Vehicle Obstacle Detection System

Embedded System
CPE-311 & CPE-312
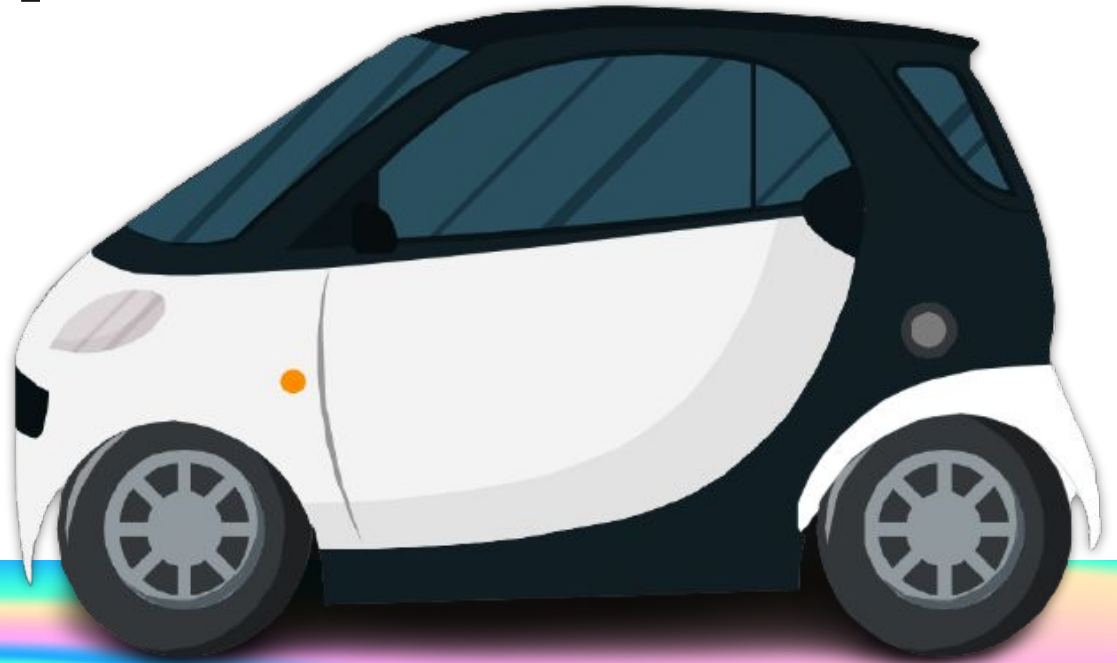
Member

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Table of contents

01 Overview

Requirements

Planning

Requirements

- When the car approaches an obstacle within 10 cm, **speaker sounds an alarm** before hitting the obstacle.

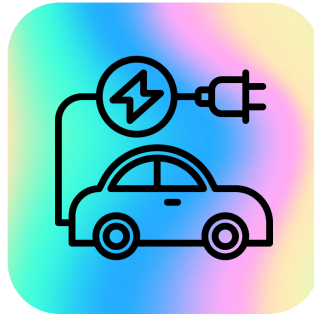- Car be able to **move forward** and **backward**.

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Planning

Description	January																				February			
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4
Requirement & Planning	■																							
Specification		■	■	■																				
Architectural design			■	■	■	■																		
Detailed Design						■	■	■	■	■	■													
Coding										■	■	■	■	■	■	■	■	■	■	■	■	■		
System Testing																							■	■
Acceptance testing																							■	■

