



VIETNAM NATIONAL UNIVERSITY – HO CHI MINH CITY
HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY

FACULTY OF ELECTRICAL & ELECTRONICS ENGINEERING
DEPARTMENT OF CONTROL ENGINEERING & AUTOMATION

THESIS PRESENTATION

TOPIC: SMART SUITCASE

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PRESENTATION CONTENTS

- **INTRODUCTION**
- **OBJECTIVE**
- **METHODOLOGY**
- **RESULTS AND ANALYSIS**
- **DISCUSSION AND FUTURE WORK**

- Not having to worry about hauling or carrying your luggage means your hands are free to multi-task, enjoy a coffee or just use your attention to take in your journey.
- Mixing and loss of suitcase while moving in a crowded platform is the most annoying problem.



CX-1 By ForwardX

OVIS BY FORWARDX™
Travel Recoded



www.forwardx.com

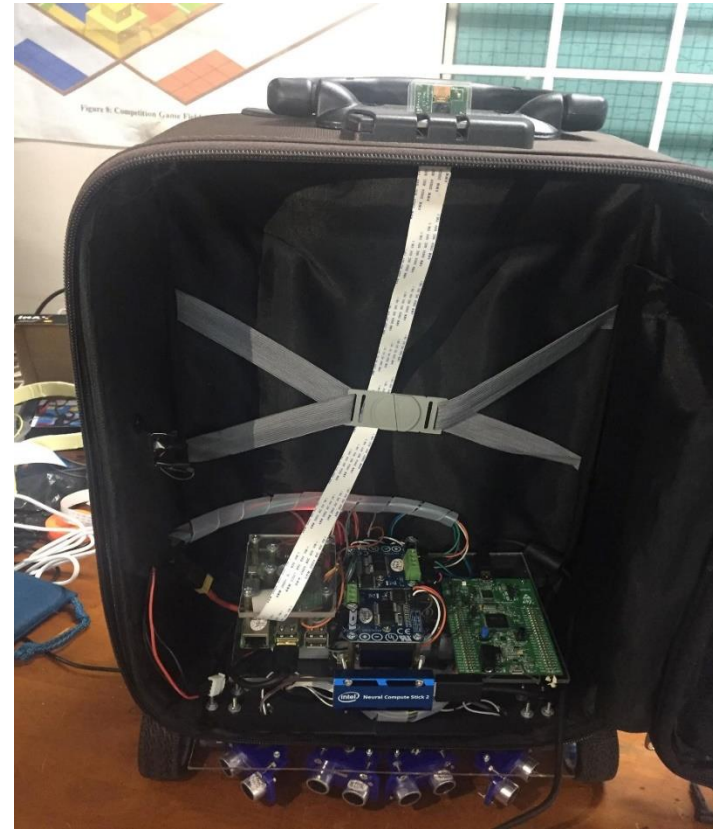
Ovis By ForwardX



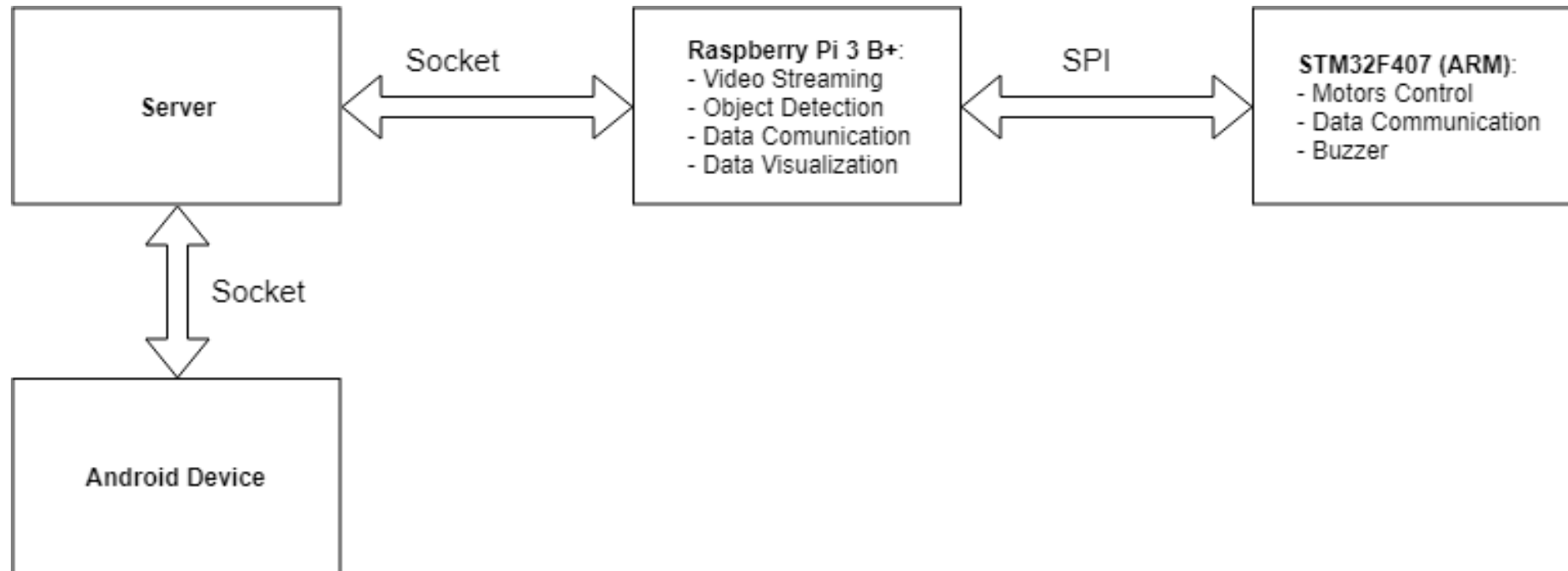
OBJECTIVE

- Owner detection in real-time with Intel Movidius Neural Compute Stick
- Self-driving and obstacles avoidance
- Android application and webpage for tracking
- Cheaper than other products on marketplace

