



Fire Fighter car

Under Supervision of



Dr. Bassem
Lecturer, Department of
Information Technology at
Egyptian E-Learning University
(EELU)



Eng. Safinaz Aalaa Eldin
Teacher Assistant, Department of
Information Technology at Egyptian
E-Learning University (EELU)

Our team

Ahmed Ramadan Ahmed
19-00251

Menna Allah Yasser Hussein
20-00952

Ahmed Mahmoud Fekry
20-01227

Mohamed Sherif Khalifa
19-00079

Maria Amgad Anwer
20-00707

Khalil Elsenosy Khalil
20-01201

Abd-Elaziz Anan Mohamed
19-00512

Introduction

1

Software & Hardware Tools

Problems Statement

2

Problems solution

3

Related Works

4

Flowchart

5

Mechanism & Methodology

6

8

References

Fire Fighting Car

1

Introduction



INTRODUCTION

01

~The primary goal of a fire fighter robot car is to extinguish fires and protect lives and property in emergency situations.

02

~Fire fighter robot cars are often remote-controlled or can operate autonomously.

03

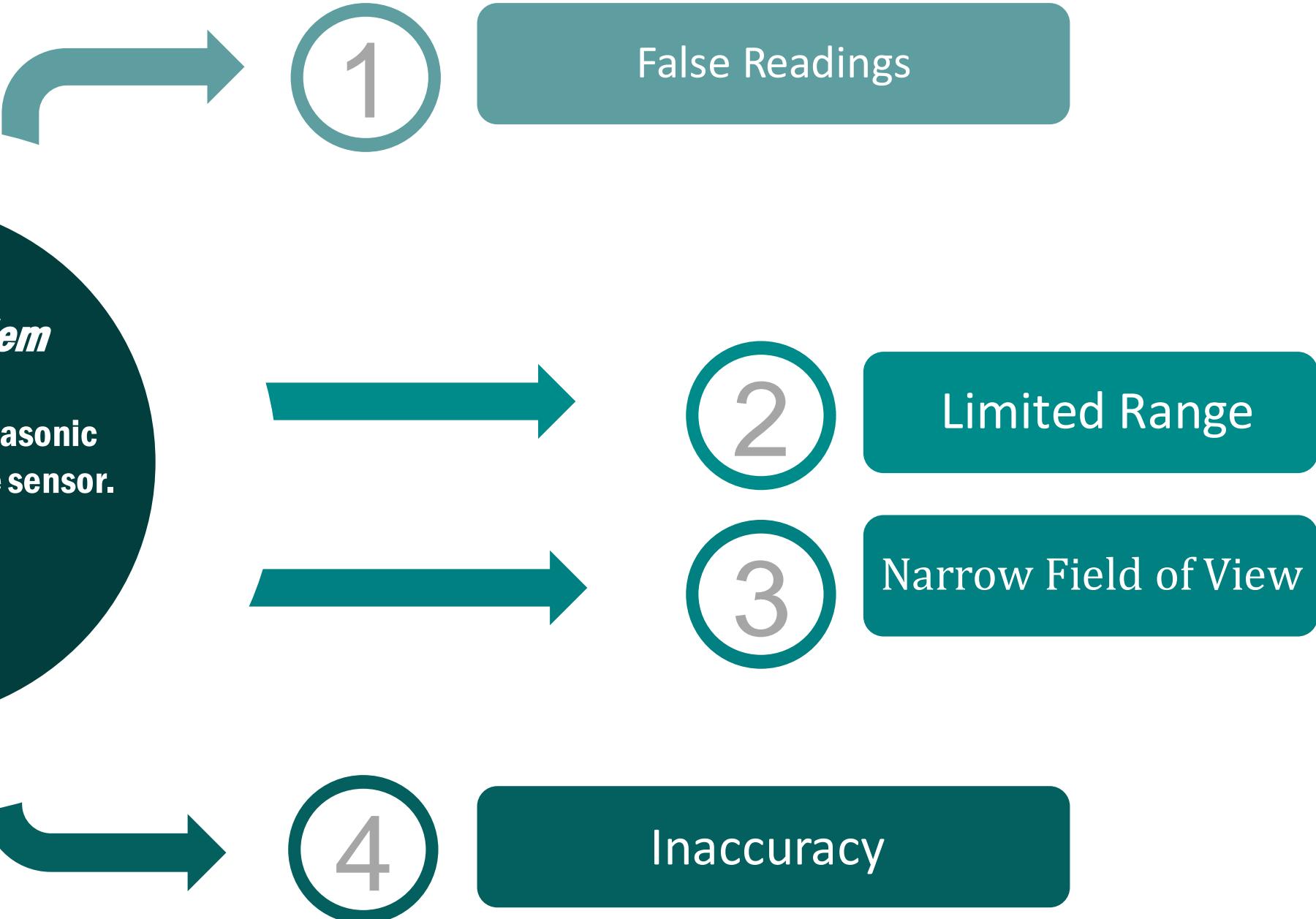
~ Firefighting robot cars are designed to work in tandem with traditional fire trucks and other firefighting apparatus.

2

Problems



Sensors Problem
According to use Ultrasonic sensor , Temperature sensor.
we Have Faced Many Problems .



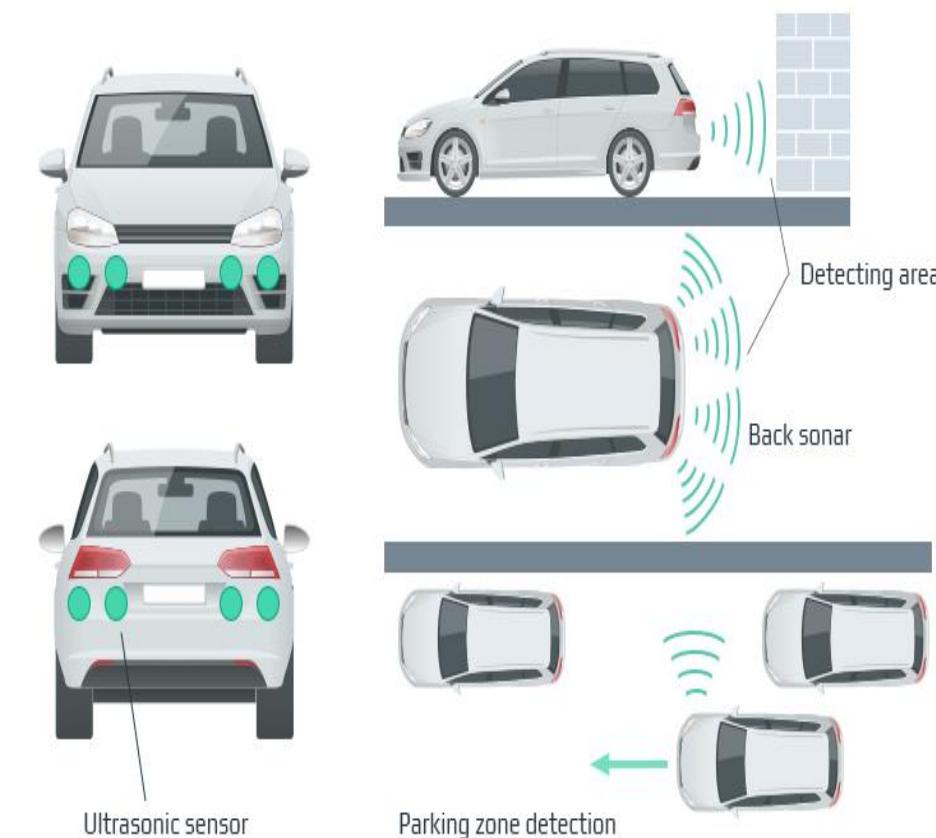
False Reading

- Ultrasonic sensors can sometimes pick up false readings caused by interference from other sources, such as reflections from nearby walls or objects.
- The temperature sensor may be in a high temperature environment.
- readings can cause the car to make incorrect decisions about its path, leading to errors in navigation.

problem

- For ultrasonic sensors, to reduce false readings, we must reduce sources of interference. This can be achieved by placing sensors where they are less likely to pick up reflections, and by using algorithms to filter out false readings.
- As for the temperature sensor, you must check the environmental temperature first.

Solution



Limited range

- Ultrasonic sensors have a limited range, typically between 2 and 4 meter.
- there are obstacles that are farther away than the sensor can detect.

problem

- To overcome the limited range of ultrasonic sensors, We have to use SERVO Motor positioned with Ultrasonic sensor to cover different angles to cover a wider area. Alternatively, other types of sensors with longer ranges, such as lidar or radar, can be used in conjunction with ultrasonic sensors to provide a more complete picture of the environment.