02 Specification

System
information

Function

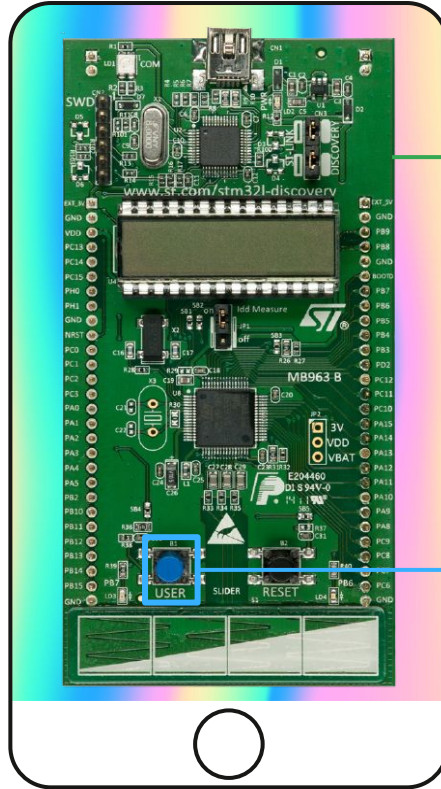Behavior

✳ System information

**Software:
Keil µVision 5**

Create, develop and monitor project

Language: C

Develop program

✳ System information
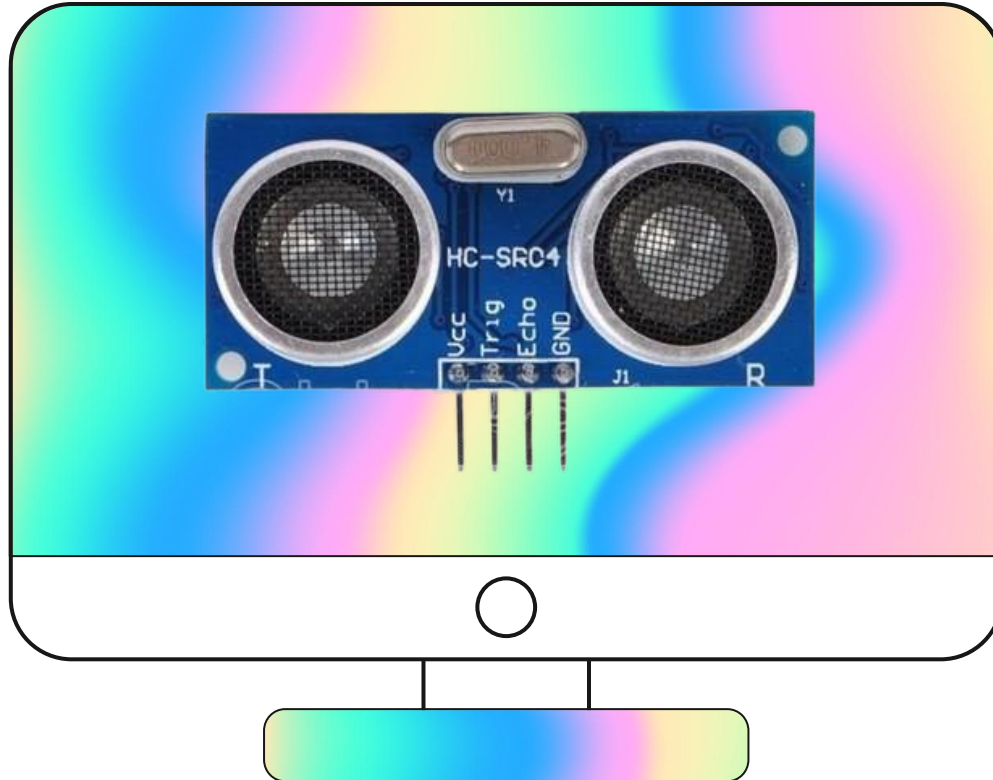

**MCU :
STM32L152RB**

Process the entire program

USER Button

Press to moves motor
clockwise (move forward)
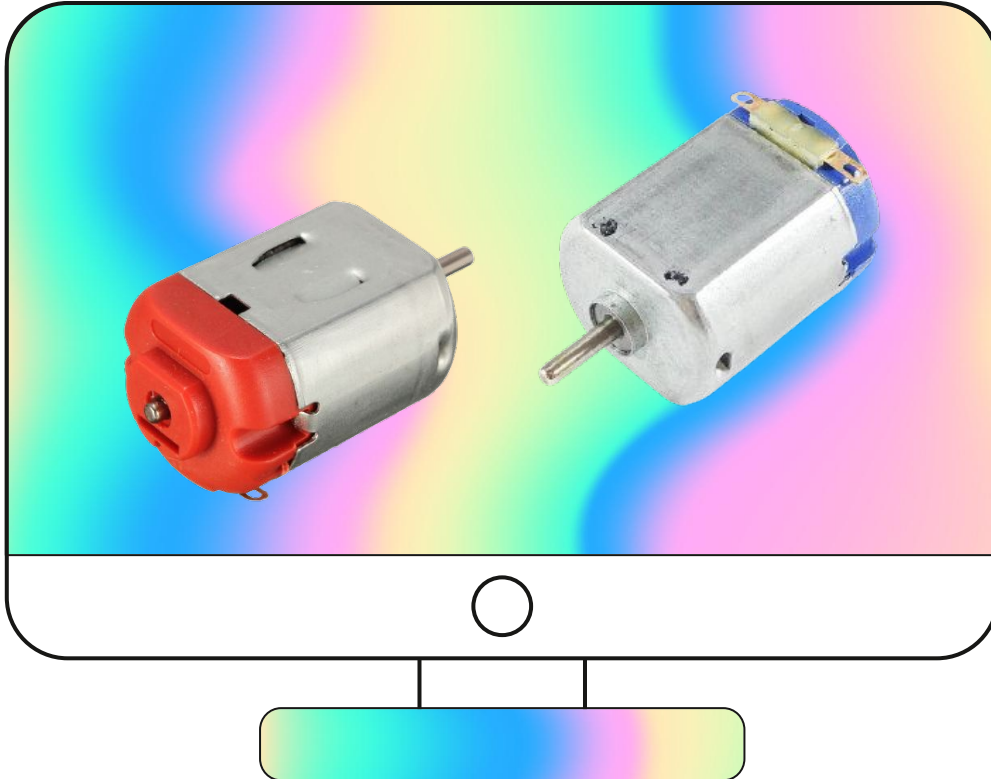
✳ System information

