TWO PICK AND PLACE COLLABORATIVE ROBOTS

Individual Project Presentation

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OUTLINE

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- Design
- Software Implementation
- Hardware Implementation
- Network and Communication
- Testing Methods
- Ethics
- Conclusion
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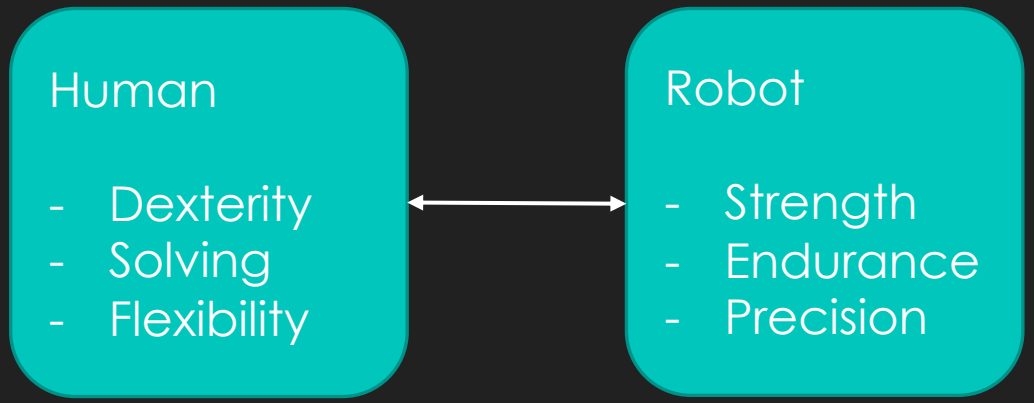
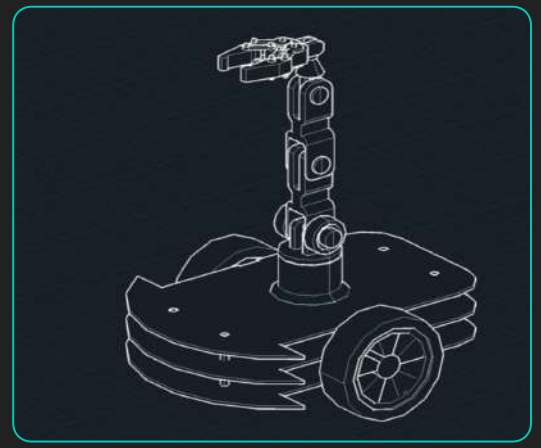
INTRODUCTION

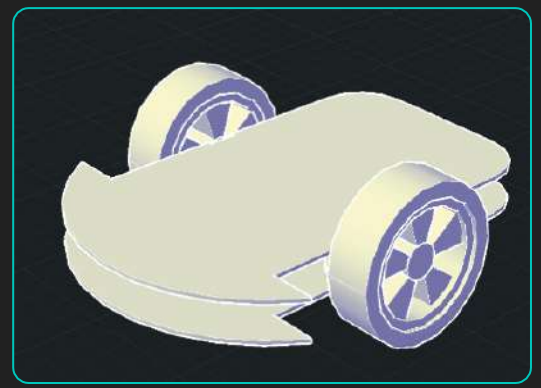
- What are Collaborative Robots?
- Combining human and robot skills [1].
- Where are Collaborative Robots mainly needed and used?



DESIGN

- Chassis shape design providing movement efficiency [2]
- Chassis dimensions to carry components
- Robotic arm design
- Combining components
- Shortfalls and solutions



