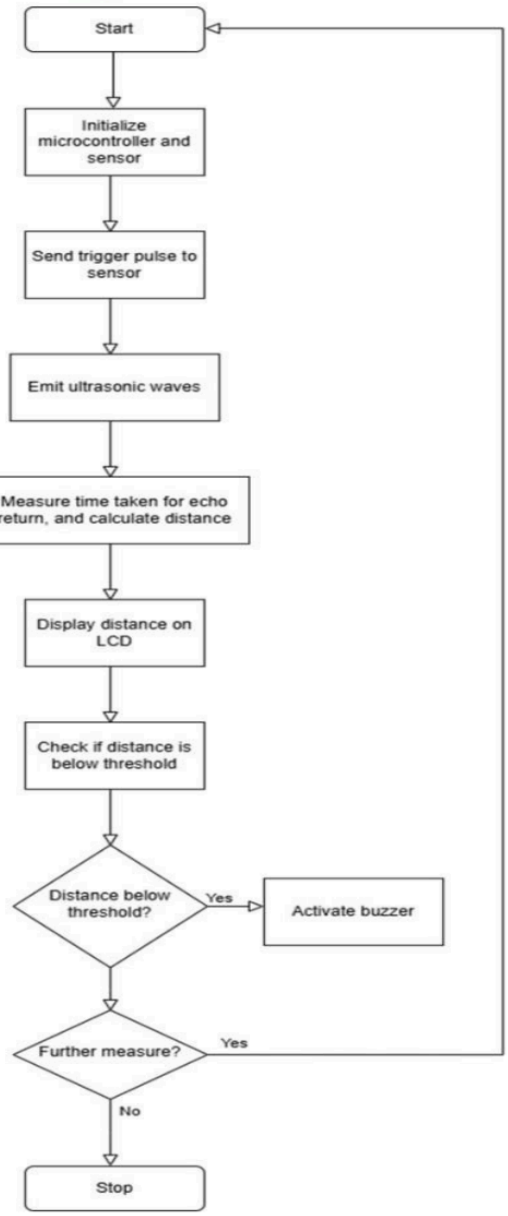

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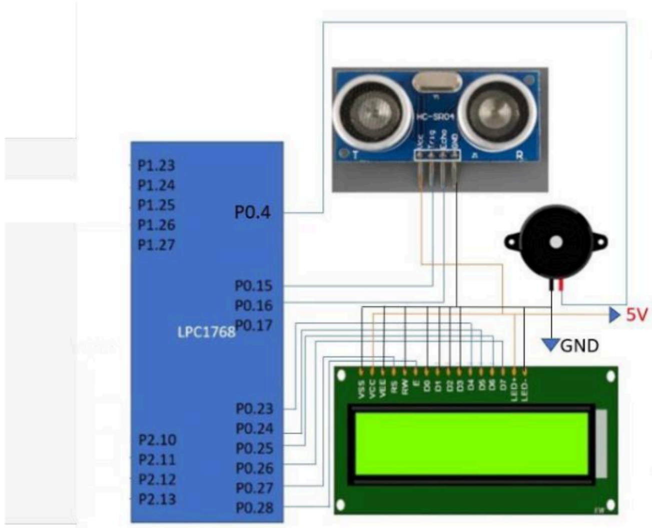