Ultrasonic sensor : HC-SR04 module

Measures the distance to an obstacle using ultrasonic sound waves

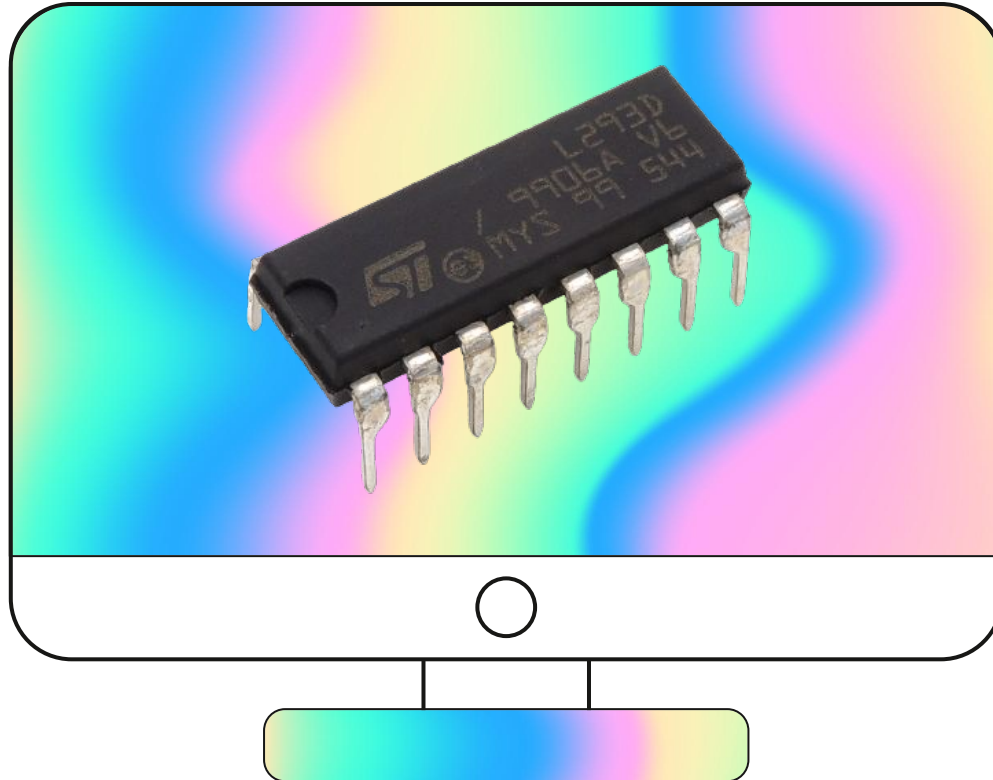# ✳ System information

2 DC motors

Control movement speed and direction (forward, backward)
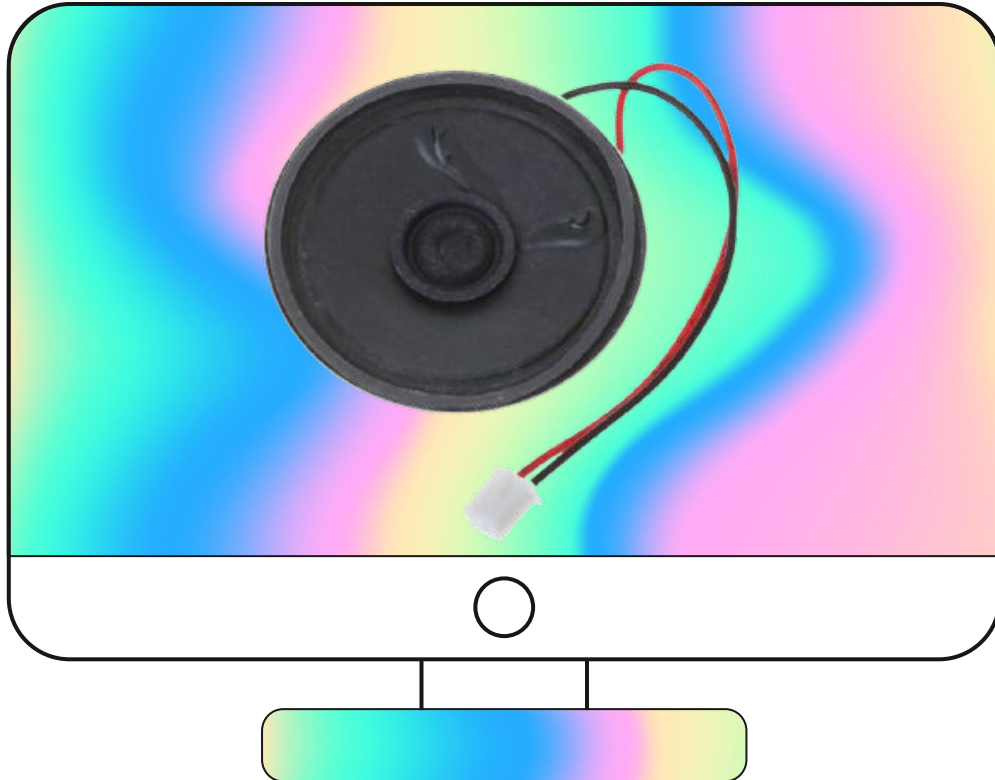
✳ System information