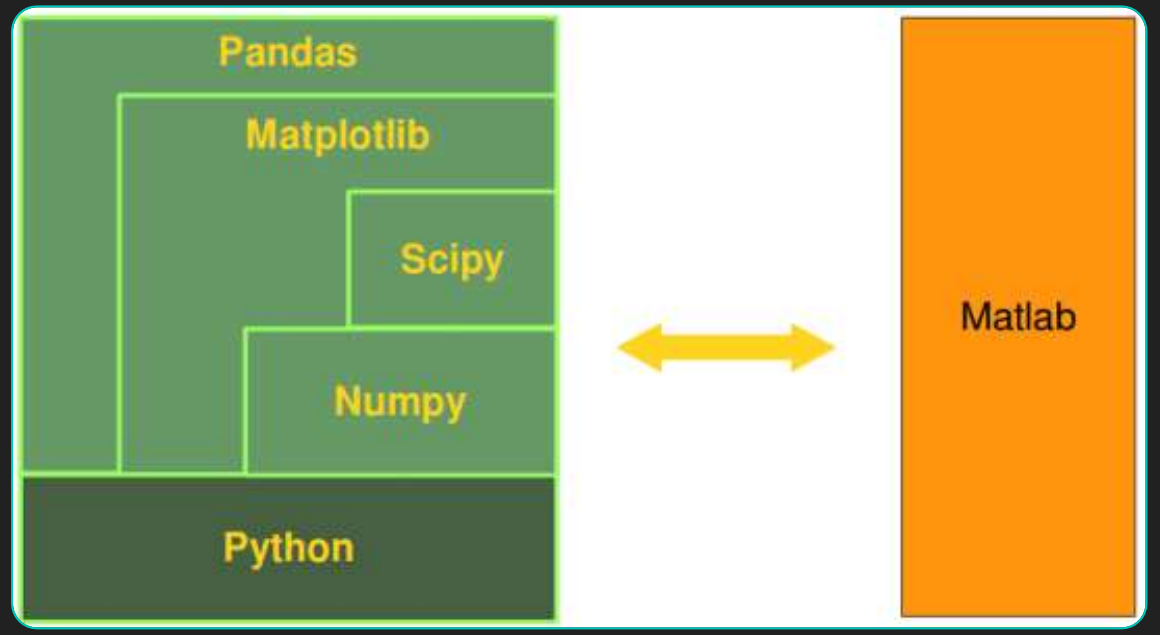


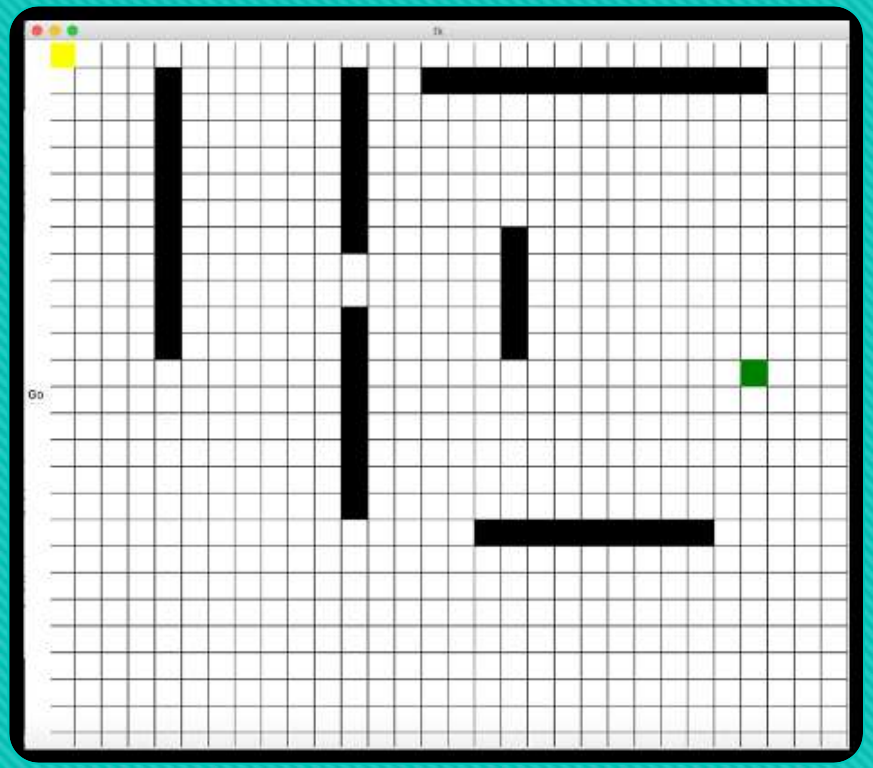
SOFTWARE IMPLEMENTATION

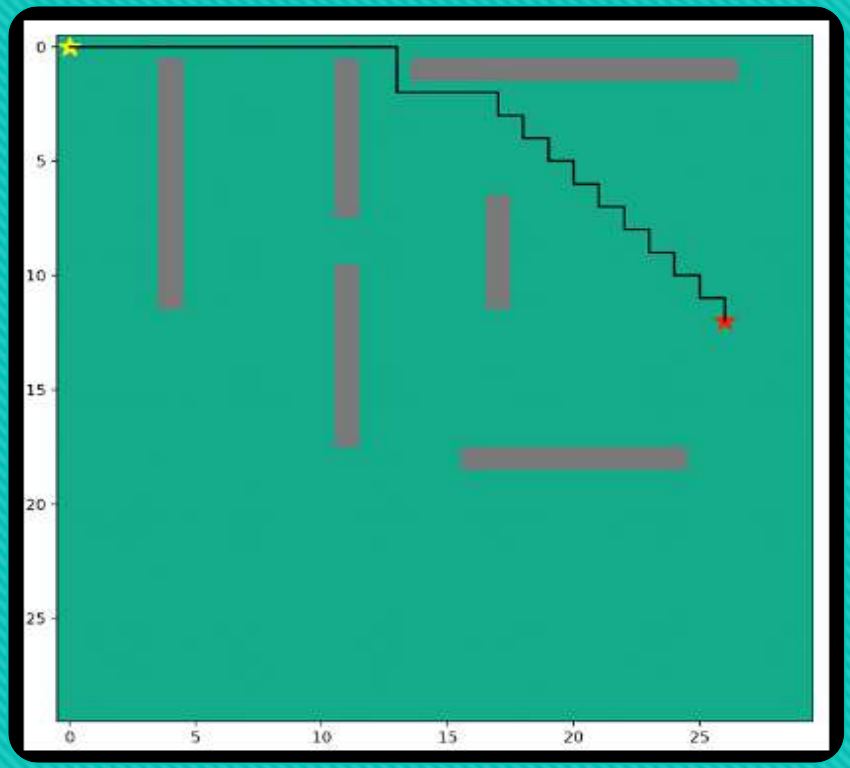
- Choice of Python as the main programming language.
- Research of different path finding algorithms.
- Reason for choosing the A* Star Algorithm [3].
- Testing and implementation.
- Shortfalls and Solutions.

Software Implementation
Software Tools

- Integrated Development Environment (IDE) used
- Graphical User Interface (GUI) used in testing and simulation (Tkinter) [4].
- Python available libraries used
  1. NumPy
  2. Heapq (Heap Queue)
  3. Matplotlib (integrated with Tkinter)