Solution



Narrow field Of View

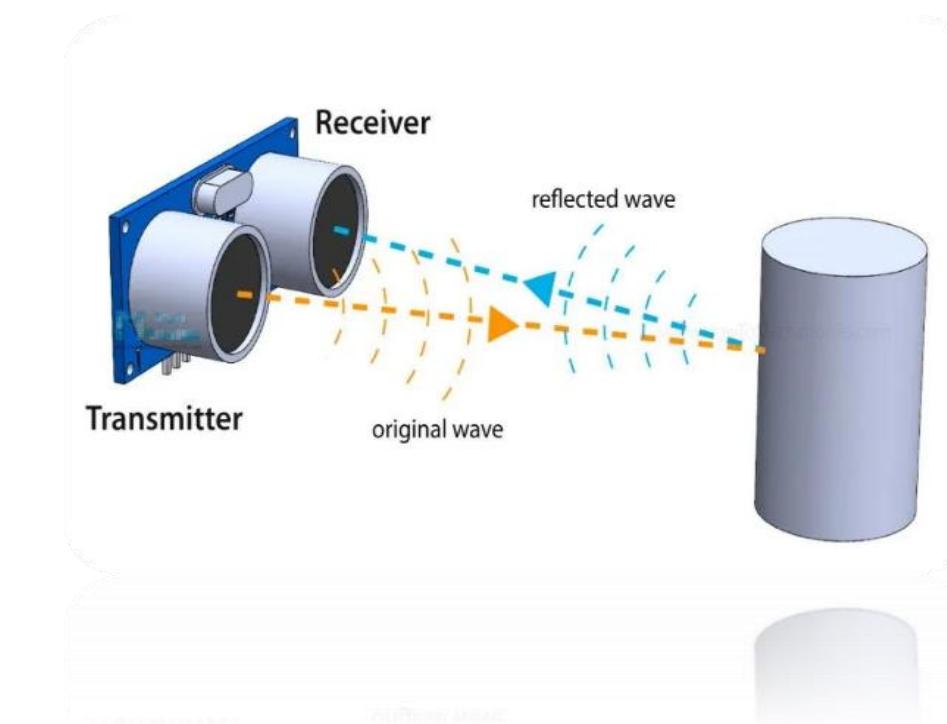
- Ultrasonic sensors have a narrow field of view, typically around 15 degrees.
- This means that they can only detect obstacles that are directly in front of them, and may miss obstacles that are to the side or behind them.

problem

- To overcome the narrow field of view, We have to use multiple sensors positioned at different angles to cover a wider area.

Because of these presented problems, we were encouraged to use 3 ultrasound devices Sensors to eliminate.

Solution



Inaccuracy

- Ultrasonic sensors or temperature sensors may be inaccurate, especially when detecting objects with angles, irregular shapes, or temperature differences from one place to another. This may lead to the car making incorrect decisions.

problem

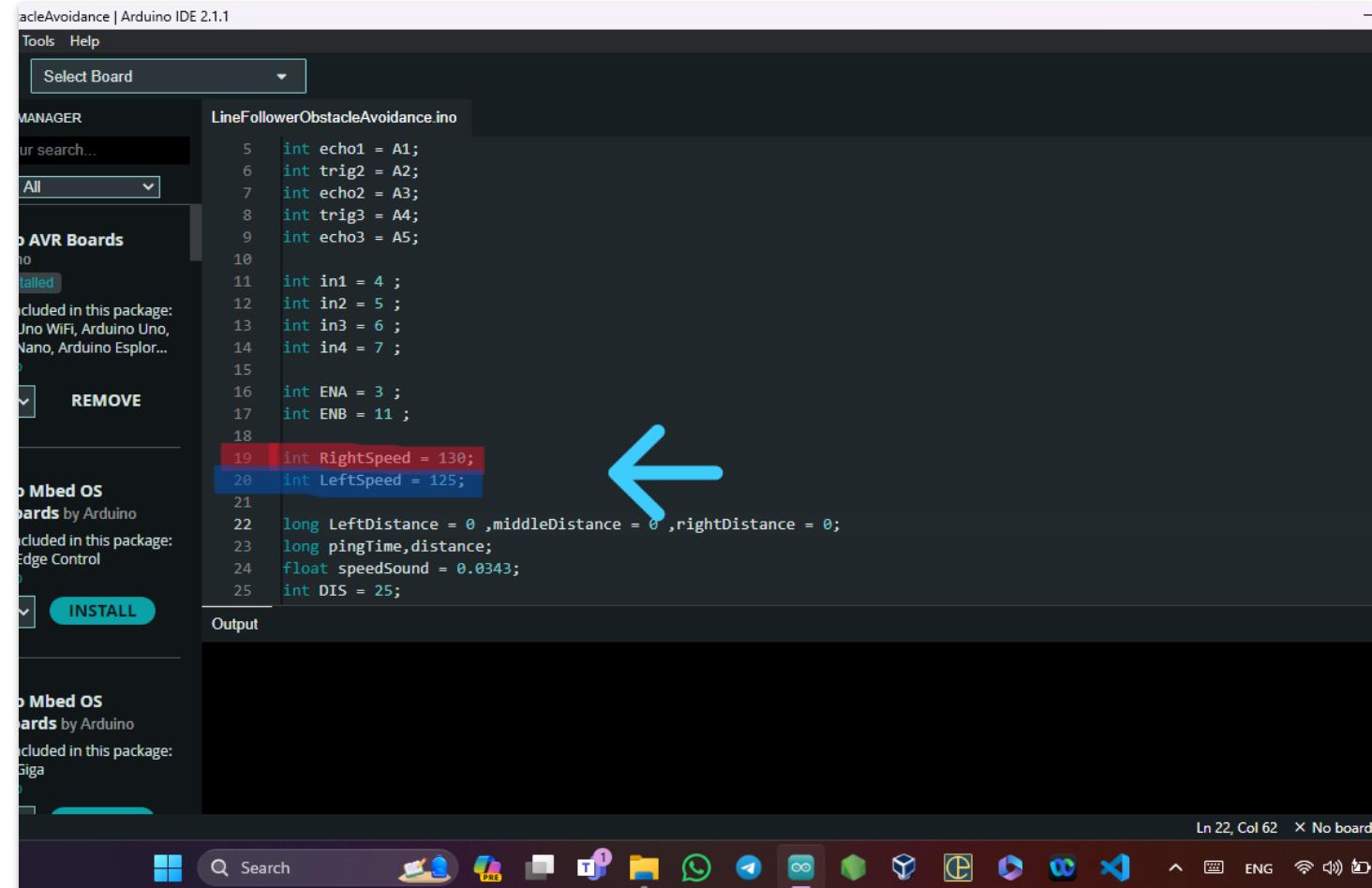
- To improve the accuracy of ultrasonic sensors, it is important to calibrate them properly and to use algorithms to compensate for their limitations. And use algorithms to compensate for their limitations.

Solution

Inaccuracy

For Example

the speed of sound in Ultrasonic sensors and a thermometer can vary depending on the location's temperature and humidity, so it is important to measure and adjust these factors. In addition, algorithms can be used to estimate the size and shape of objects based on sensor readings and determine the location of hot objects, which can improve the accuracy of detecting obstacles and fires at the same time.



The screenshot shows the Arduino IDE interface with the title "ObstacleAvoidance | Arduino IDE 2.1.1". The left sidebar displays the "BOARD MANAGER" with sections for "All Boards" and "Mbed OS Boards by Arduino". The main area shows the code for "LineFollowerObstacleAvoidance.ino". The code includes declarations for pins (echo1-A1, trig2-A2, echo2-A3, trig3-A4, echo3-A5, in1-in4, ENA, ENB), speeds (RightSpeed=130, LeftSpeed=125), and distances (LeftDistance, middleDistance, rightDistance). It also includes constants for pingTime, distance, speedSound, and DIS. A blue arrow points to the line "int RightSpeed = 130;".

```
ObstacleAvoidance | Arduino IDE 2.1.1
Tools Help
Select Board
MANAGER LineFollowerObstacleAvoidance.ino
Your search...
All
ARDUINO Boards
No installed
Included in this package: Uno WiFi, Arduino Uno, Nano, Arduino Esplor...
REMOVE
MBED OS Boards by Arduino
Included in this package: Edge Control
INSTALL
Output
5 int echo1 = A1;
6 int trig2 = A2;
7 int echo2 = A3;
8 int trig3 = A4;
9 int echo3 = A5;
10
11 int in1 = 4 ;
12 int in2 = 5 ;
13 int in3 = 6 ;
14 int in4 = 7 ;
15
16 int ENA = 3 ;
17 int ENB = 11 ;
18
19 int RightSpeed = 130;
20 int LeftSpeed = 125;
21
22 long LeftDistance = 0 ,middleDistance = 0 ,rightDistance = 0;
23 long pingTime,distance;
24 float speedSound = 0.0343;
25 int DIS = 25;
```