IC : L293D module

Motor Driver IC which allows the DC motor to drive on any direction
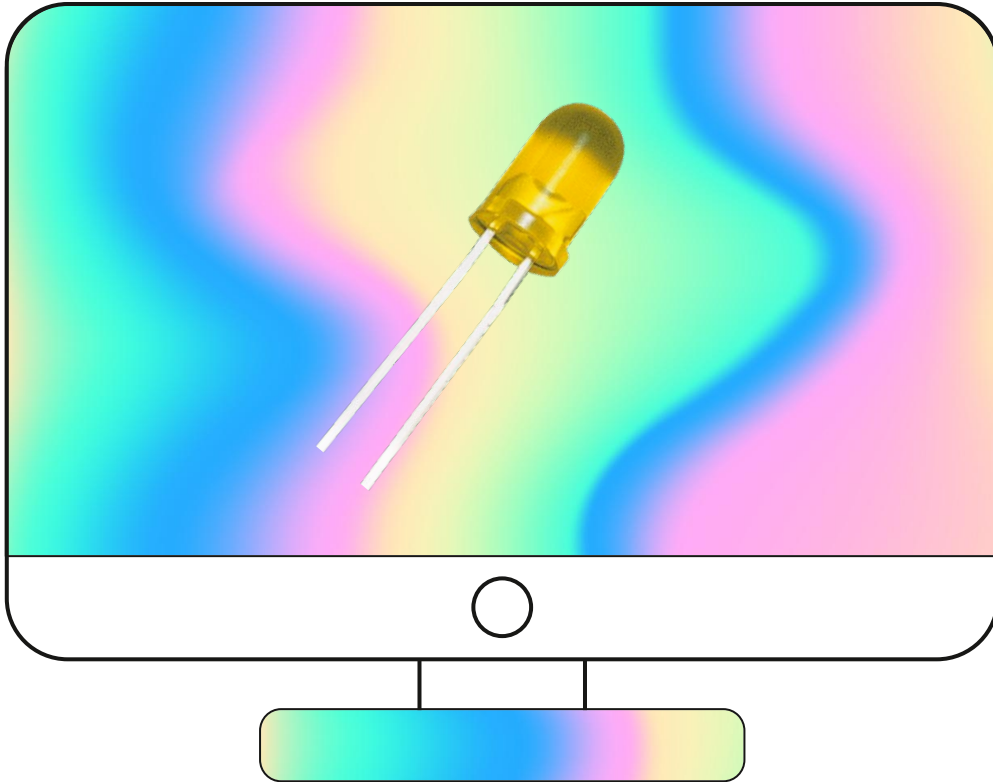
✳ System information

Speaker

Sound an alarm when approaches an obstacle in specified range
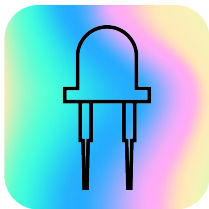
✳ System information

LED

The light flashes when an obstacle is within the specified range

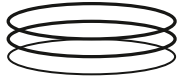# Function

Control movement
(Motor)

Flashing light
(LED action)

Calculate distance
(Ultrasonic sensor)

Alert
(Speaker)

Behavior

Movement Path

1. Button controls a motor
2. Motor direction with wheels
3. Slow down to stop move when speaker is activated.

Display Path

1. Receive action from movement path to activate LED
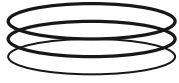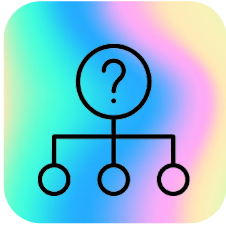
Behavior

Ultrasonic Path

1. Calculate distance from car to obstacle
2. When a car almost hit obstacle (within 10 cm.), motor stopped
3. sent signal to speaker

Speaker

1. Alert while near object
2. Stop sound when car move forward

03 Architectural design

Block diagram
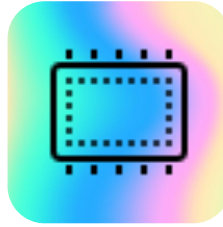
Hardware detail selection

STM32L152RB Pin allocation

Block diagram

10 < d < 10 = 15
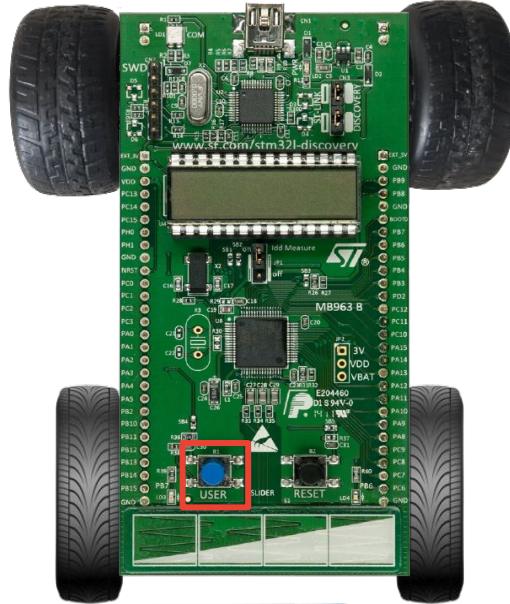
counterclockwise

Hardware detail selection

Ultrasonic ranging module : HC-SR04
Datasheet

15mm

43mm

20mm

40mm

22.5° 0° 22.5°

45° 45°

10'
9'
8'
7'
6'
5'
4'
3'
2'
1'
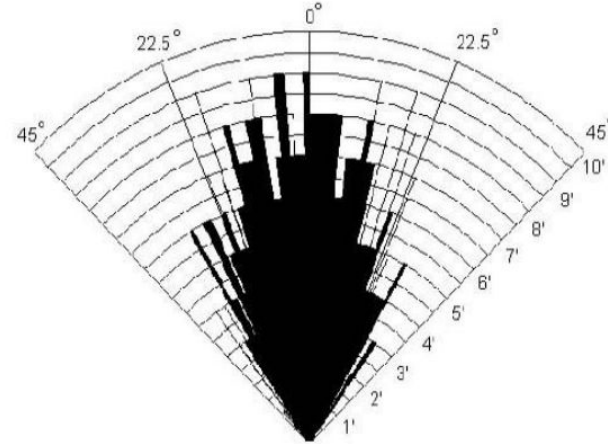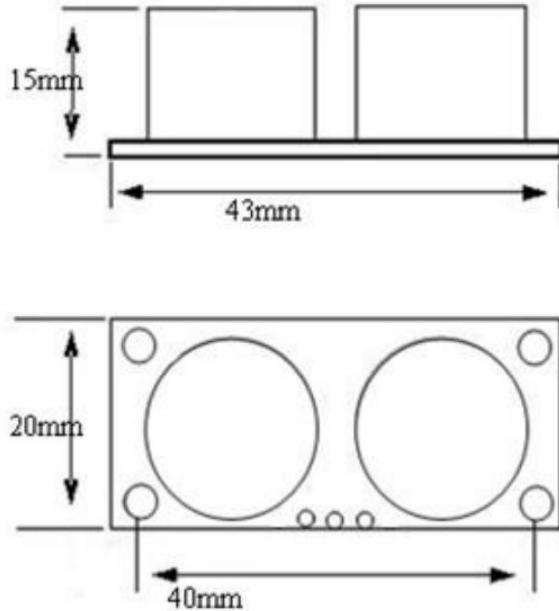
Practical test of performance,
Best in 30 degree angle