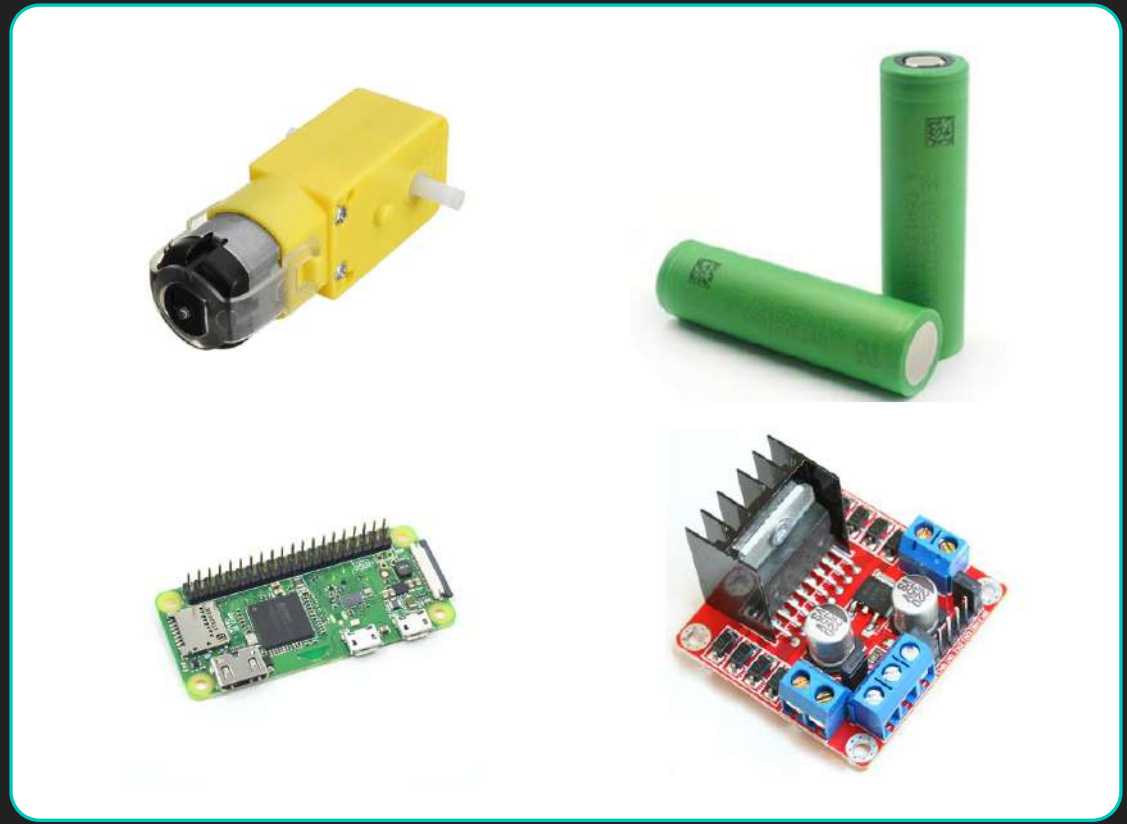




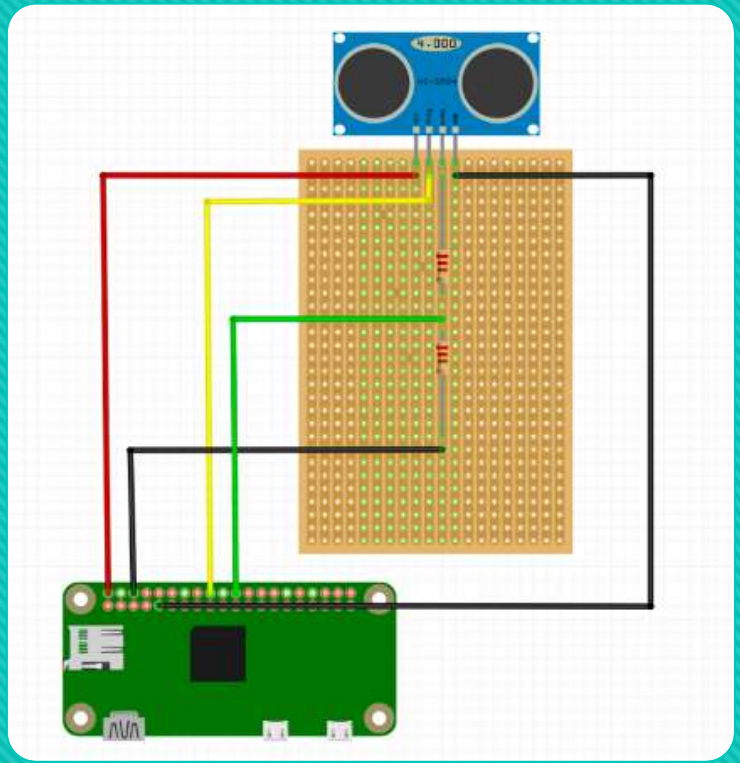
SOFTWARE IMPLEMENTATION

HARDWARE IMPLEMENTATION

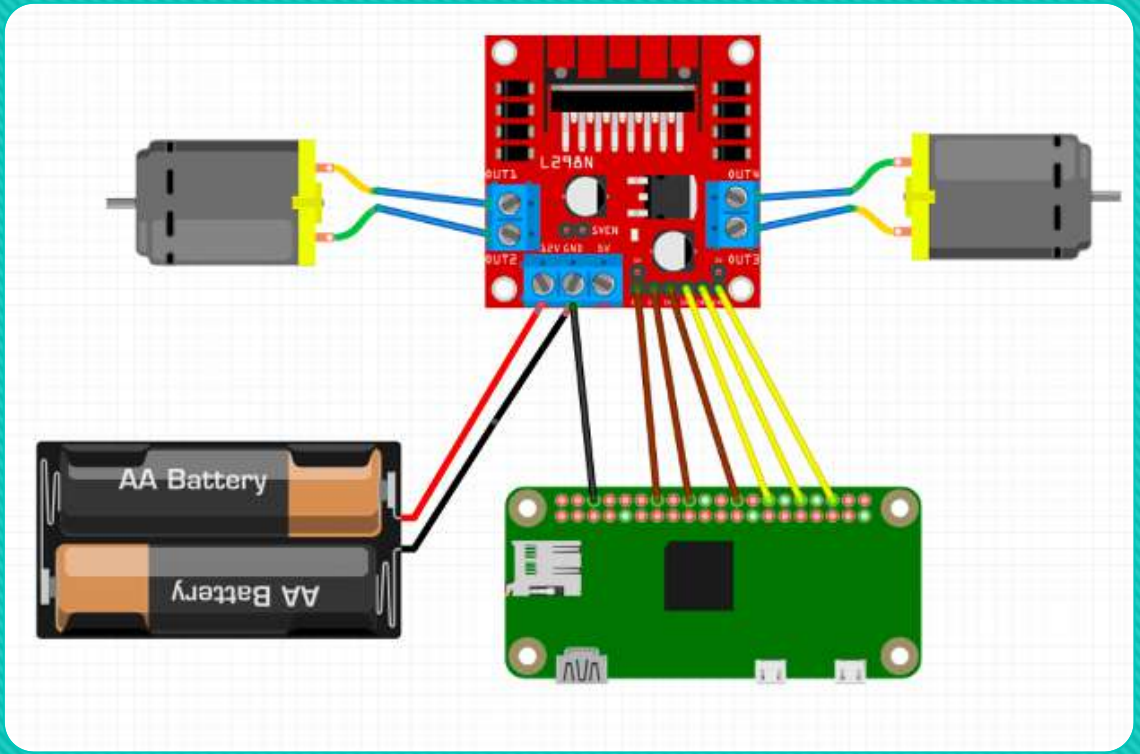
- Choice of components:
  - Raspberry Pi Zero W Microcontroller
  - DC Motors (3V – 6V)
  - Motor Driver (L298N)
  - Ultrasonic sensors
  - Servo Motor
  - Batteries
- Programming the hardware