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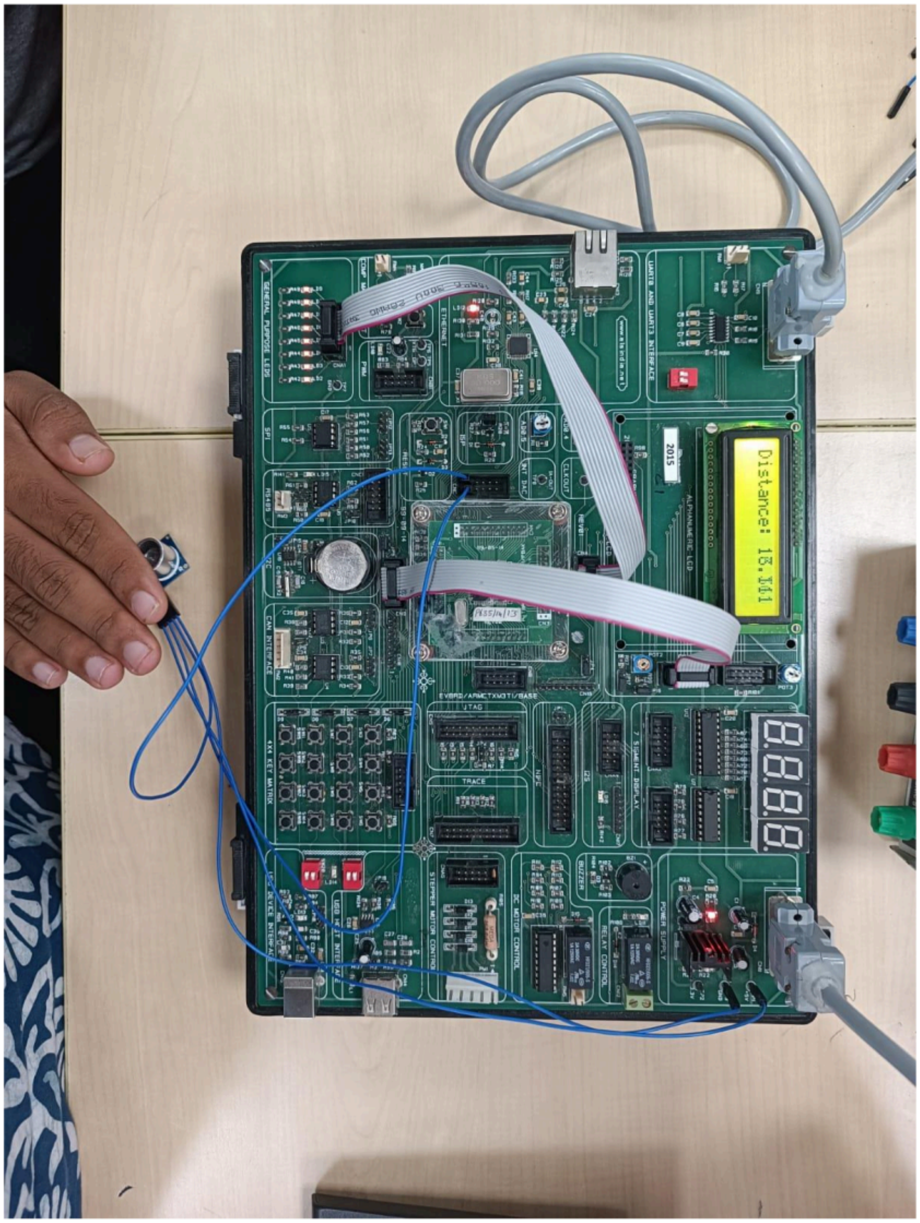

Fig. 4: Photographs of the System

b. Working and relevance of the system

Ultrasonic sensors play a vital role in modern automotive and smart traffic systems due to their ability to accurately detect objects and measure distances in real time. In Automatic Parking Assist Systems, ultrasonic sensors are mounted on vehicle bumpers to detect nearby obstacles, assisting drivers in parking safely. When an object is too close, the system can trigger a buzzer or visual display to alert the driver, reducing the risk of collisions in tight spaces. Similarly, in a Blind Spot Detection System, these sensors

monitor areas around the vehicle that the driver cannot easily see, such as the rear or sides.
When reversing, the system detects obstacles behind the car and provides audio or LED-based alerts, helping avoid accidents. In the domain of traffic management, Traffic Monitoring and Vehicle Counting systems utilize overhead ultrasonic sensors to detect and count vehicles in each lane. This data is crucial for analyzing traffic density, adjusting signal timings, and optimizing flow at intersections. The system can even detect the presence or absence of waiting vehicles to determine if a green signal is needed.
In advanced automotive applications, Collision Avoidance Systems use ultrasonic sensors to constantly scan the vehicle's surroundings. If an object or vehicle is detected too close, the system can automatically slow down or stop the car, greatly enhancing safety in autonomous or semi-autonomous vehicles. Additionally, in smart city infrastructure, Speed Bump Monitoring Systems use these sensors to check if vehicles are slowing down when approaching a speed bump. If a vehicle fails to reduce speed, the system can trigger a warning or log a fine, promoting safer driving behavior. Collectively, these applications highlight the effectiveness and versatility of ultrasonic sensors in enhancing road safety, improving vehicle automation, and supporting intelligent traffic systems.

References:

1. LPC 1768 Microcontroller Documentation: https://www.nxp.com/docs/en/user-guide/UM10360.pdf
2. Keil uVision IDE: https://www.keil.com/mdk5/
3. Ultrasonic Sensor (HC-SR04) Working Principles: https://techatronic.com/hc-sr04-ultrasonic-sensor-working-and-explanation/
4. LCD Display Interfacing with LPC1768: https://www.bascom-tutorials.com/lcd-interfacing-with-lpc176