Hardware detail selection

Ultrasonic ranging module : HC-SR04
Datasheet

Electric Parameter

Working Voltage	DC 5 V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
MeasuringAngle	15 degree
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in proportion
Dimension	45*20*15mm

Hardware detail selection

Ultrasonic ranging module : HC-SR04
Datasheet

Sequence chart

Initiate

10uS TTL to signal pin

Echo back

pulse width corresponds to distance
(about 150uS-25ms, 38ms if no obstacle)

Signal

Formula:

pulse width (uS) /58= distance (cm)

pulse width (uS) /148= distance (inch)

Internal

Ultrasonic Transducer will issue 8 40kHz pulse

Hardware detail selection

ST

L293D
L293DD

PUSH-PULL FOUR CHANNEL DRIVER WITH DIODES

- 600mA OUTPUT CURRENT CAPABILITY PER CHANNEL
- 1.2A PEAK OUTPUT CURRENT (non repetitive) PER CHANNEL
- ENABLE FACILITY
- OVERTEMPERATURE PROTECTION
- LOGICAL "0" INPUT VOLTAGE UP TO 1.5 V (HIGH NOISE IMMUNITY)
- INTERNAL CLAMP DIODES

DESCRIPTION

The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoides, DC and stepping motors) and switching power transistors.

To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included.

This device is suitable for use in switching applications at frequencies up to 5 kHz.

SO(12+4+4) Powerdip (12+2+2)

ORDERING NUMBERS:

L293DD L293D

The L293D is assembled in a 16 lead plastic packaage which has 4 center pins connected together and used for heatsinking

The L293DD is assembled in a 20 lead surface mount which has 8 center pins connected together and used for heatsinking.
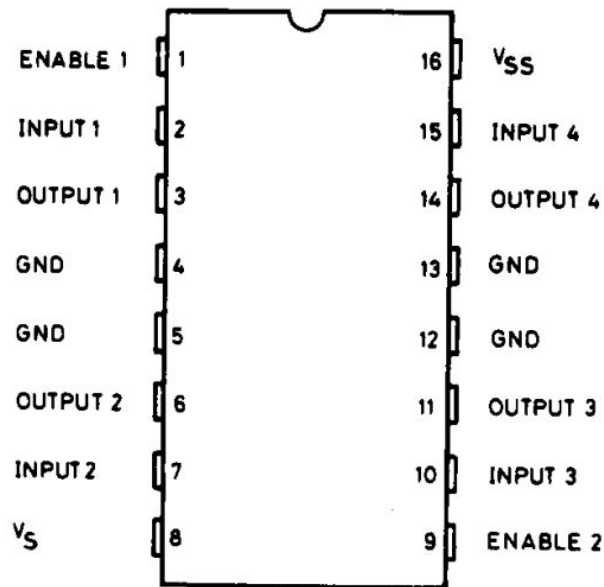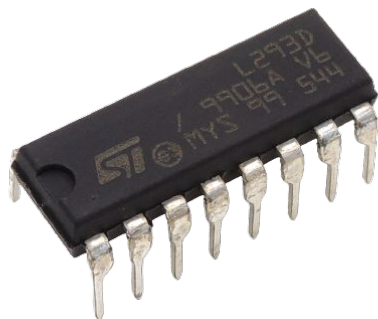
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Hardware detail selection

L293D
L293DD

PUSH-PULL FOUR CHANNEL DRIVER WITH DIODES

ENABLE 1	1	16	V_{SS}
INPUT 1	2	15	INPUT 4
OUTPUT 1	3	14	OUTPUT 4
GND	4	13	GND
GND	5	12	GND
OUTPUT 2	6	11	OUTPUT 3
INPUT 2	7	10	INPUT 3
V_S	8	9	ENABLE 2

S-6574

Powerdip(12+2+2)

Hardware component lists

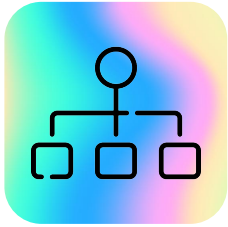| Component list	Qty.	มีแล้ว	แหล่งที่ซื้อ	ราคา/ชิ้น	ราคารวม
STM32L152RB board	1	/			
Ultrasonic sensor	1	/			
DC Motor	2	/			
Speaker	1	/			
LED	1	/			
Wires	-	/			
Gear	8	/			
Toy car wheels	4	/			
					0

PIN Allocation

PIN\PORT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A																
B																
C																
D																
H																

Available pins
Special pins
No pin out

Input 1	Input 2	Output1	Output 2	output 3
User button	UltraSonic	Motor	LED	Speaker