● Hardware design

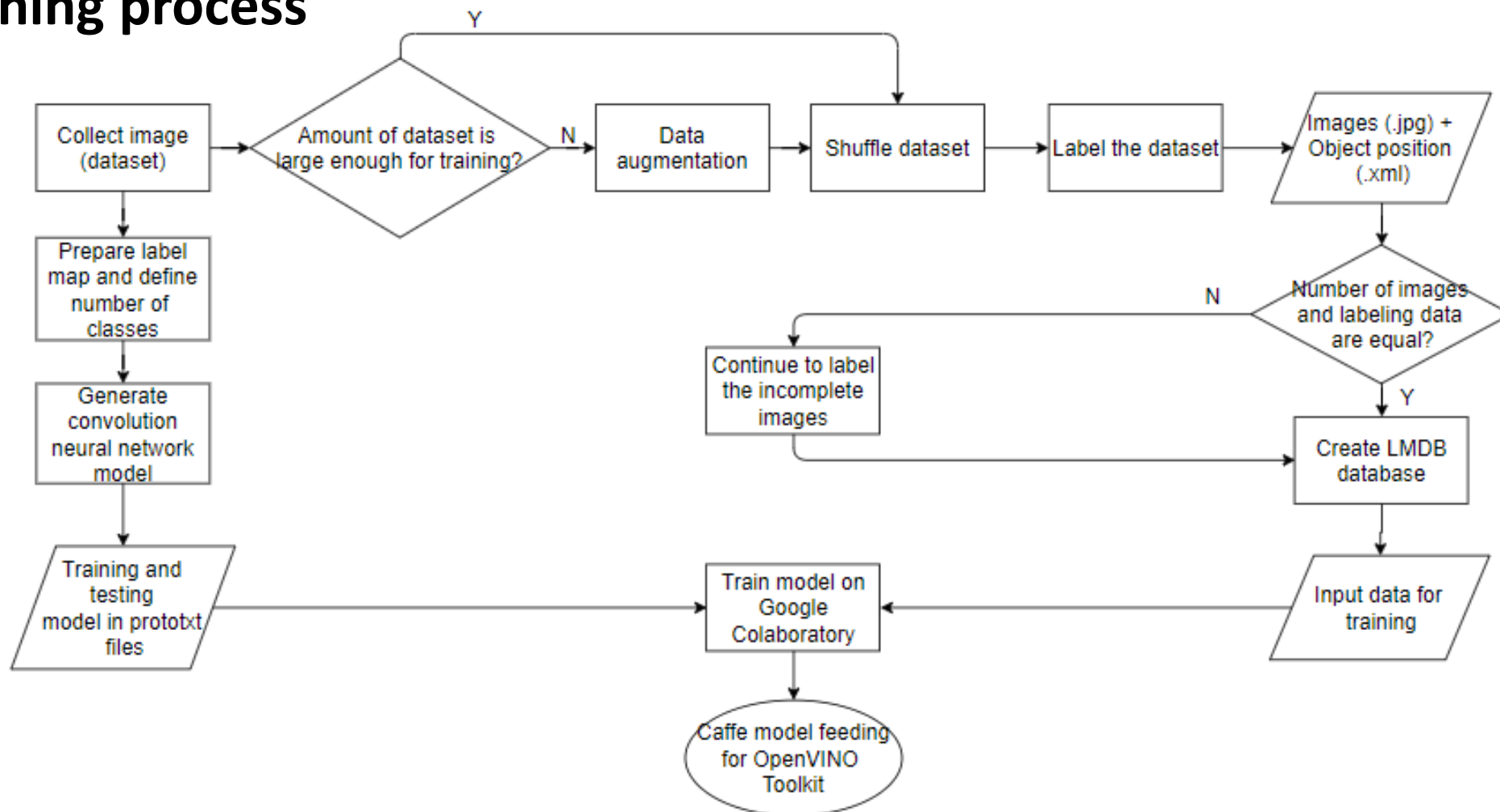


Overview

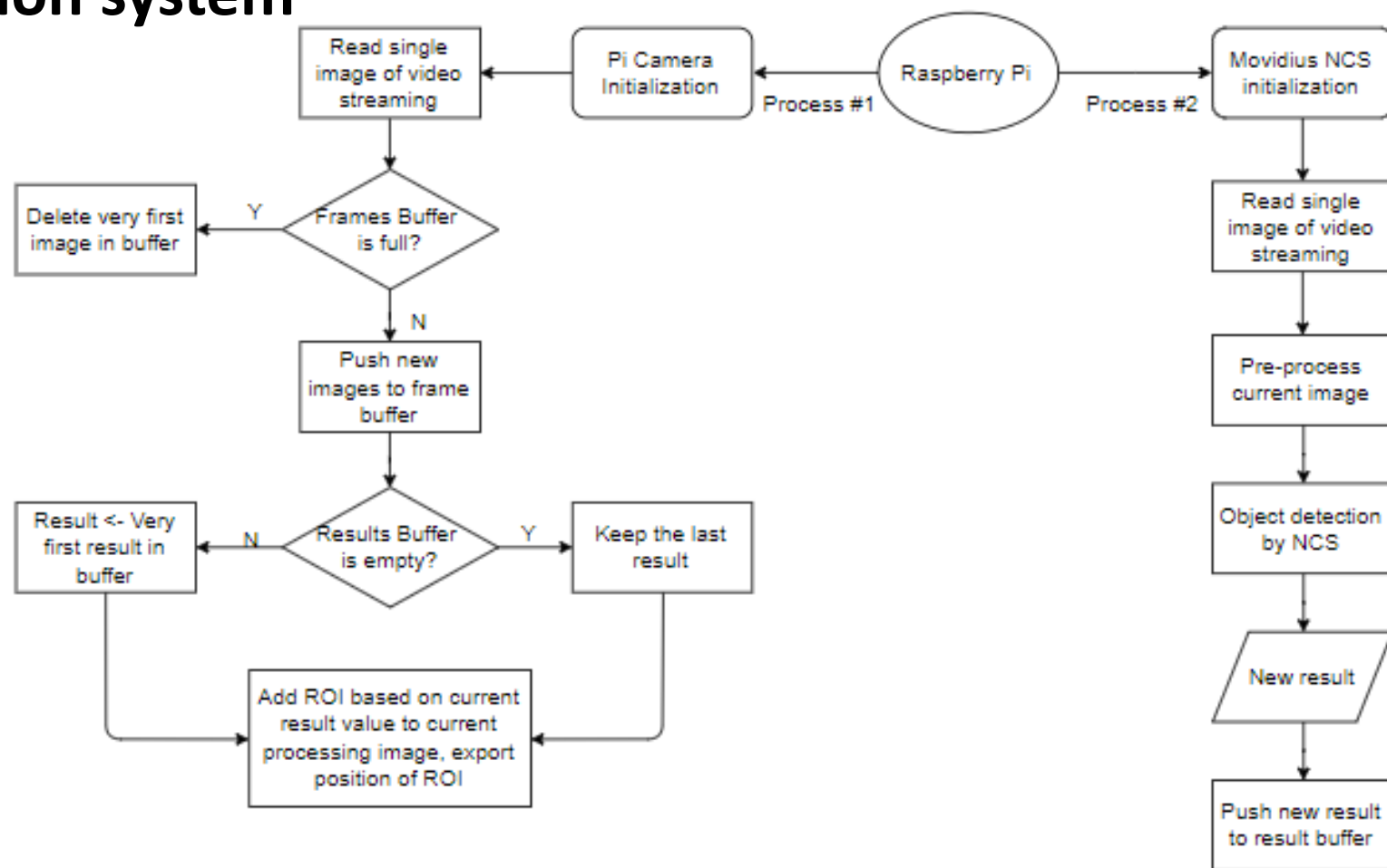