The Challenges

**Navigation
&
Localization**

**Route
Planning**

**Obstacle
Avoidance**

**Performance
optimization**

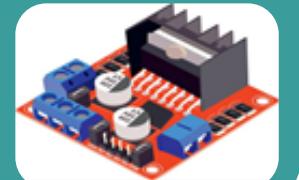
3 *Hardware/ Software*



**ARDUINO
UNO**



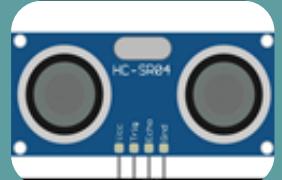
**MOTOR
*DRIVER***



WHEELS



**ULTRASONIC
SENSOR**



**DC
MOTORS**



LITHIUM-
ION
BATTERY



JUMPER
CABLES



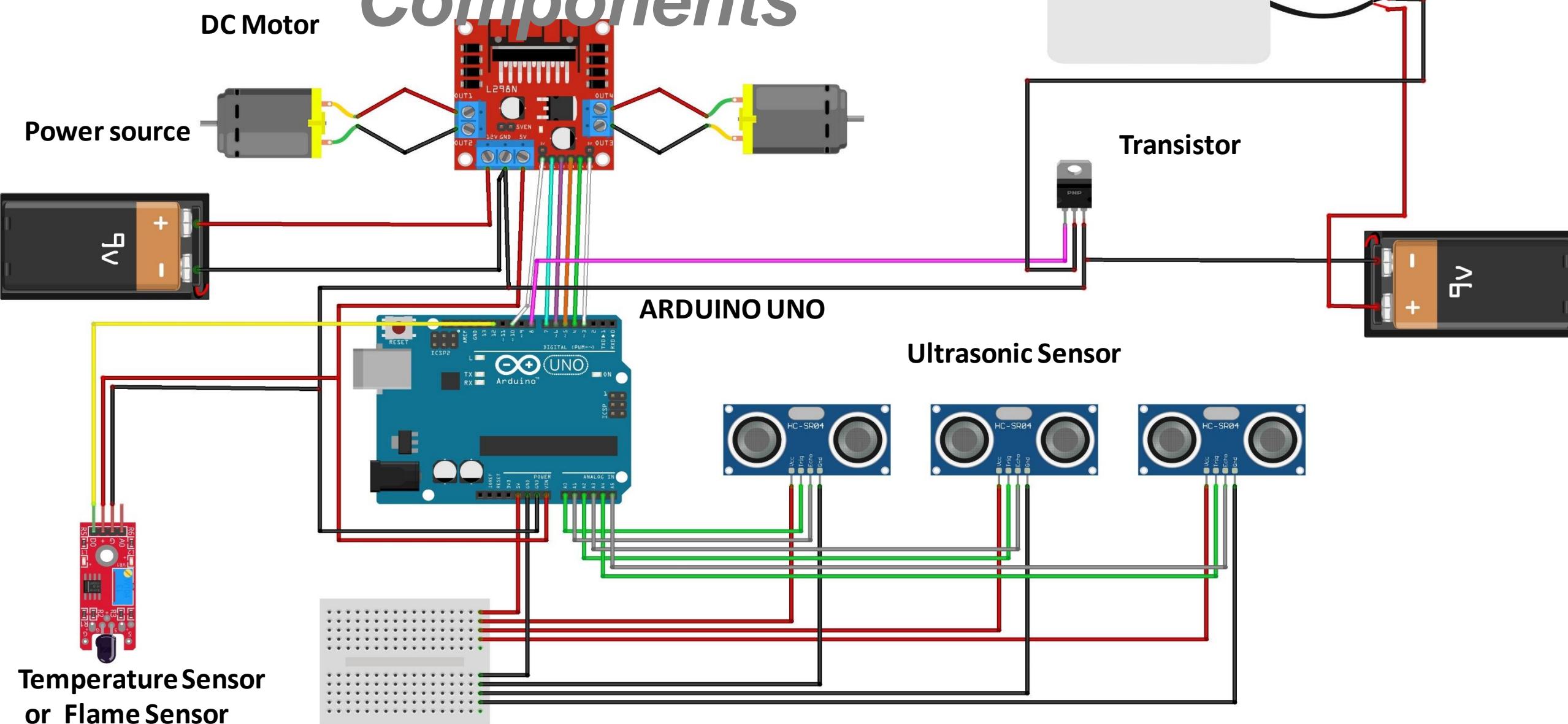
Temperature
or
Flame Sensor



WATER
PUMP



Hardware Components



The whole fire fighter robot can be divided into 3 sections

01

Controller (Arduino UNO)

- Arduino UNO R3 is used for controlling the whole the process of the fire fighting Robot.
- Arduino read these signals and send commands to driver circuit to driveline follower.

02

SENSOR SECTION

- This section contains an Ultrasonic sensor to detect and avoid obstacles
- As well as Temperature sensor and flame sensor, to fire detection and dealing with it.

03

DRIVER SECTION

- The driver section consists of motor driver and two dc motors .
- The motor driver is used for driving motors because Arduino does not supply enough voltage and current to the motor.

→So we add a motor driver circuit to get enough voltage and current for the motor. Arduino sends commands to this motor driver and then it drives motors

Arduino UNO

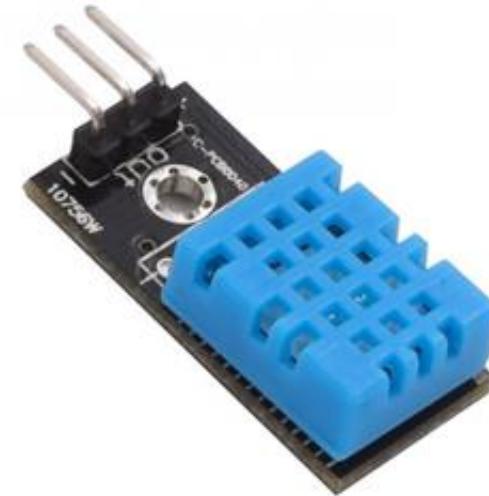
- Arduino uno is the main controller in the project.
- the data from the sensors (Ultrasonic sensor or Temperature sensor or IR sensors) will be given to Arduino and it gives corresponding signals to the motor driver dc .



TEMPERATURE SENSOR

Consisting of :

- Two main parts : the sensitive stage and the electronic circuit.
The sensitive stage (which may be a temperature-sensitive transistor or similar) is placed.
- When the temperature is changed, these changes in heat level are transmitted to the integrated electronic circuit, The electronic circuit processes the electrical signal to produce a digital temperature reading. This reading is used to determine the temperature level and determine if there is a fire or any abnormal thermal changes in the environment surrounding the car to extinguish fires.



ULTRASONIC SENSOR

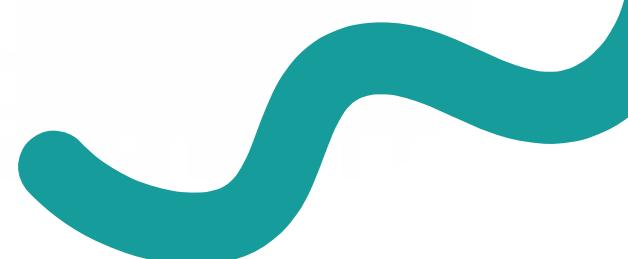
Consisting of :

- The transmitter (emits sound using piezoelectric crystals).
- The receiver (which faces the sound beyond it Travel to and from the target)