04 Detailed design

Top-down design
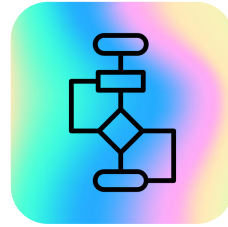
Flowchart

Gantt chart

Top-down design

Vehicle Obstacle Detection System

Function: SystemClock configuration

Function: LED configuration

Function: Set motor speed

- **Function:** Motor GPIO configuration
- **Function:** Motor Timebase configuration

Function: Duration of sound is played

- **Function:** Set loudness level of sound with notes are assigned
- **Function:** Sound Timebase configuration
- **Function:** Sound GPIO configuration

Function: Ultrasonic configuration

Function: Interaction with user by User Button

Motor Movement

Function: Motor move clockwise (Object is being forward)

Function: Motor move counterclockwise (Object is being backward)
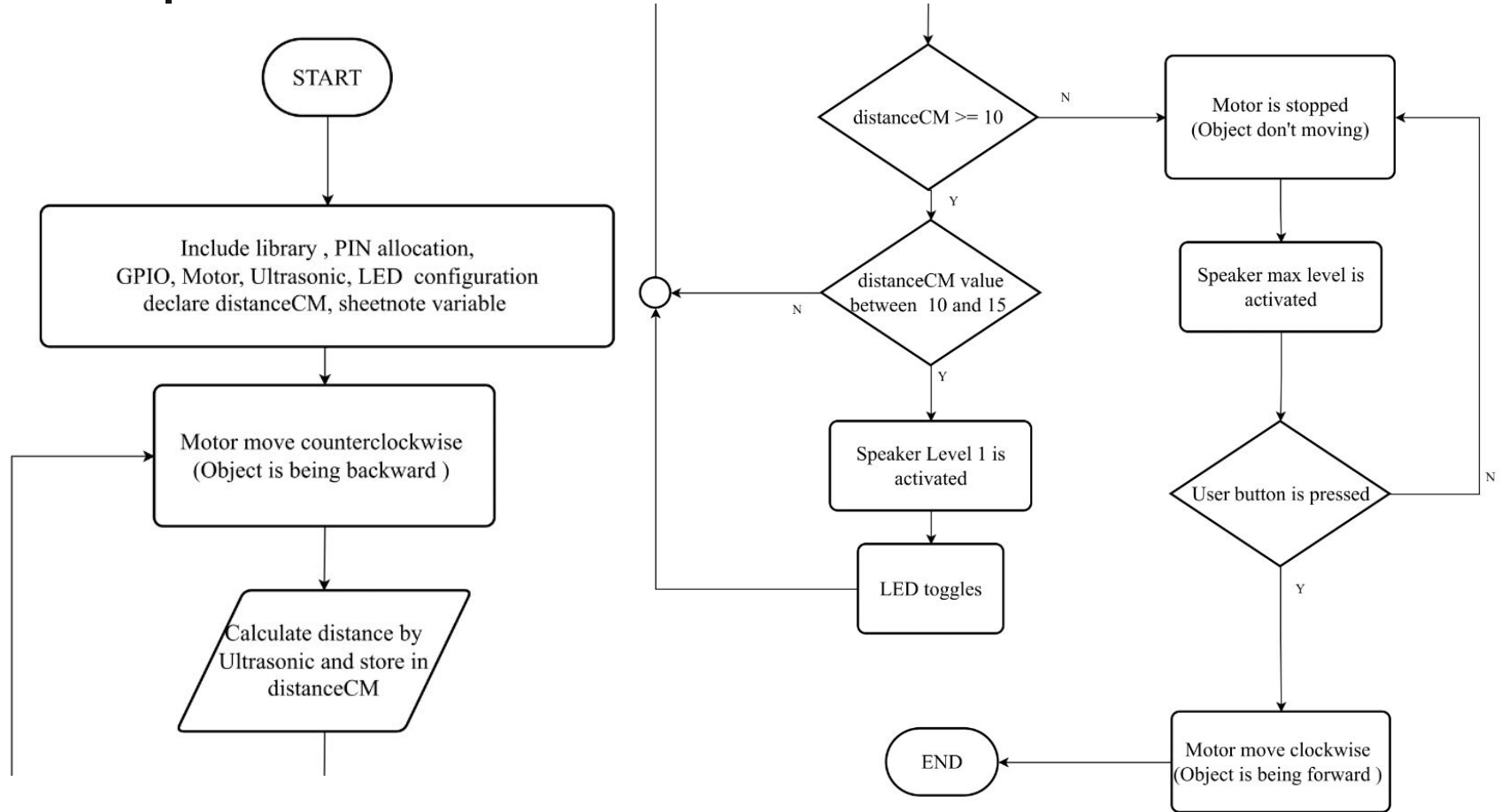
Function: Motor is stopped (Object don't moving)

Hardware

LED   **Motor**   **Speaker**   **Ultrasonic**   **User Button**

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Flowchart

START

Include library , PIN allocation, GPIO, Motor, Ultrasonic, LED configuration declare distanceCM, sheetnote variable

Motor move counterclockwise (Object is being backward)

Calculate distance by Ultrasonic and store in distanceCM

distanceCM >= 10 — N

distanceCM value between 10 and 15 — N

Y

Speaker Level 1 is activated

LED toggles

Motor is stopped (Object don't moving)

Speaker max level is activated

User button is pressed — N

Y

Motor move clockwise (Object is being forward)

