DISTANCE MEASUREMENT USING ULTRASONIC SENSOR

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Date: 30th April, 2024

ABSTRACT

This project measures distance using an 8051 microcontroller and an ultrasonic sensor (HC-SR04). The system processes the sensor data in C and shows the output on an LCD screen. To calculate distance accurately, the ultrasonic sensor pulses and counts the time it takes for the echoes to return. These signals are interpreted by the 8051 microcontroller, which also does the necessary calculations and outputs the distance data to the LCD for the user interface. This configuration provides a practical and economical option for measuring distance, having applications in robotics, automation, and security systems among other domains.

INTRODUCTION

This project measures distance using an 8051 microcontroller and an HC-SR04 ultrasonic sensor, displaying the findings on an LCD display. Upon activation, the sensor emits ultrasonic waves to initiate the operation. When these waves come into contact with an item, they continue to travel through the atmosphere until they return to the sensor. These returning waves are picked up by the sensor's echo pin, which indicates a "1" state until all waves are received. The ultrasonic wave travel time to and from the item is determined by the system by measuring the length of time in this '1' condition.

Formula used:

Distance=(Time*Speed of Sound)/2;

Since the ultrasonic waves travel to and from the object, this formula divides the total duration by two. The velocity of sound in the medium (in this case, air) is explained by the speed of sound, a constant in the formula. This technique offers a quick and accurate way to measure distance, and it can be used in a number of different applications, including robotics, proximity detection, and automated systems that need to know exact spatial awareness.

The built-in timer of the microcontroller in this project makes it easier to measure the amount of time the echo stays in the "1" condition. Through the use of the timer's features, we are able to precisely measure the echo signal's duration. With a crystal frequency of 11.0592 MHz, a time interval of precisely 1.085 microseconds is associated with each count of the timer. The system uses the time elapsed to determine the distance by utilizing this timing resolution. This calculated distance is then converted into ASCII codes for display on the LCD screen. This methodology integrates hardware and software components effectively, offering a reliable and cost-efficient solution for distance measurement.

COMPONENTS USED

1)Microcontroller(AT89C51): Used for controlling and processing the data in correct order.

2)Ultrasonic Sensor(HC-SR04): Used for sending and receiving transmitted and reflected ultrasonic waves.

3)Crystal(11.0592): For providing clock to the microcontroller.

4)Liquid Crystal Display(1602A): Used in this project for displaying distance at which object is placed.

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WORKING

Sensor Placement:
1)Sensor is placed such that it can send the waves which is not obstructed by any component of the circuit.

2)It's transmitter send the waves and receiver receives the waves which are reflected back from the object. Echo pin of the sensor gives us the time that waves take to complete the distance.

Distance Measurement
1)By using the timer available in microcontroller we can calculate the time for which echo pin remains1.

2)By using this time we can find the distance of the object using speed distance relationship.