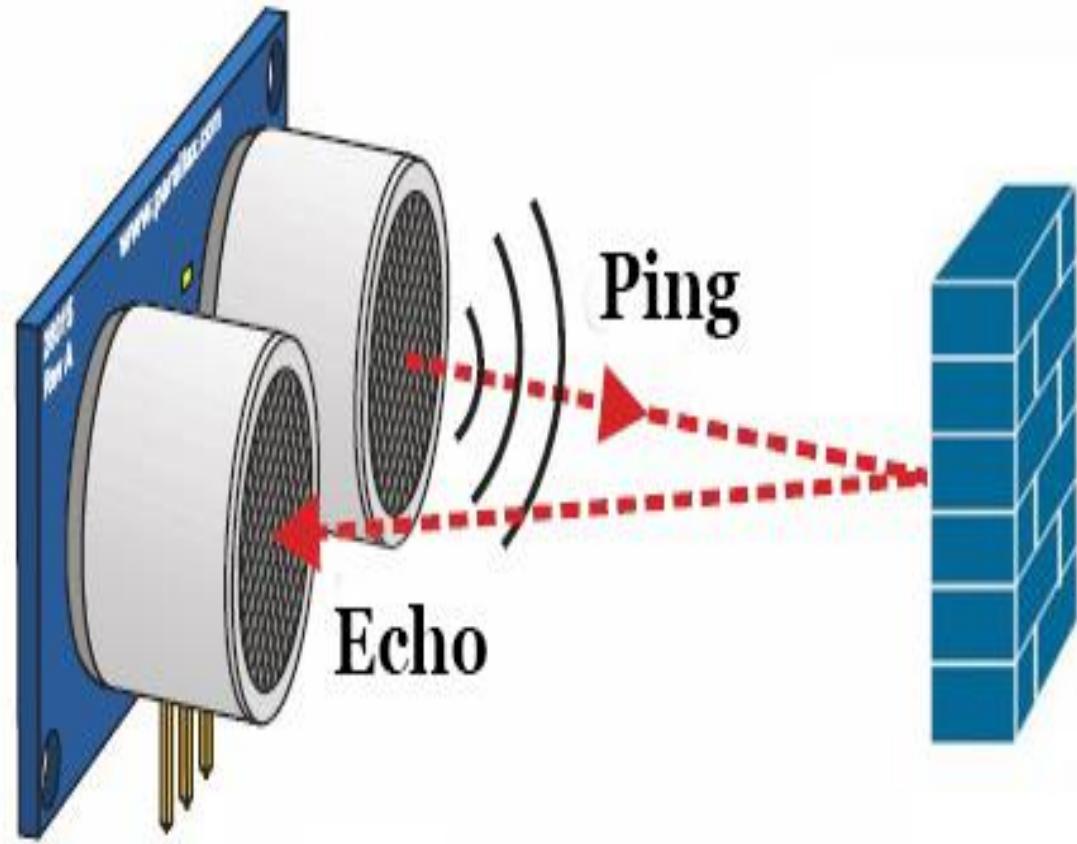


How Does It Work (fire fighting with Obstacle Avoidance) :

- The fire fighting Robotic Vehicle Uses Ultrasonic Sensors For Its Movements.
- The Ultrasonic Sensor Is Attached In Front Of The Robot. Whenever The Robot Is Going On - The transmitter The Desired Path The Ultrasonic Sensor Transmits The Ultrasonic Waves Continuously From Its Sensor Head.
- The Ultrasonic Sensor Transmits The Ultrasonic Waves From Its Sensor Head And Again Receives The Ultrasonic Waves Reflected From An Object.
- Whenever An Obstacle Comes Ahead Of It The Ultrasonic Waves Are Reflected From An Object And That Information Is Passed To The Microcontroller. The Microcontroller Controls The Motors Left, Right, Back, Front, Based On Ultrasonic Signals. To Control The Speed Of Each Motor Pulse Width Modulation Is Used (PW)
- Ultrasonic sensors work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required.



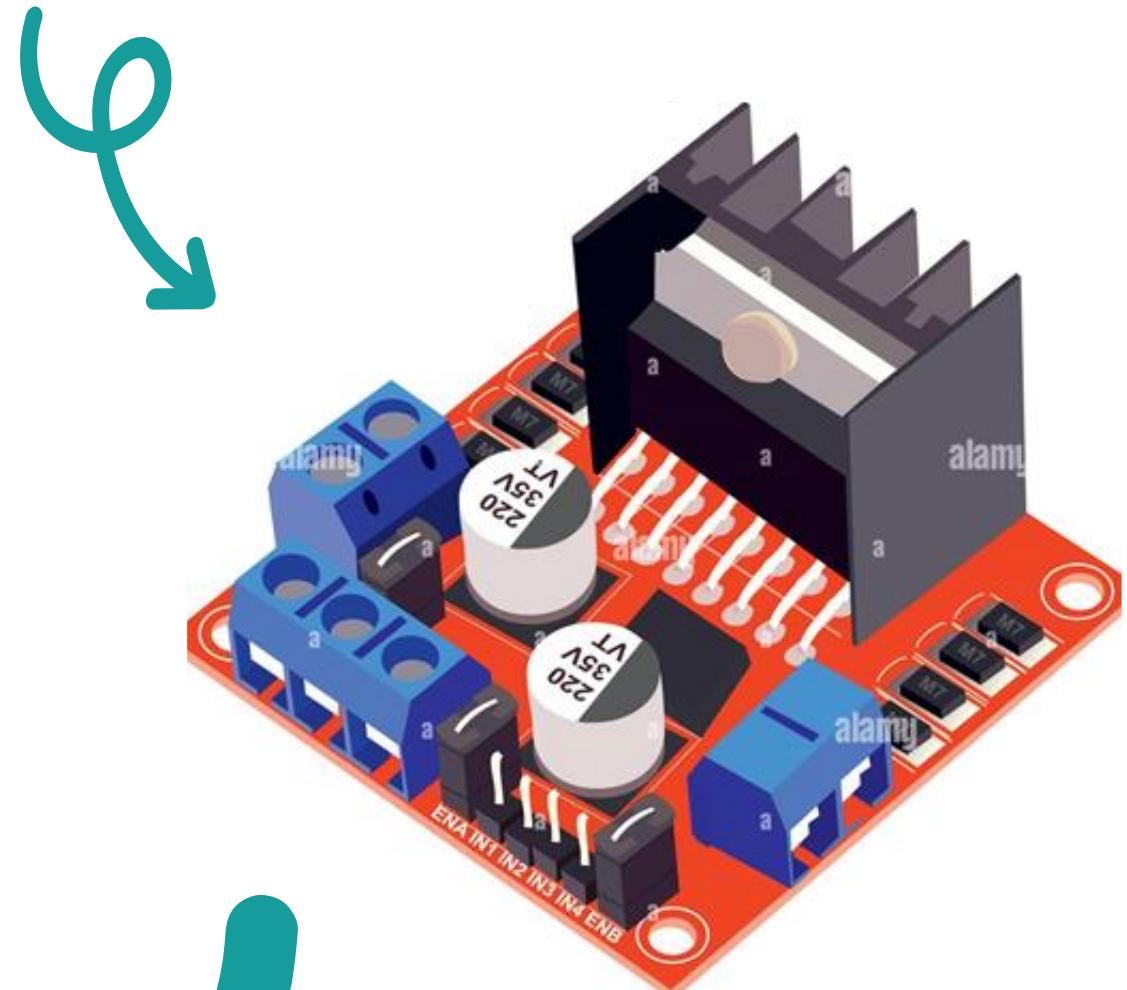
Summary for ULTRASONIC SENSOR



- The Ultrasonic Sensor Emits The Short And High-frequency Signal. These Propagate In The Air At The Velocity Of Sound. If They Hit Any Object, Then They Reflect An Echo Signal To The Sensor. The Ultrasonic Sensor Consists Of A Multivibrator, Fixed To The Base.
- The Multivibrator Is A Combination Of A Resonator And A Vibrator.
- The Resonator Delivers Ultrasonic Wave Generated By The Vibration.
- The Ultrasonic Sensor Consists Of Two Parts; The Emitter Which Produces A 40Khz Sound Wave And The Detector Detects A 40Khz Sound Wave And Sends An Electrical Signal Back To The Microcontroller.
- If you need to measure the specific distance :
 - Distance = $\frac{1}{2} T \times C$
 - (T = Time and C = the speed of sound) .

MOTOR DRIVER (L298N)

- We used four DC motors at the bottom of the robot to control the rotation speed of the wheels.
- These Motors Provide More Torque Than Normal Motors And Can Be Used For Carrying Some Load As Well.



DC MOTOR

- We Have Used Two Geared Motors At The Rear Of The Line Follower Robot.
- These Motors Provide More Torque Than Normal Motors And Can Be Used For Carrying Some Load As Well.