Overview about software design

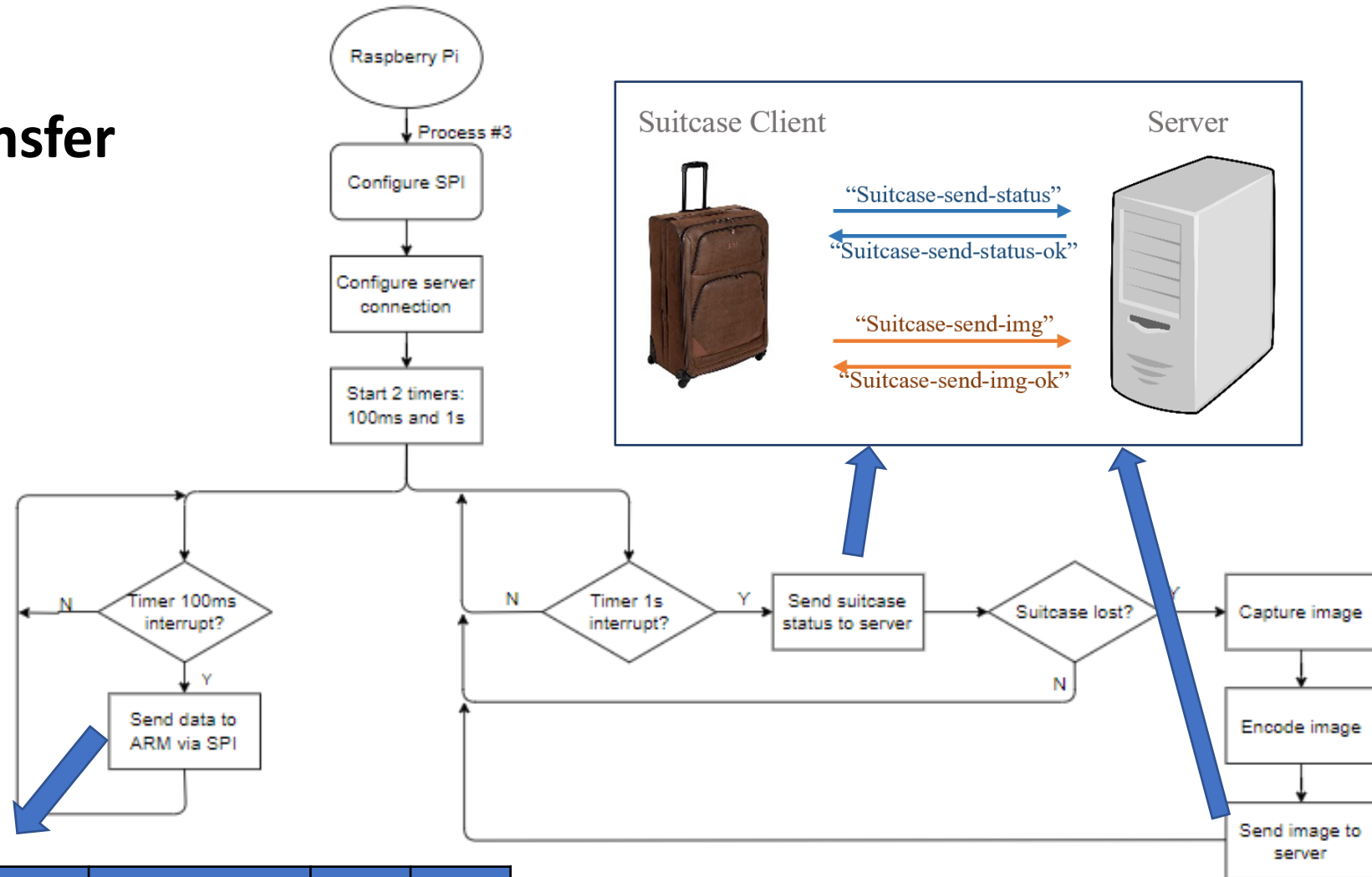
Training process