Sensors Circuitry



Motors Circuitry

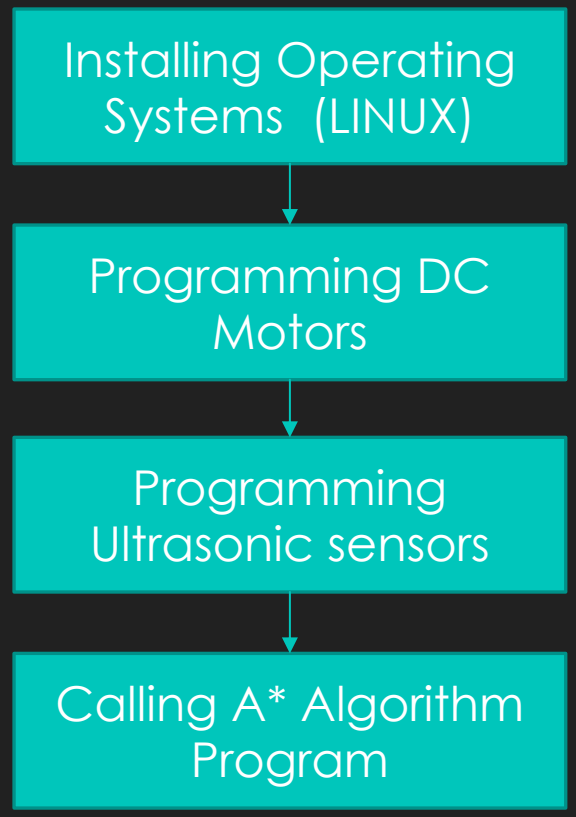


HARDWARE IMPLEMENTATION
Circuitry

HARDWARE IMPLEMENTATION

Programming the hardware

- Installing the Raspberry Pi Operating System and IDE
- Importing libraries
  1. *Rpi.GPIO library*
  2. *Time library*
  3. *PWM Output Device*
- Controlling the Raspberry Pi GPIOs [5].
- Programmed hardware components:
  1. *Motors*
  2. *Sensors*
- Combining hardware programs



Network & Communication

- Connecting the two Raspberry Pis to the same network - Wi Fi
- Using *"Socket Library"*
- Visualizing output of each Raspberry Pi on a computer screen
- Testing connection between the two robots:
  1. Sending "Hello World" text over Wi Fi to print
  2. Send output / location of a robot Pi to the other Pi
  3. React to sent data

```
import socket

UDP_IP = "192.168.1.24"
UDP_PORT = 5005
MESSAGE = " Raspberry Pis are connecting "

print "UDP target IP: ", UDP_IP
print "UDP target port: ", UDP_PORT
print "message: ", MESSAGE

sock = socket.socket(socket.AF_INET, #Internet
socket.SOCK_DGRAM) #UDP

socket.sendto(MESSAGE, (UDP_IP, UDP_PORT))
```

```
import socket

UDP_IP = "192.168.1.30"
UDP_PORT = 5005

sock = socket.socket (socket.AF_INET, #Internet
                      socket.SOCK_DGRAM) #UDP

sock.bind((UDP_IP, UDP_PORT))

while True:
    data, addr = sock.recvfrom(1024) #Buffer size is 1024 bytes
    print "received message: ", data
```

```
[pi@raspberrypi:~/Desktop/send $ sudo nano send.py
[pi@raspberrypi:~/Desktop/send $ sudo python send.py
UDP target IP:  192.168.1.24
UDP target port:  5005
message:   Raspberry Pis are connecting
[pi@raspberrypi:~/Desktop/send $ sudo nano send.py
[pi@raspberrypi:~/Desktop/send $ sudo python send.py
UDP target IP:  192.168.1.24
UDP target port:  5005
message:   Raspberry Pis are connected successfully
pi@raspberrypi:~/Desktop/send $
```

Testing Methods

Software Testing:

- Testing different algorithms on simulation grids
- Visualizing which algorithm is faster
- Movement position is always "right" when implemented in hardware

Hardware testing:

- Testing DC motors on their own
- Testing ultrasonic sensors on their own
- Combination of motors and sensors - visualizing output