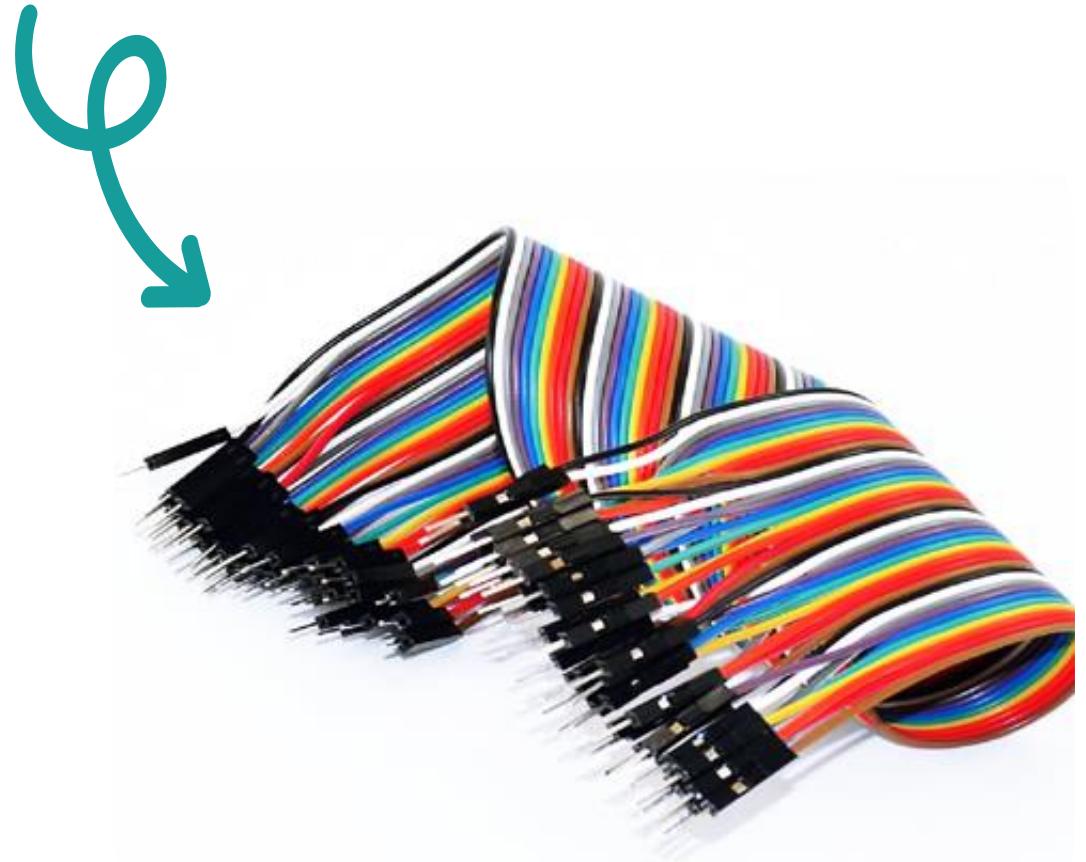
Battery

- Rechargeable Source of Energy To The Power Supply Circuit.
- It Gives Voltage 3.7V .



Jumper Cables

- Jumper cables are insulated wires.
- They come in pairs and have alligator clips that are used to connect a car battery to another energy source.



Arduino IDE

- The Arduino Integrated Development Environment - or Arduino Software (IDE).
- contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus.
- It connects to the Arduino hardware to upload programs and communicate with them.



Proteus

- The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation.
- The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards

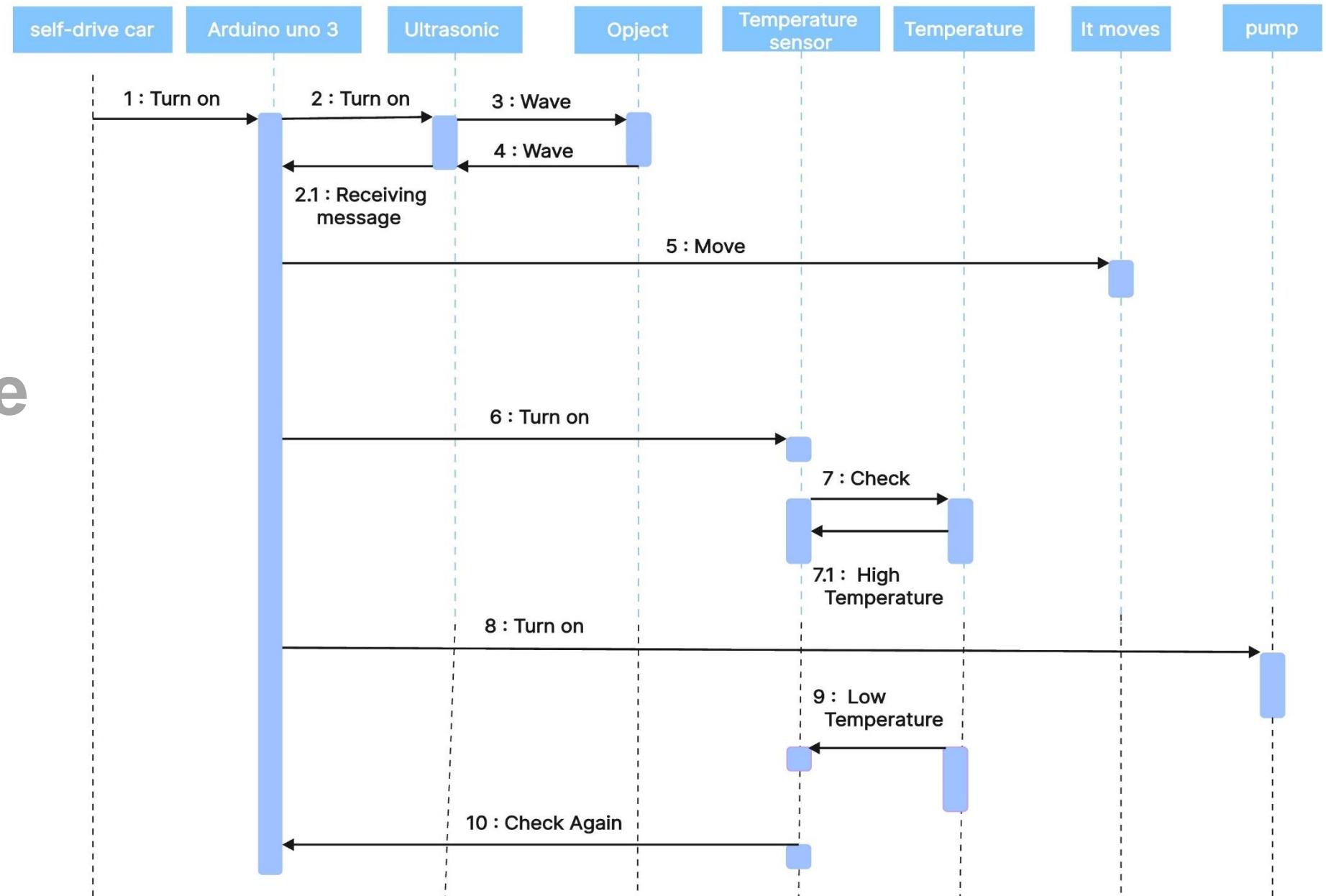


PROTEUS

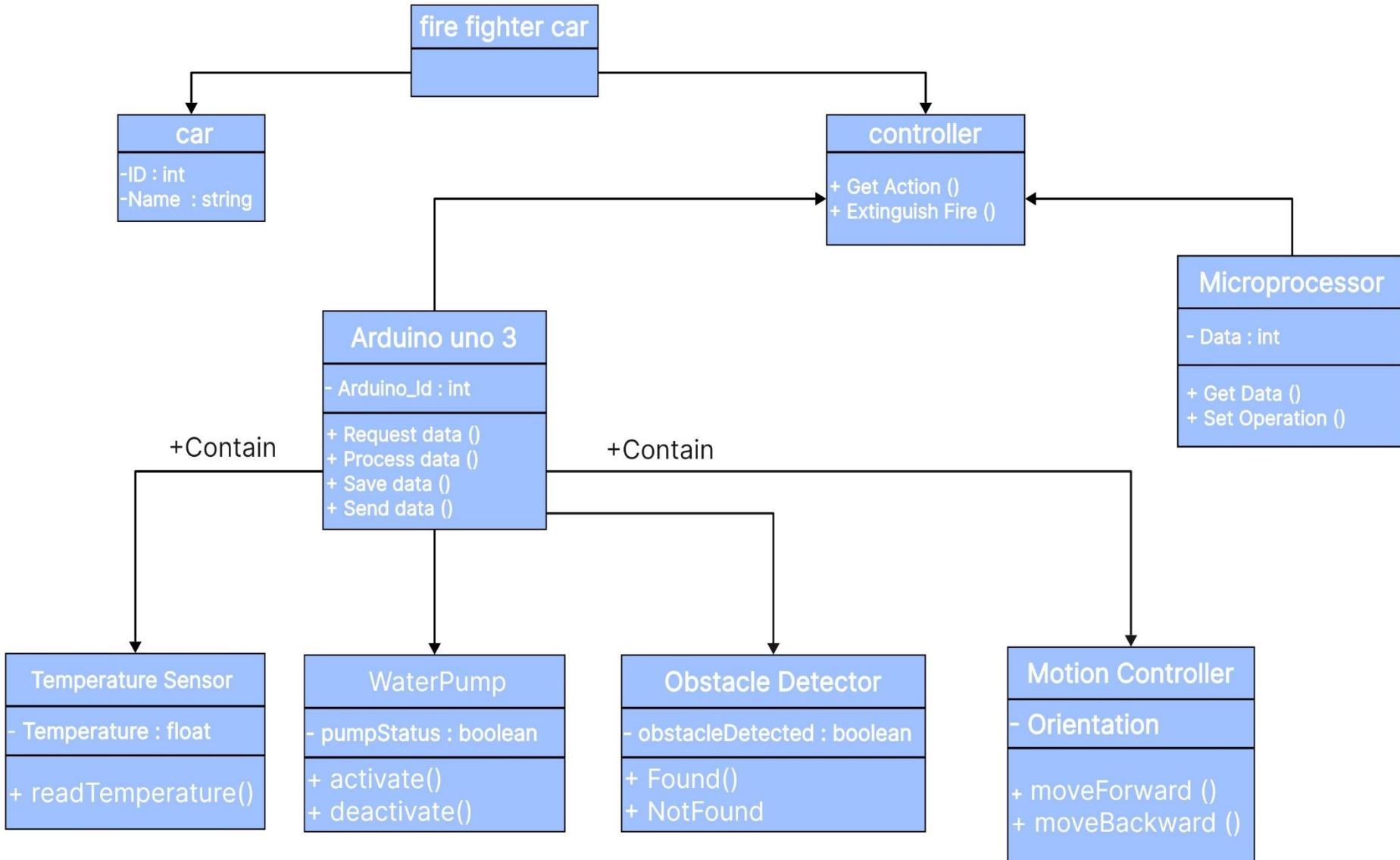
4 Mechanism

A fire truck is shown from a rear three-quarter perspective, spraying a powerful stream of water from its hose onto a building engulfed in flames. The scene is set at night, with the fire truck's lights and the glow of the fire illuminating the dark surroundings. The fire truck is red and white, with a ladder visible on its side.