END

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Gantt Chart

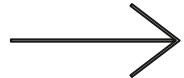| Description	Responsible person	January																				February			
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4
Project planning	EVERYONE	Plan																							
		Done																							
Project Design	Thanyaluck, Kittipat & Phattaranan		Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan													
			Done	Done	Done	Done	Done	Done	Done	Done															
Coding & Debugging	Rakphong & Panuwit										Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan			
											Done	Done	Done	Done	Done	Done	Done	Done	Done	Done	Done	Done		Delay	
Presentation	EVERYONE																							Plan	Plan
																								Done	Done

Plan · **Done** · **Delay**
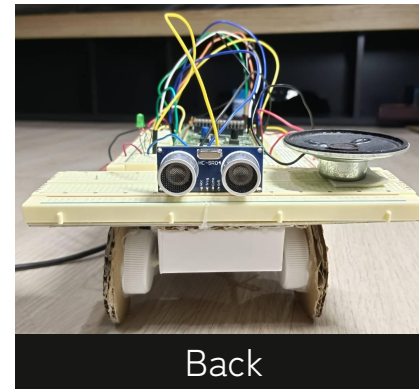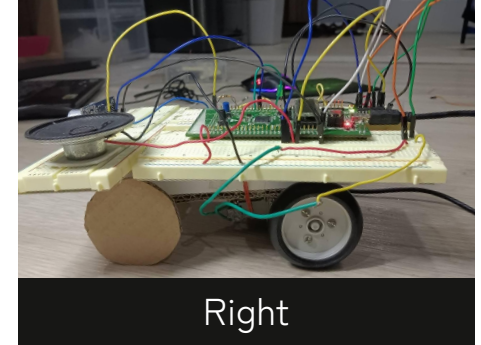
05 Project Demo

The final product

Demo Video

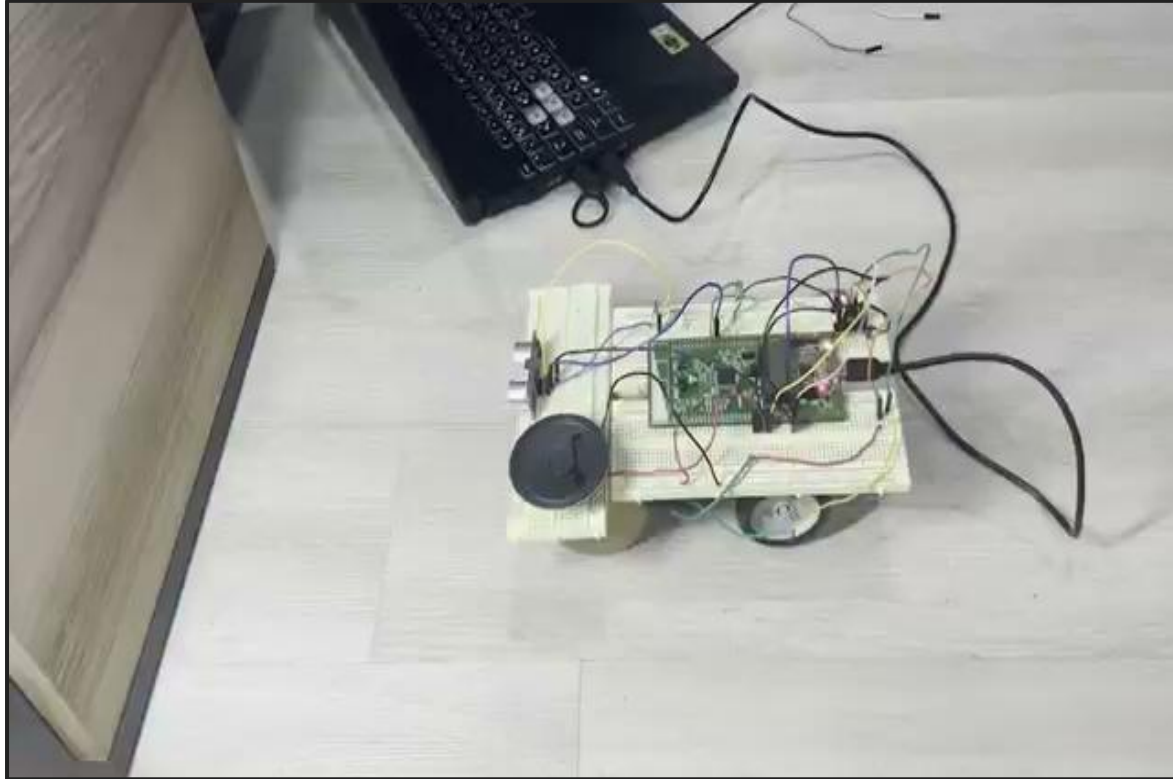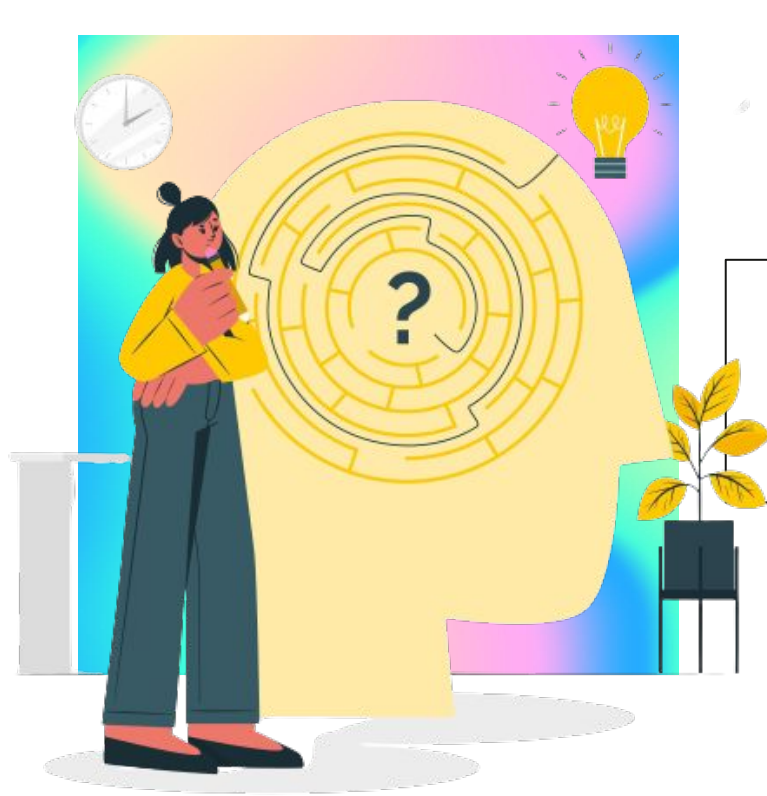# The final product