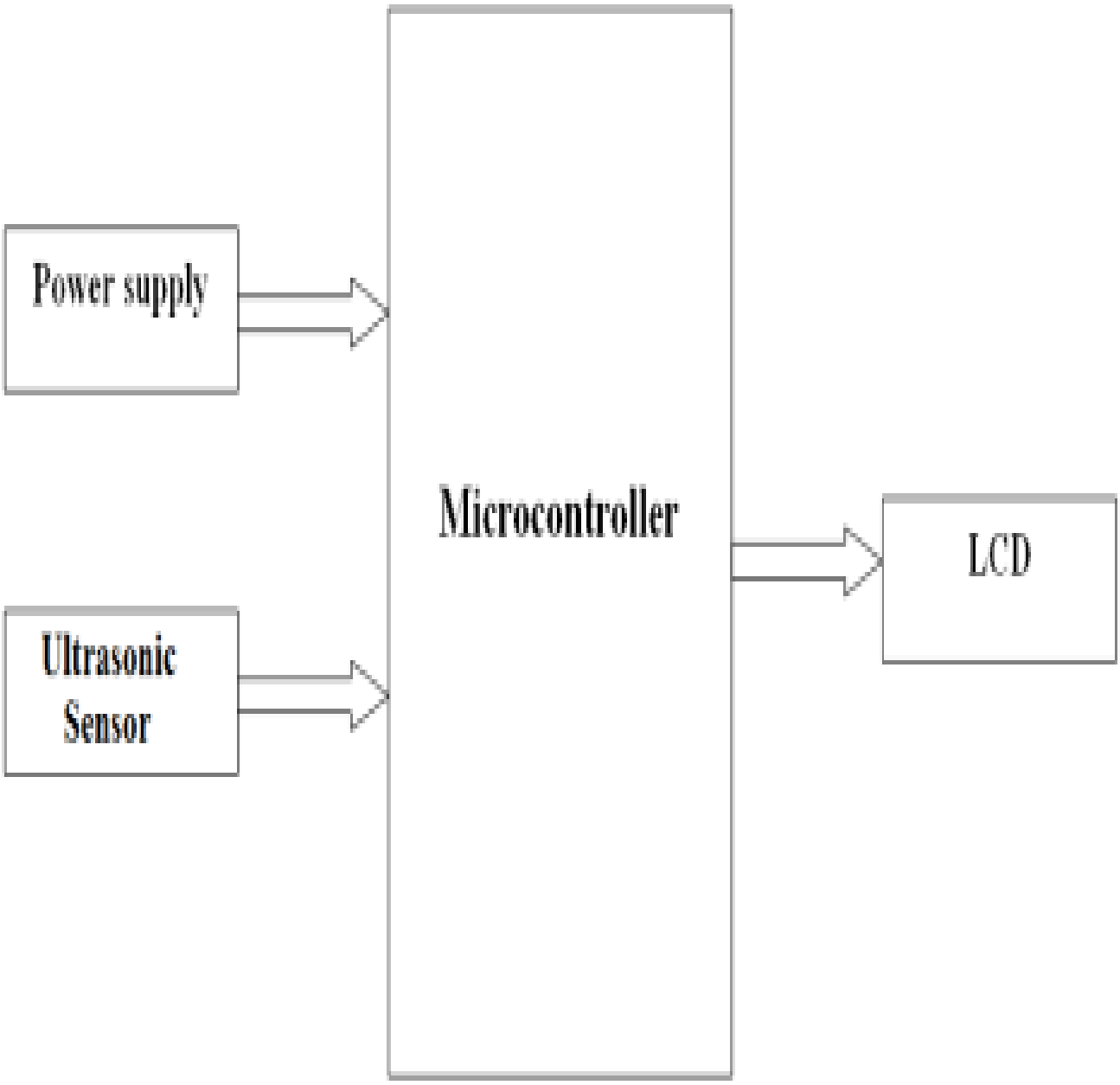
8051 Operation:
1)Here microcontroller is interfaced with Ultrasonic Sensor and LCD.

2)Microcontroller is used for performing calculation which is required for calculating distance.