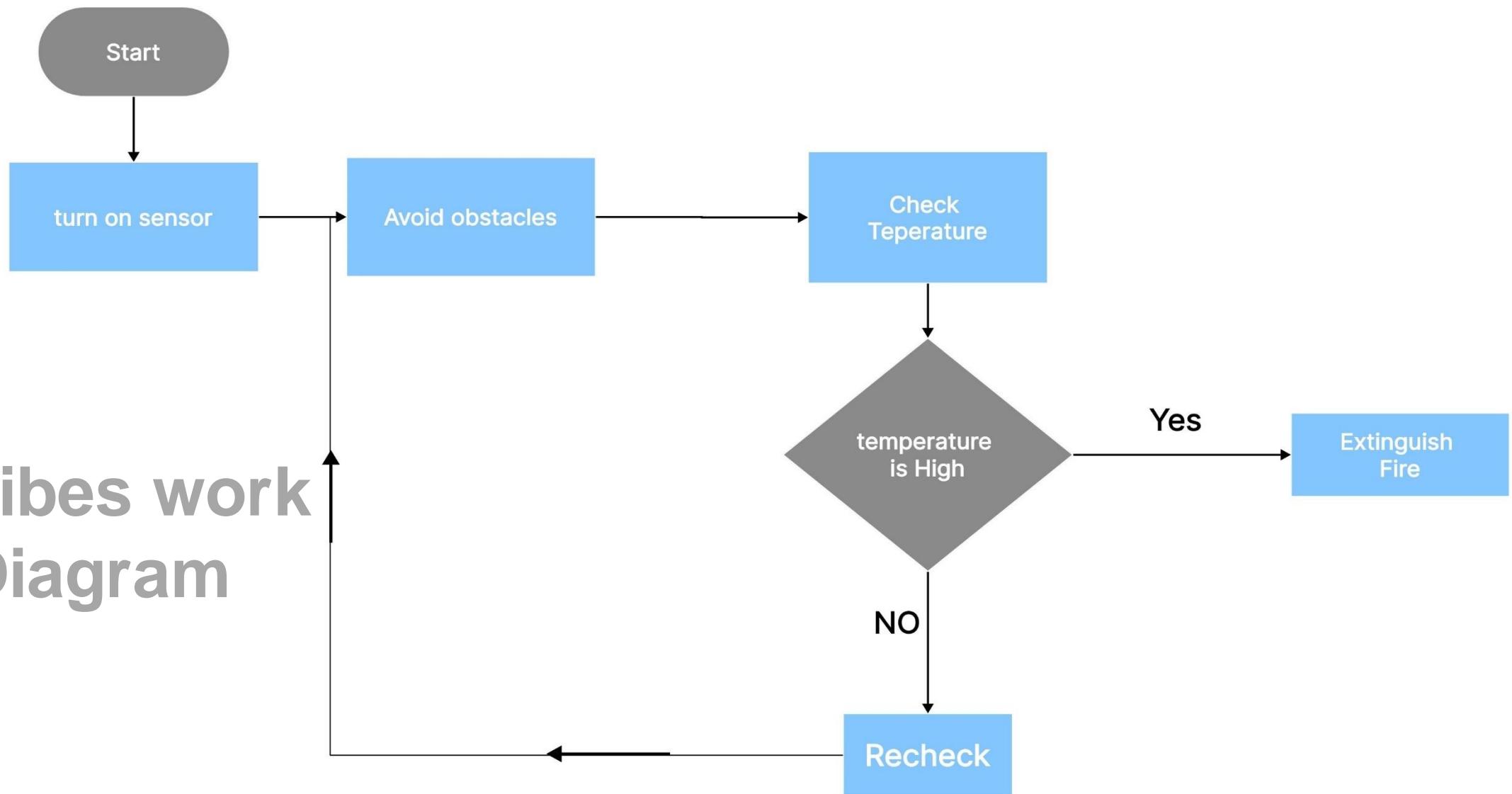
Sequence Diagram



UML Class Diagram



Describes work Diagram



Mechanism

01

The mechanism of the car in project involves integrating these components together to create fire fighting car self-driving .

The microcontroller reads the sensor data, makes decisions about how to move the car, and sends signals to the motors to drive the wheels.

As the car moves , it continues to gather sensor data and adjust its movements accordingly, until it completes a specific task.

02

The mechanism of a fire fighter car in a project typically involves several components working together to navigate , extinguish the fire. Here are the main components and how they work:

1- Chassis: The chassis is the basic structure of the car and provides a platform for mounting the other components. It is usually made from lightweight materials such as plastic or metal

03

2-Microcontroller: The microcontroller is the brain of the car and controls its movements based on the sensor readings. It is usually a small computer that can be programmed to respond to different inputs and make decisions about how to navigate ,extinguish the fire .

3-Power source: The power source provides the energy needed to drive the motors and power the microcontroller and sensors. It is usually a battery or set of batteries that can be recharged as needed.

Mechanism

04

4-Sensors: Sensors are used to Temperature measurement and detect obstacles , navigate.

-Use any type of temperature sensor to measure the temperature accurately, such as DHT11 or NTC thermistor sensor .

-Ultrasonic sensors are commonly used in self-driving projects, but other types of sensors such as infrared or lidar sensors can also be used.

05

5-Motors: The motors are used to drive the car's wheels and provide motion. They are usually DC motors that can be controlled using a microcontroller.

6-Wheels: The wheels provide traction and support for the car as it moves . They are usually made of rubber or plastic and can be driven by the motors using gears or belts.

5 methodology

A photograph of two fire trucks at night. Both trucks have their aerial ladders extended upwards. The truck on the left is red with yellow and red reflective stripes on its rear. The truck on the right is also red with similar stripes. Both trucks have blue emergency lights on top. The background is dark, suggesting it's nighttime.

Methodology

Implementation and Algorithms :

~ Mainly We have Used 2 Algorithms :