Top

Bottom

Left

Right

Back
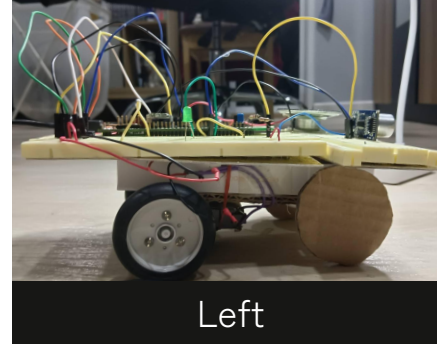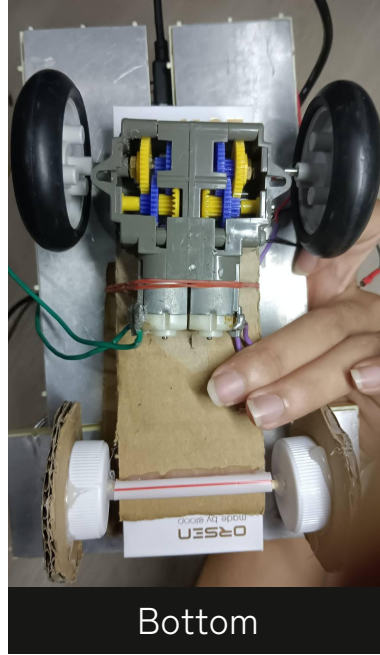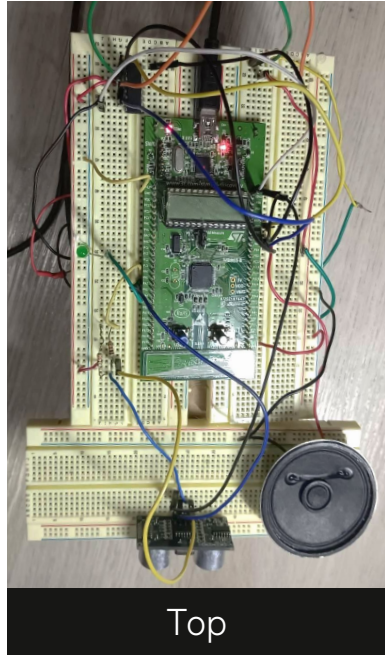
Demo Video

06

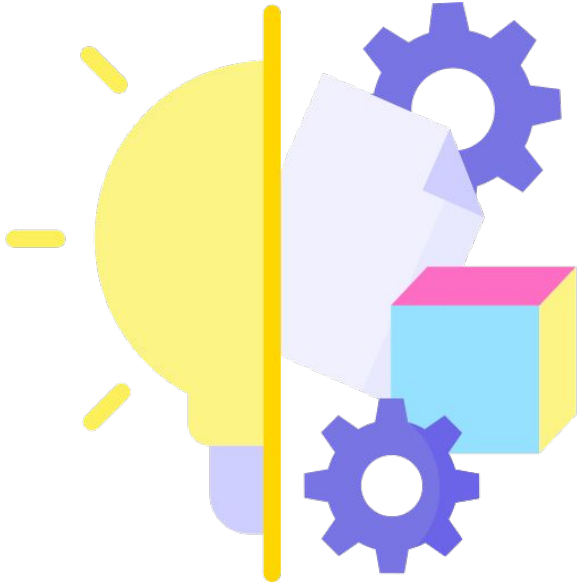# Problem & Solution

Problem

- Online communication
- Insufficient equipment
- The results were not as expected

Solution

- Use GitHub to collaborate and plan project
- Instead, use different equipment
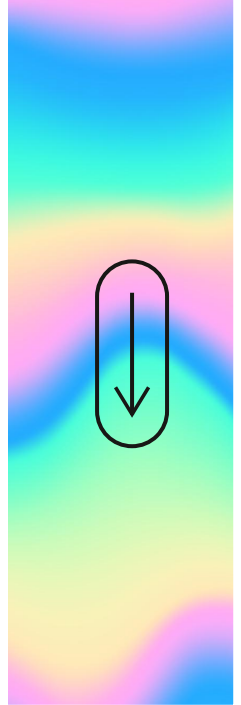- Adjust some functions

Conclusion

1

The result would be excellent tools for further development in the future projects

2

To improve the project's efficiency, some functions can be added and altered.

Thank You!