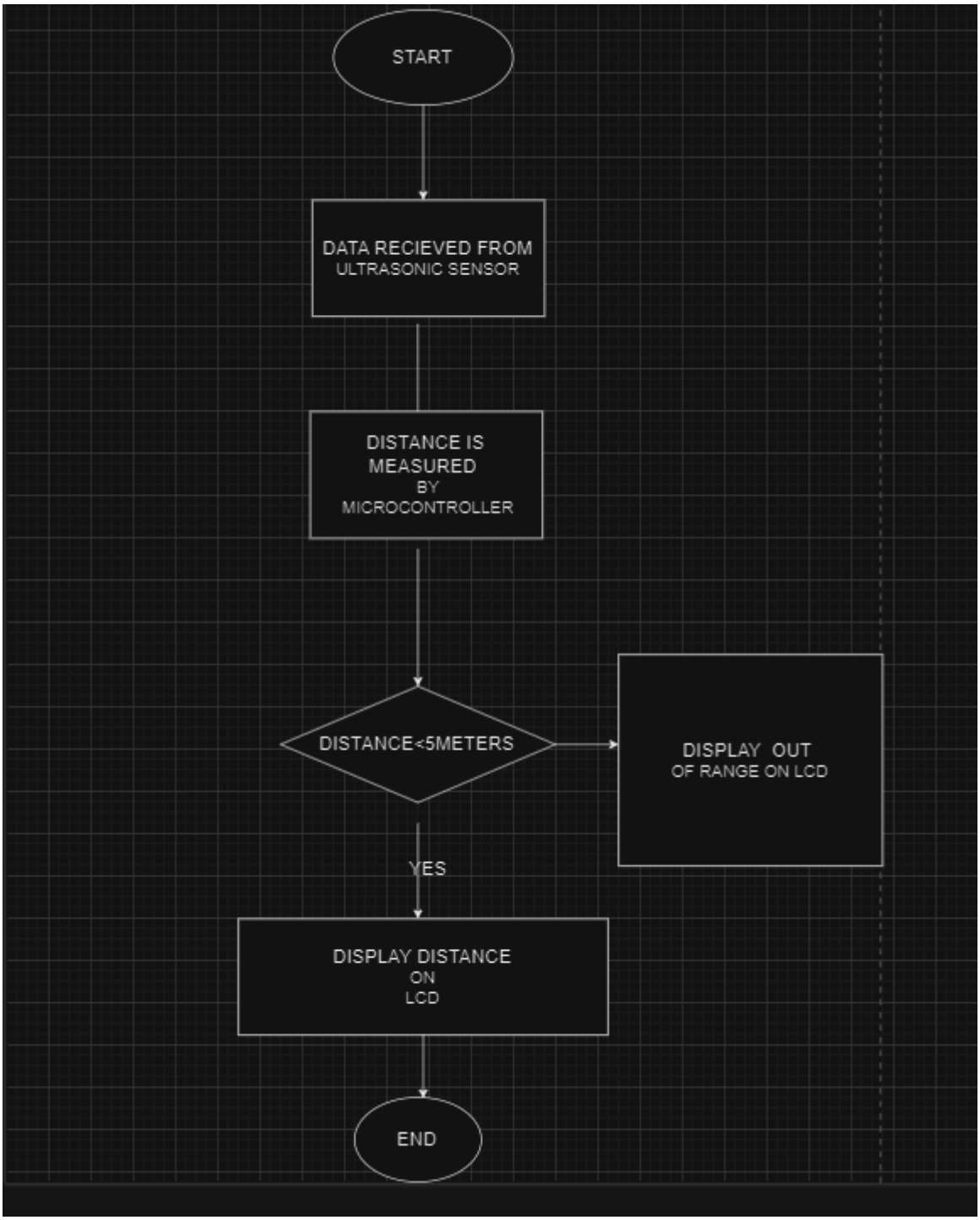
3)It is also used for displaying the distance on LCD by sending various codes which are required to initialize the LCD.

LCD:
1)In our project LCD is used for displaying the distance at which the object is placed.
2)Display of LCD continuously changes as the distance of the object placed is changed.