1 Wall Follower Algorithms

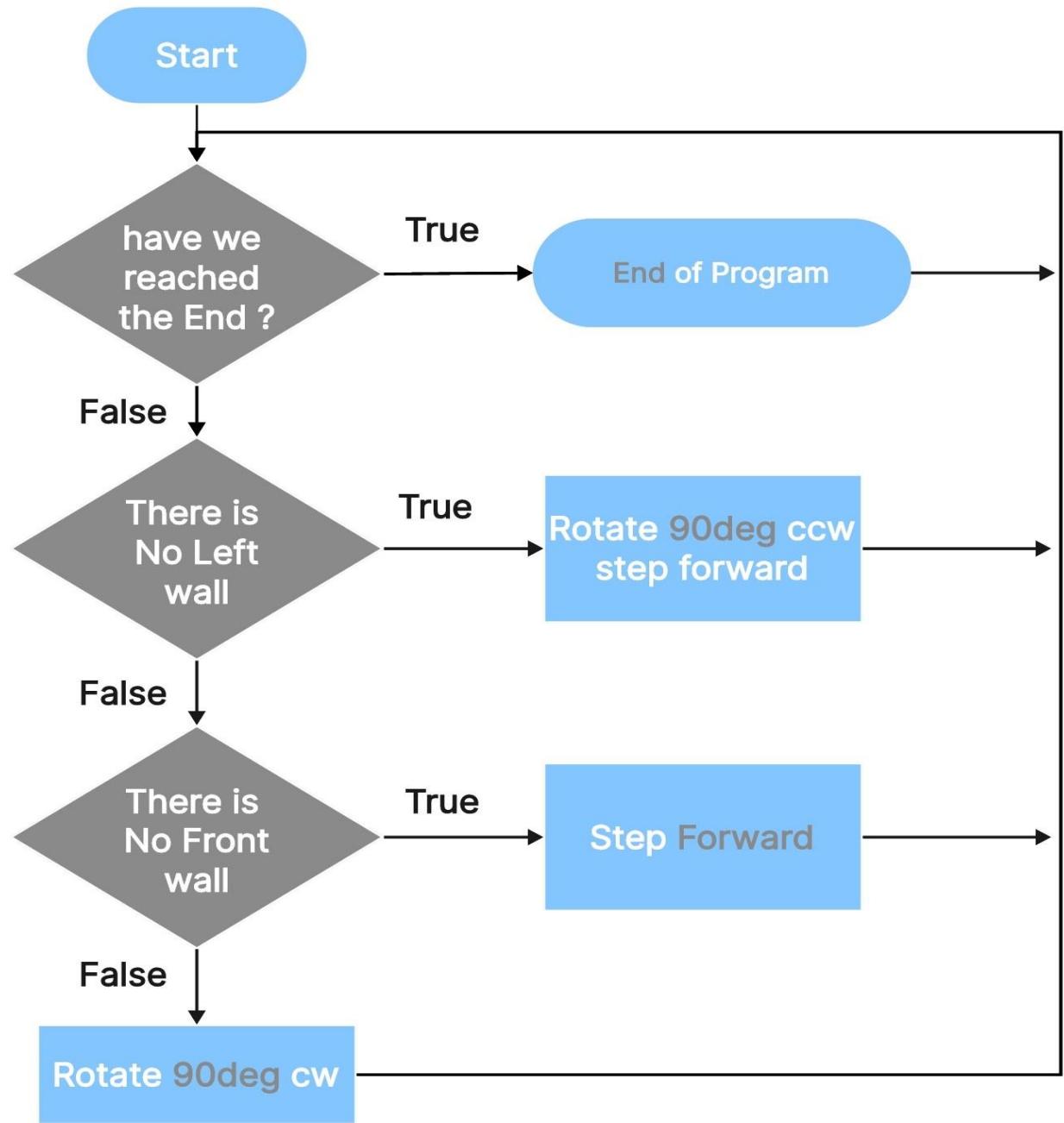
2 Flood Fill Algorithm

1-Wall Follower Algorithm

- ~ The most common algorithm for self-drive car robot is Wall following algorithm. The robot will take its direction by **following either left or right wall**. This algorithm also **called : left hand-right hand rules**.
- ~ Whenever the robot reaches a junction, it will sense for the opening walls and select it direction giving the priority to the selected wall.
- ~ By taking the walls as guide, this strategy is capable to make the robot reaches the finish point of the maze without actually solving it. But, this algorithm is not efficient method to solve a maze. Cause, the wall follower algorithm will fail to solve some maze construction, such as a maze with a closed loop region

Wall Follower Algorithms

ccw (counter clockwise)
cw (clockwise)

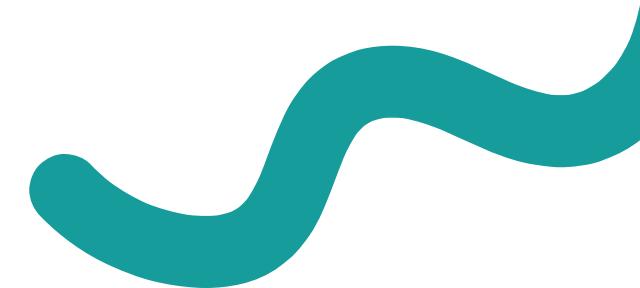


~The instructions used in the algorithm for both left and right wall is given in a table below:

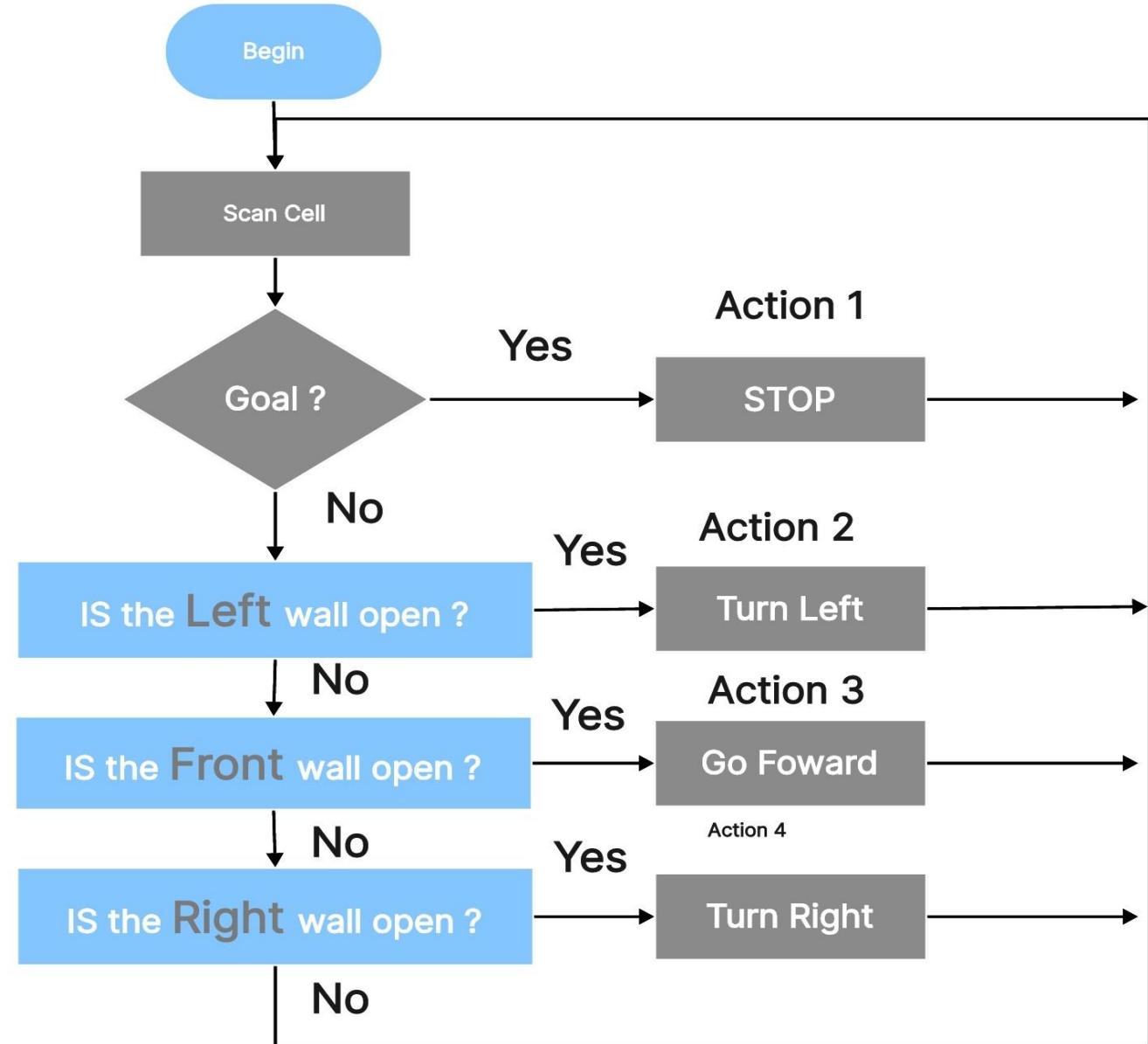
Right wall following routine	Left wall following routine
if there is no wall at right,	if there is no wall at left
turn right	turn left
else	else
if there is no wall at straight	if there is no wall at straight
keep straight	keep straight
else	else
if there is no wall at left	if there is no wall at right
turn left	turn right
else	else
turn around	turn around



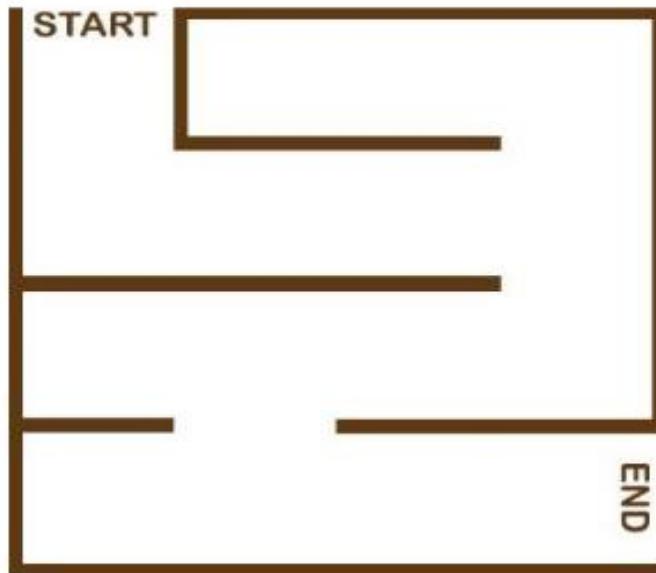
2-Flood Fill Algorithm

- ~The most efficient self-drive car algorithm is flood fill algorithm. It is derived from “**Bellman Ford Algorithm** ”.
 - ~ The Algorithm works by assigning value for all cells in the maze, where these **values indicate the steps from any cell to the destination cell**. The first array is holding the walls map values, while the other one is storing the distance values.
- 