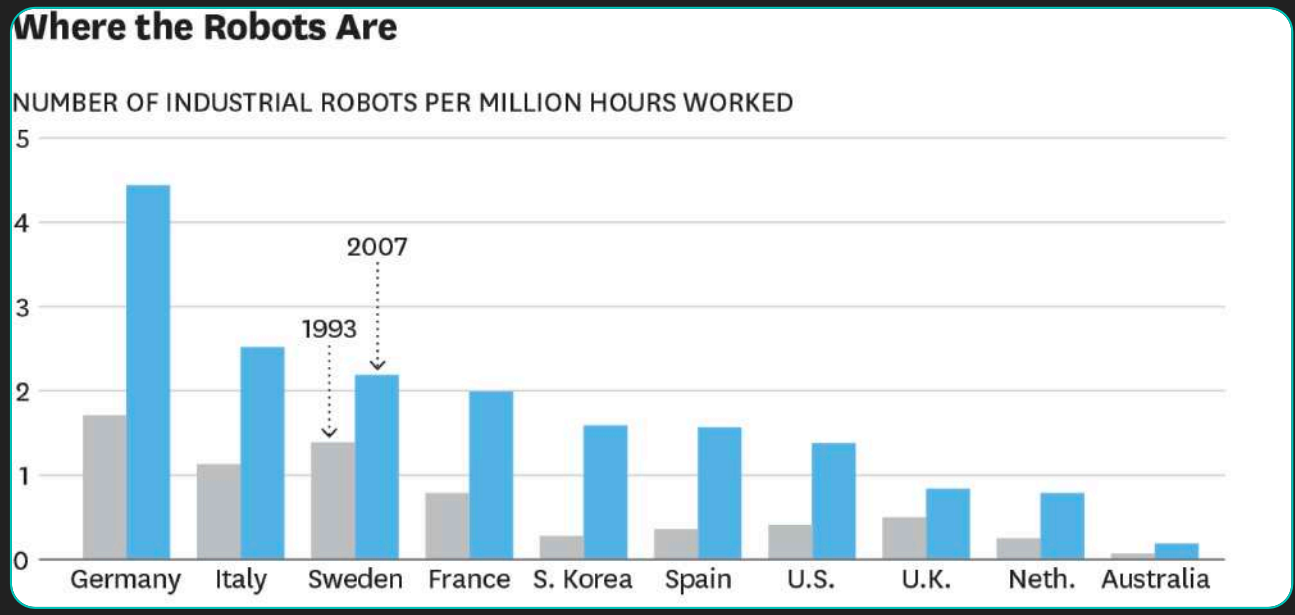
Communication Testing:

- Sending packets and data through Wi Fi
- Visualizing sent data through output on screen

Full system test

ETHICS

- How will collaborative robots impact jobs?
- Environmental cost and life cycle
- Human safety when working around collaborative robots



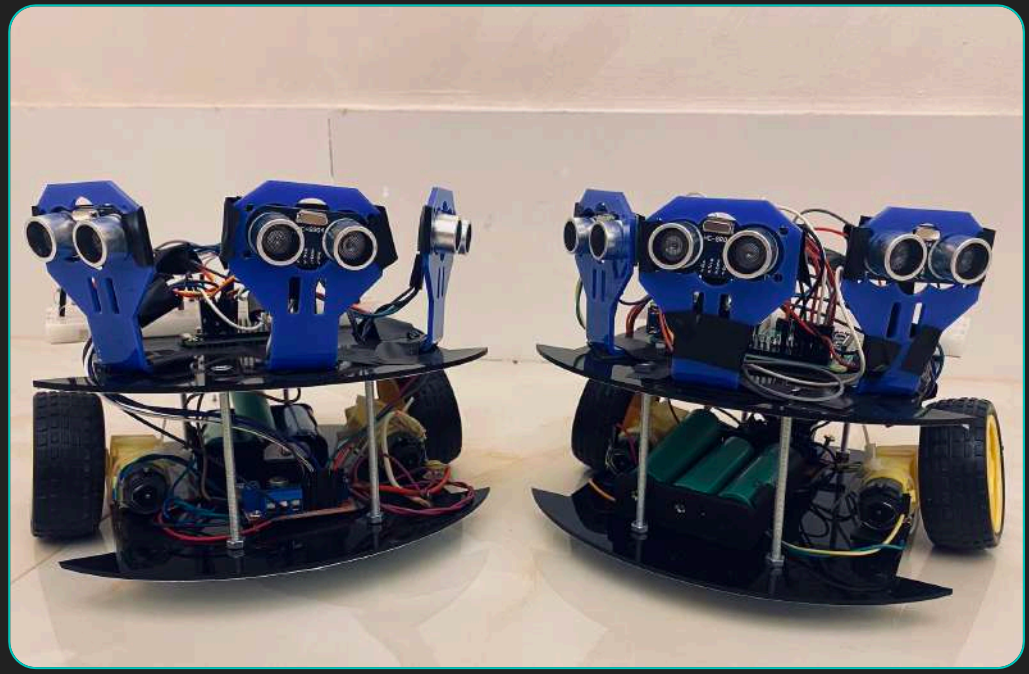
Conclusion

Solutions for issues and problems faced:

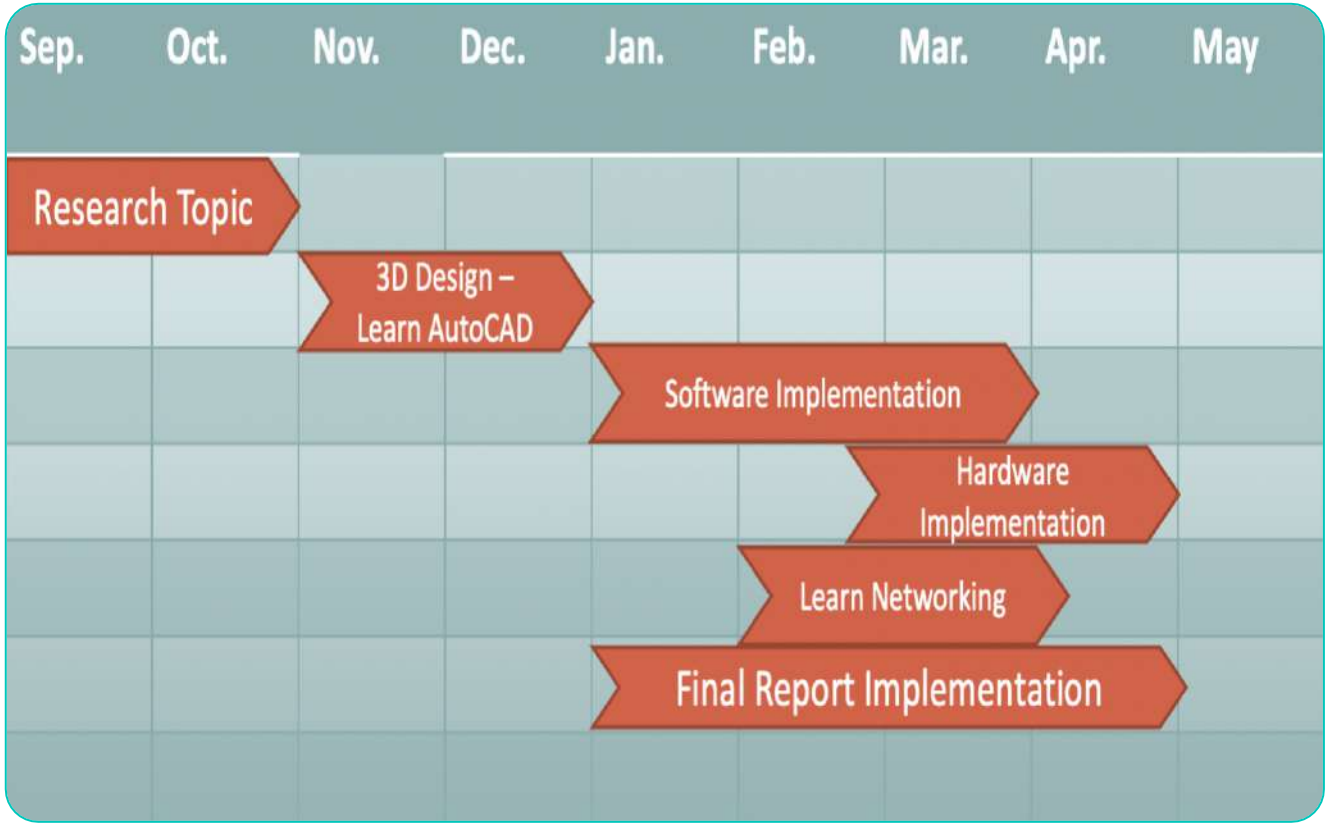
- Lowering height of the robot for better stability
- Testing two different pathfinding algorithms for more efficient choice
- Using Lithium-Ion batteries rather than AA Alkaline batteries for better power consumption and cost
- Using 3V – 6V geared DC motors rather than 12V DC motors for better power consumption and torque [6].
- Sending small commands between different PIs to assure good connection

What could have been improved

- Network Infrastructure
- Robotic arm design and sensors
- Testing methods



Time Plan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Research Topic
3D Design – Learn AutoCAD
Software Implementation
Hardware Implementation
Learn Networking
Final Report Implementation

References

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