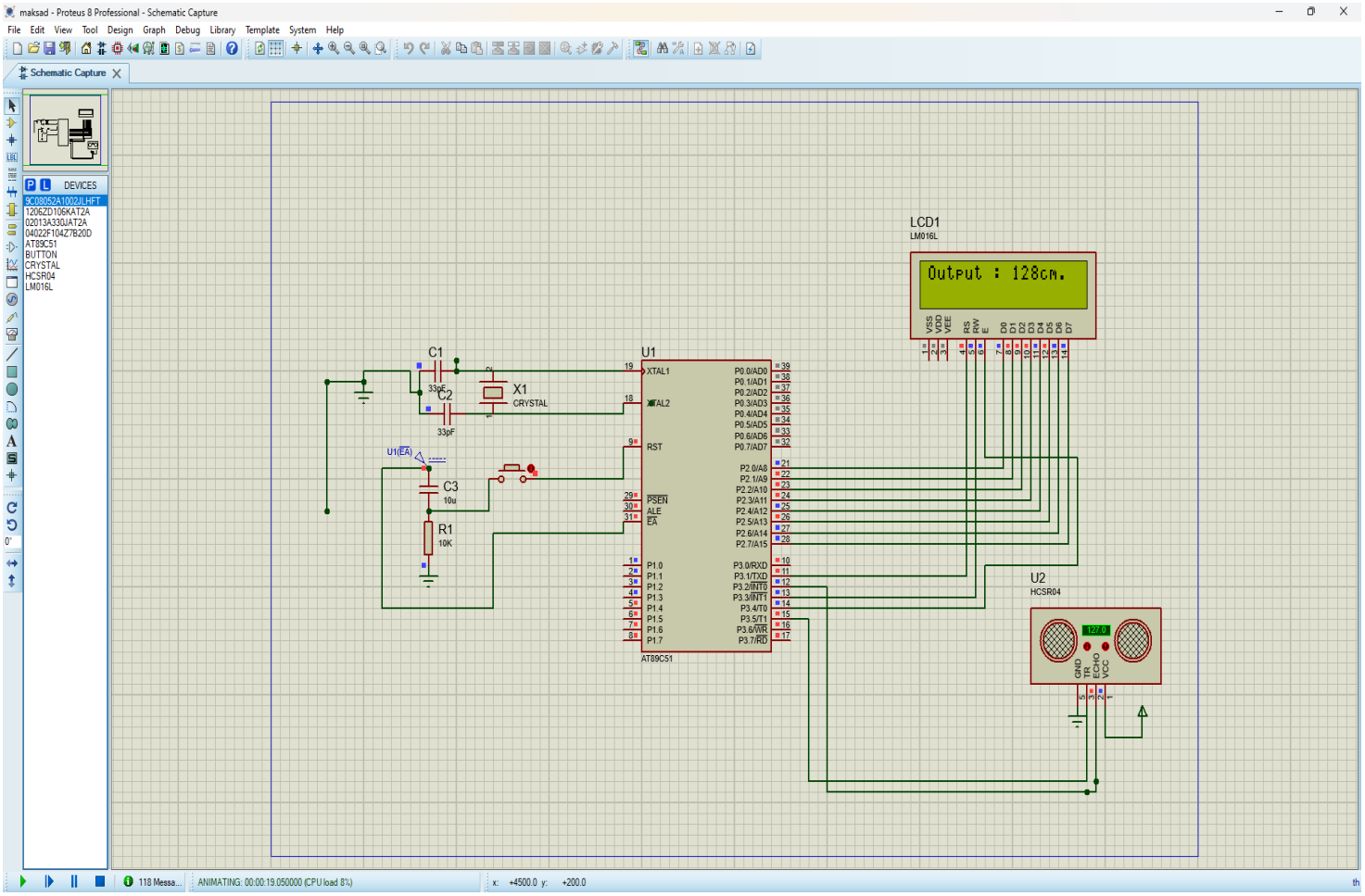
BLOCK DIAGRAM



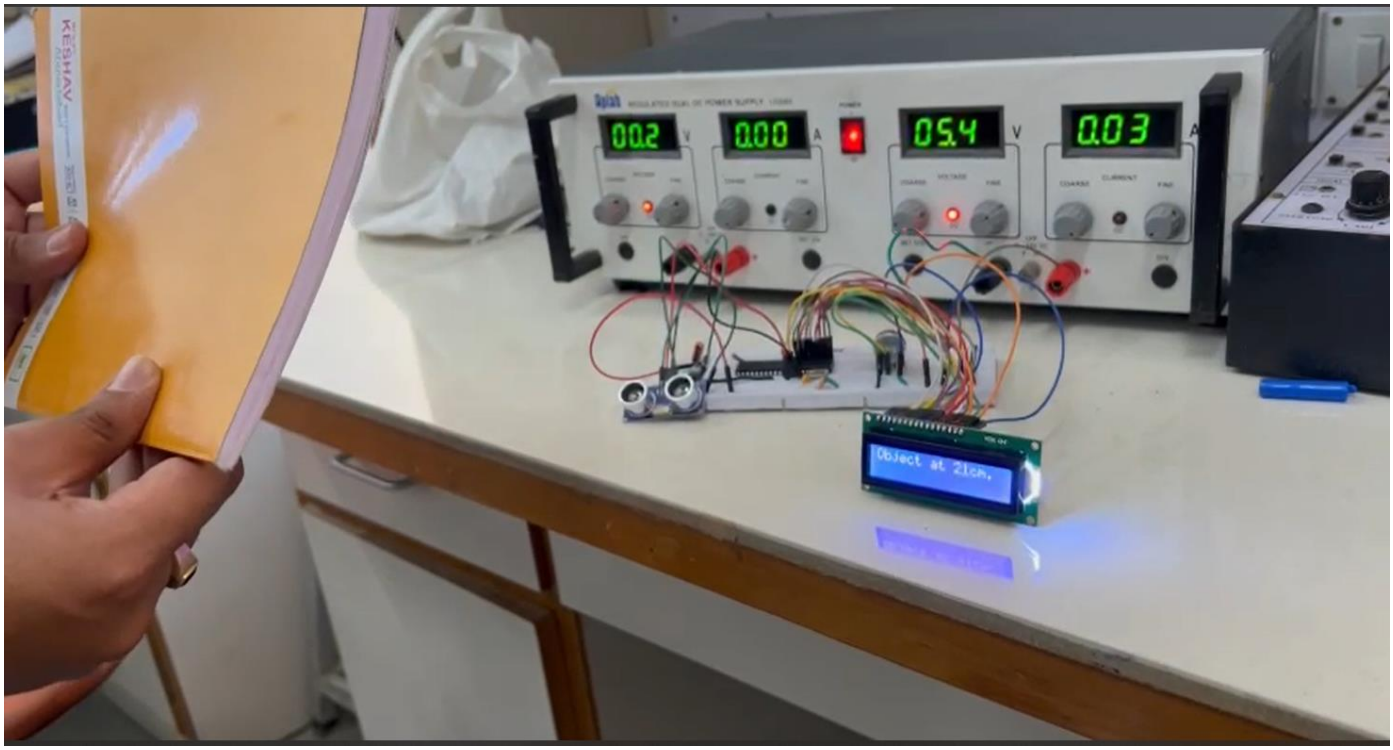
FlOWCHART

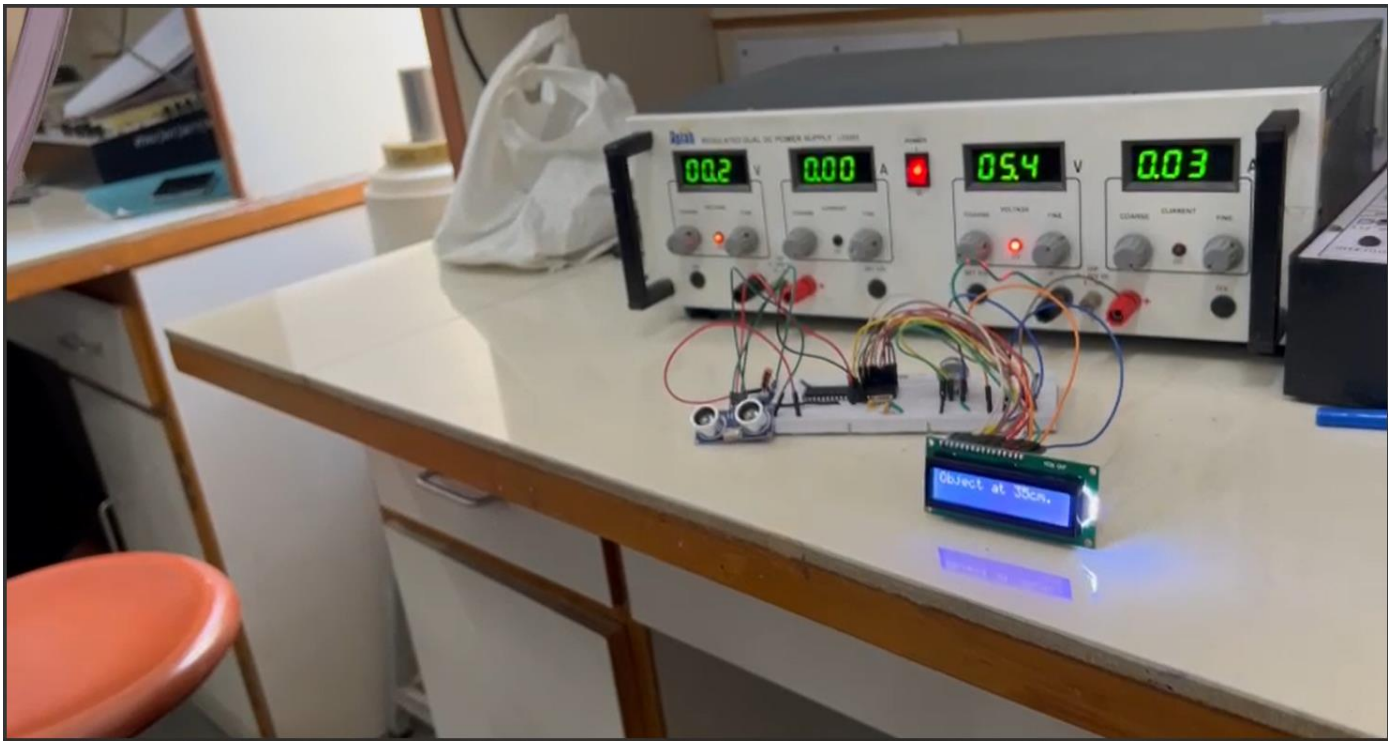

START
DATA RECIEVED FROM
ULTRASONIC SENSOR
DISTANCE IS
MEASURED
BY
MICROCONTROLLER
DISTANCE<5METERS
DISPLAY OUT
OF RANGE ON LCD
YES
DISPLAY DISTANCE
ON
LCD
END