C Code with Comments:

```
#include <stdio.h>
#include <LPC17xx.h>
#include <string.h>



#define LED_Pinsel 0xFF // P0.4-0.11 (LEDs)
#define TRIGGER_PIN (1 << 15) // P0.15 (Trigger Pin)
#define ECHO_PIN (1 << 16) // P0.16 (Echo Pin)



char ans[20] = "";
int temp, temp1, temp2 = 0;
int flag = 0, flag_command=0;
int i, j, k, l, r, echoTime = 5000;
float distance = 0;



void lcd_wr(void);
void port_wr(void);
void delay(int r1);
void timer_start(void);
float timer_stop();
void timer_init(void);
void delay_in_US(unsigned int microseconds);

void delay_in_US(unsigned int microseconds)
{
        LPC_TIM0->TCR = 0x02;
        LPC_TIM0->PR = 0; // Set prescaler to the value of 0
        LPC_TIM0->MR0 = microseconds - 1; // Set match register for 10us
        LPC_TIM0->MCR = 0x01; // Interrupt on match
        LPC_TIM0->TCR = 0x01; // Enable timer
        while ((LPC_TIM0->IR & 0x01) == 0); // Wait for interrupt flag
        LPC_TIM0->TCR = 0x00; // Stop the timer
        LPC_TIM0->IR = 0x01; // Clear the interrupt flag
}

void timer_init(void)
{
        // Timer for distance
        LPC_TIM0->CTCR = 0x0;
        LPC_TIM0->PR = 11999999; //To maintain 12Mhz as per specified for LPC 1768
        LPC_TIM0->TCR = 0x02; // Reset Timer
}
```

```
void timer_start(void)
{
    LPC_TIM0->TCR = 0x02; // Reset Timer
    LPC_TIM0->TCR = 0x01; // Enable timer
}

float timer_stop()
{
    LPC_TIM0->TCR = 0x0;
    return LPC_TIM0->TC;
}


void delay(int r1)
{
    for (r = 0; r < r1; r++);
}


void port_wr()
{
    int j;
    LPC_GPIO0->FIOPIN = temp2 << 23;
    if (flag_command == 0){
        LPC_GPIO0->FIOCLR = 1 << 27;
    }
    else{
        LPC_GPIO0->FIOSET = 1 << 27;
    }
    LPC_GPIO0->FIOSET = 1 << 28;
    for (j = 0; j < 50; j++);           //delay(50);
    LPC_GPIO0->FIOCLR = 1 << 28;
    for (j = 0; j < 10000; j++);        //delay(10000);
}


void lcd_wr()
{
    temp2 = (temp1 >> 4) & 0xF;
    port_wr();
    temp2 = temp1 & 0xF;

    port_wr();
}
```

```
int main()
{
        int command_init[] = {3, 3, 3, 2, 2, 0x01, 0x06, 0x0C, 0x80};
        SystemInit();
        SystemCoreClockUpdate();
        timer_init();


          LPC_PINCON->PINSEL0 &= 0xFFFFF00F; // LEDs P0.4-P0.11
          LPC_PINCON->PINSEL0 &= 0x3FFFFFFF; // TRIG P0.15
          LPC_PINCON->PINSEL1 &= 0xfffffff0; // ECHO P0.16


          LPC_GPIO0->FIODIR |= TRIGGER_PIN | 1 << 17; // Direction for TRIGGER pin

          LPC_GPIO1->FIODIR |= 0 << 16; // Direction for ECHO PIN
          LPC_GPIO0->FIODIR |= LED_Pinsel << 4; // Direction for LED
          LPC_PINCON->PINSEL1 |= 0;
          LPC_GPIO0->FIODIR |= 0XF << 23 | 1 << 27 | 1 << 28; // Direction For LCDs
          flag_command = 0;
          for (i = 0; i < 9; i++)
          {
              temp1 = command_init[i];
              lcd_wr();
              for (j = 0; j < 30000; j++);        //delay(30000);
          }


          i = 0;
          flag = 1;
          LPC_GPIO0->FIOCLR |= TRIGGER_PIN;
          while (1){
              LPC_GPIO0->FIOSET = 0x00000800;    // Output 10us high on TRIGGER pin
              LPC_GPIO0->FIOMASK = 0xFFFF7FFF;
              LPC_GPIO0->FIOPIN |= TRIGGER_PIN;
              delay_in_US(10);
              LPC_GPIO0->FIOCLR |= TRIGGER_PIN;
              LPC_GPIO0->FIOMASK = 0x0;
              while (!(LPC_GPIO0->FIOPIN & ECHO_PIN)){
                     // Wait till ECHO PIN becomes high
           }


           timer_start();
           while (LPC_GPIO0->FIOPIN & ECHO_PIN);   // Wait till ECHO becomes low
           echoTime = timer_stop(); // Store the time taken on stopping the timer
           distance = (0.00343 * echoTime) / 2; //Calculations of Distance in cm
           sprintf(ans, " Distance: %.3f", distance);
           flag_command = 1;
           i = 0;
           flag_command = 0;
           temp1 = 0x01;
           lcd_wr();
```

```
        flag_command = 1;
        while (ans[i] != '\0'){
            temp1 = ans[i];
            lcd_wr();
            for (j = 0; j < 30000; j++);
            i++;
        }


        if (distance < 20){
            LPC_GPIO0->FIOSET = LED_Pinsel << 4;
            LPC_GPIO0->FIOSET = 1 << 17;
        }
        else{
            LPC_GPIO0->FIOCLR = LED_Pinsel << 4;
            LPC_GPIO0->FIOCLR = 1 << 17;
        }
        delay(88000);
    }
}
```

Group9_ES.pdf

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