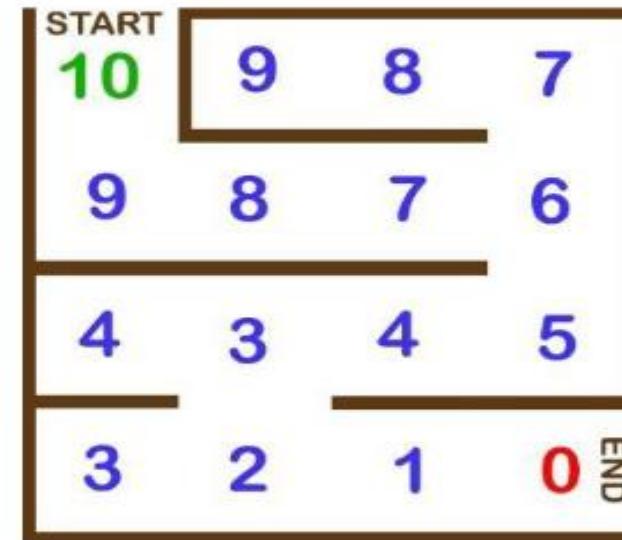
Flood Fill Algorithms



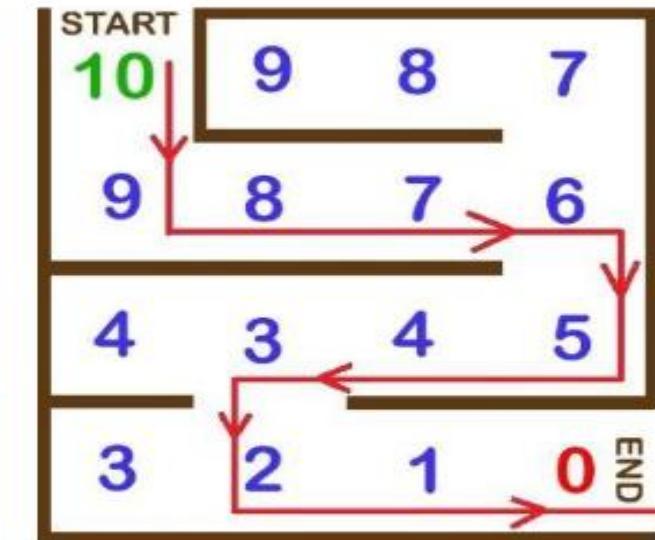
- ~ In every cell, robot will follow the following steps :
- Update the wall map.
- Flood the maze with the new distance values.
- Decide which neighboring cell has the lowest distance value.
- Move to the neighboring cell with the lowest distance value.



The Maze



Apply Flood Fill

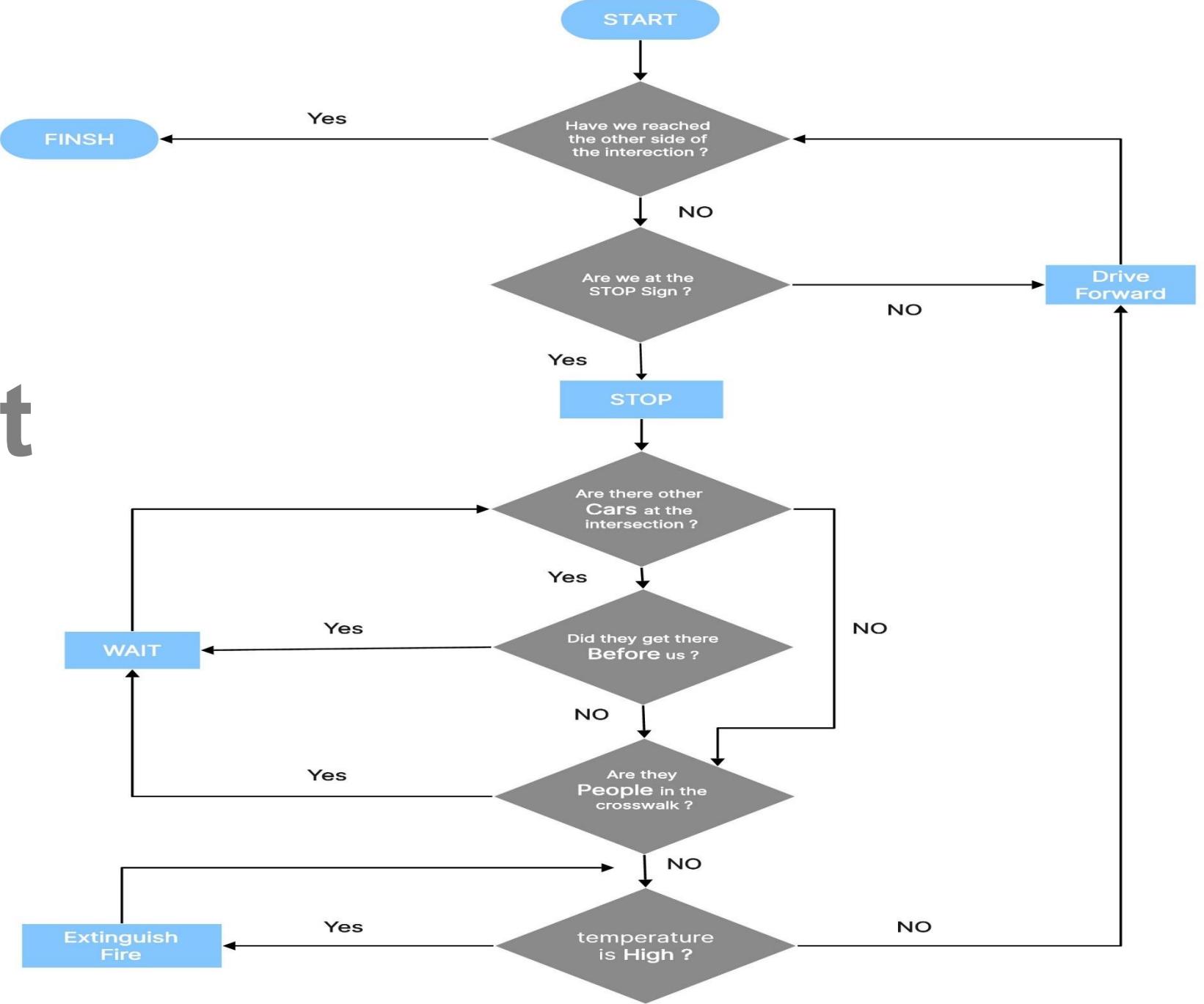


Shortest pathfinder

6 Flowchart



Flow chart





SWEPSONVILLE VOL. FIRE DEPT.

Related works



TESLA

Tesla has been a leader in the development of advanced driver assistance systems (ADAS) and autonomous driving technology.

Their Autopilot system uses a combination of cameras, radar, and ultrasonic sensors to detect and respond to obstacles and other road users.

Problems :

1 - The car's reaction was so high that it could have led to the loss of a person's life while avoiding obstacles.

2 - There were problems with weather conditions such as heavy fog, heavy snow, and heavy rain. These conditions affect the performance of sensitive systems.



Apollo

Apollo is an open-source autonomous driving platform developed by Baidu.

The platform includes a comprehensive set of tools and algorithms for perception, decision-making, and control, as well as a simulation environment for testing and validation

Problems :

Continuous updates and development: Autonomous driving technologies require continuous updates to improve their performance Adapting it to technological developments and legislation , **which leads to increased costs for the user .**



Waymo

Waymo, a subsidiary of Alphabet Inc. (formerly Google), has been developing autonomous driving technology since 2009. Their research has focused on developing perception and decision-making systems that can operate safely and reliably in a variety of environments, including complex urban environments.

Problems :

This company relied only on the camera to transmit and analyze events, and therefore many accidents occurred.



A photograph of a fire station at night. In the foreground, a chain-link fence runs across the frame. Behind it, several red fire trucks with blue lighting are parked in a row. The building behind them is dark blue with a prominent MAGIRUS logo and the slogan "SERVING HEROES SINCE 1864".

8 Timeplane & References

Time plane

Month	Activities
Mars	<ul style="list-style-type: none">• Surveys.• Problem Analyzation.• An Initial Prototype.
April	<ul style="list-style-type: none">• Simple Design.• Project Development• Project Evaluation.
May	<ul style="list-style-type: none">• Components Interfacing.• Circuit Implementation.• Detecting Some Errors.
June	<ul style="list-style-type: none">• Working on fixing Problems.• Try to Add Another Features.• The final project

1

www.techtarget.com/searchenterpriseai/definition/driverless-car

2

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9316796/>

3

<https://spectrum.ieee.org/colossus-the-firefighting-robot-that-helped-save-notre-dame>

4

www.mapfreglobalrisks.com/en/risks-insurance-management/article/the-emergence-of-robotics-as-a-firefighting-tool/

5

<https://theconversation.com/driverless-cars-could-be-a-revolution-for-people-with-disabilities-but-they-also-have-good-reason-to-be-worried-213314>

thanks