CIRCUIT DIAGRAM



RESULTS





CODE

```
#include <REGX52.h>
#include <stdio.h>

#define dataport P2

sbit trig = P3^5;
sbit echo = P3^2;
sbit rs = P3^1;
sbit rw = P3^3;
sbit e = P3^4;


int cms;

void delay(unsigned int msec) {
    unsigned int i, j;
    for(i = 0; i < msec; i++)
        for(j = 0; j < 1275; j++);
}

void lcd_cmd(unsigned char item) {
    dataport = item;
    rs = 0;
    rw = 0;
    e = 1;
    delay(1);
    e = 0;
}

void lcd_data(unsigned char item) {
    dataport = item;
    rs = 1;
    rw = 0;
    e = 1;
    delay(1);
    e = 0;
}

void lcd_data_string(unsigned char *str) {
    while(*str != '\0') {
        lcd_data(*str);
        str++;
        delay(1);
    }
}

void send_pulse(void) {
    TH0 = 0x00;
    TL0 = 0x00;
    trig = 1;
```

```
    delay(5);
    trig = 0;
}

unsigned int get_range(void);

void int_to_string(int num, char *buffer) {
    sprintf(buffer, "%d", num);
}

unsigned int get_range(void) {
    long int timer_val;

    send_pulse();
    while(!echo);
    while(echo);
    timer_val = (TH0 << 8) + TL0;

    return (timer_val < 38000) ? timer_val / 53 : -1;
}

void display_range(int range) {
    char buffer[16];
    lcd_cmd(0x01);
    lcd_cmd(0x80);
    lcd_data_string("distance is  : ");

    if (range != -1) {
        char buffer[16];
        int_to_string(range, buffer);
        lcd_data_string(buffer);
        lcd_data_string("cm.");
    } else {
        lcd_cmd(0x01);
        lcd_data_string("Object out of range");
    }
}

void initialize_lcd() {
    lcd_cmd(0x38);
    delay(5);
    lcd_cmd(0x0C);
    delay(5);
    lcd_cmd(0x01);
    delay(5);
    lcd_cmd(0x80);
    delay(5);
}


void main() {
    initialize_lcd();
```

```
    lcd_data_string("Start");
    delay(100);

    TMOD = 0x09;
    TR0 = 1;
    TH0 = 0x00;
    TL0 = 0x00;

    while(1) {
        int range = get_range();
        display_range(range);
        delay(10);
    }
}
```

BILL

ITEM NUMBER	ITEM	QUANTITY	AMOUNT
1	ULTRASONIC SENSOR	1	61
2	AT89C51	1	100
3	LCD	1	150
4	PUSH BUTTON	1	3
5	CRYSTAL	1	5
6	CAPACITOR AND RESISTOR	5	10
7	JUMPER WIRE AND OTHER MISCLLANEOUS	1	100
TOTAL			429

APPLICATIONS

1)**Automated Guided Vehicles:** (AGVs): AGVs used in warehouses, factories, or hospitals can benefit from accurate distance sensing to navigate through environments safely.

2)**Security Systems**: Distance measurement can enhance security systems by detecting intrusions or unauthorized access based on proximity to certain areas or objects.

3) **Parking Assistance**: In automotive applications, this technology can aid drivers in parking by providing real-time distance feedback to obstacles.

SUMMARY

This project uses an 8051 microcontroller and an HC-SR04 ultrasonic sensor to measure distances precisely. The device measures the time it takes for echoes to return after releasing ultrasonic waves in order to determine an object's distance. With each count equal to 1.085 microseconds, the microcontroller's built-in timer allows for accurate timing measurements. Distance is calculated using the formula distance = (time * speed of sound) / 2, and it is shown using ASCII codes on an LCD screen. The project's adaptability is demonstrated by its applications in robotics, automation, security systems, and more. All things considered, it provides an economical and effective solution for measuring distance, showcasing the integration of hardware and software components for useful real-world applications.

REFERENCES

[1] https://www.researchgate.net/publication/316739272_Design_Implementation_and_Testing_of_Ultrasonic_High_Precision_Contactless_Distance_Measurement_System_Using_Microcontroller
[2] https://app.diagrams.net (for drawing flowchart)
[3] https://github.com