Object detection system

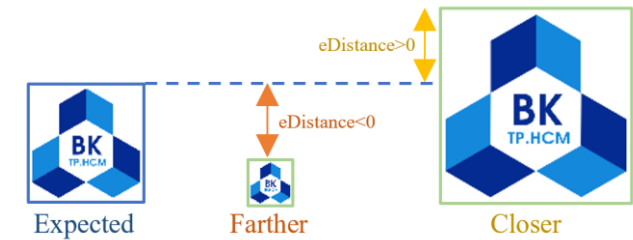
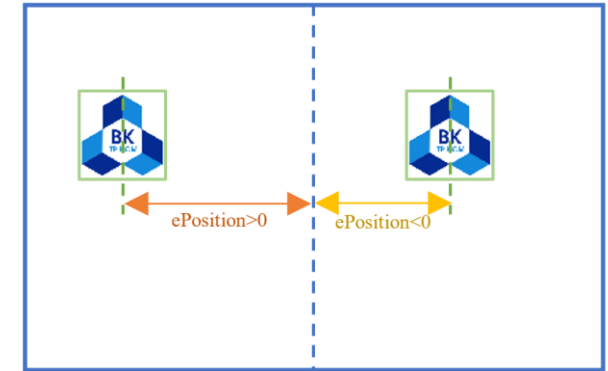
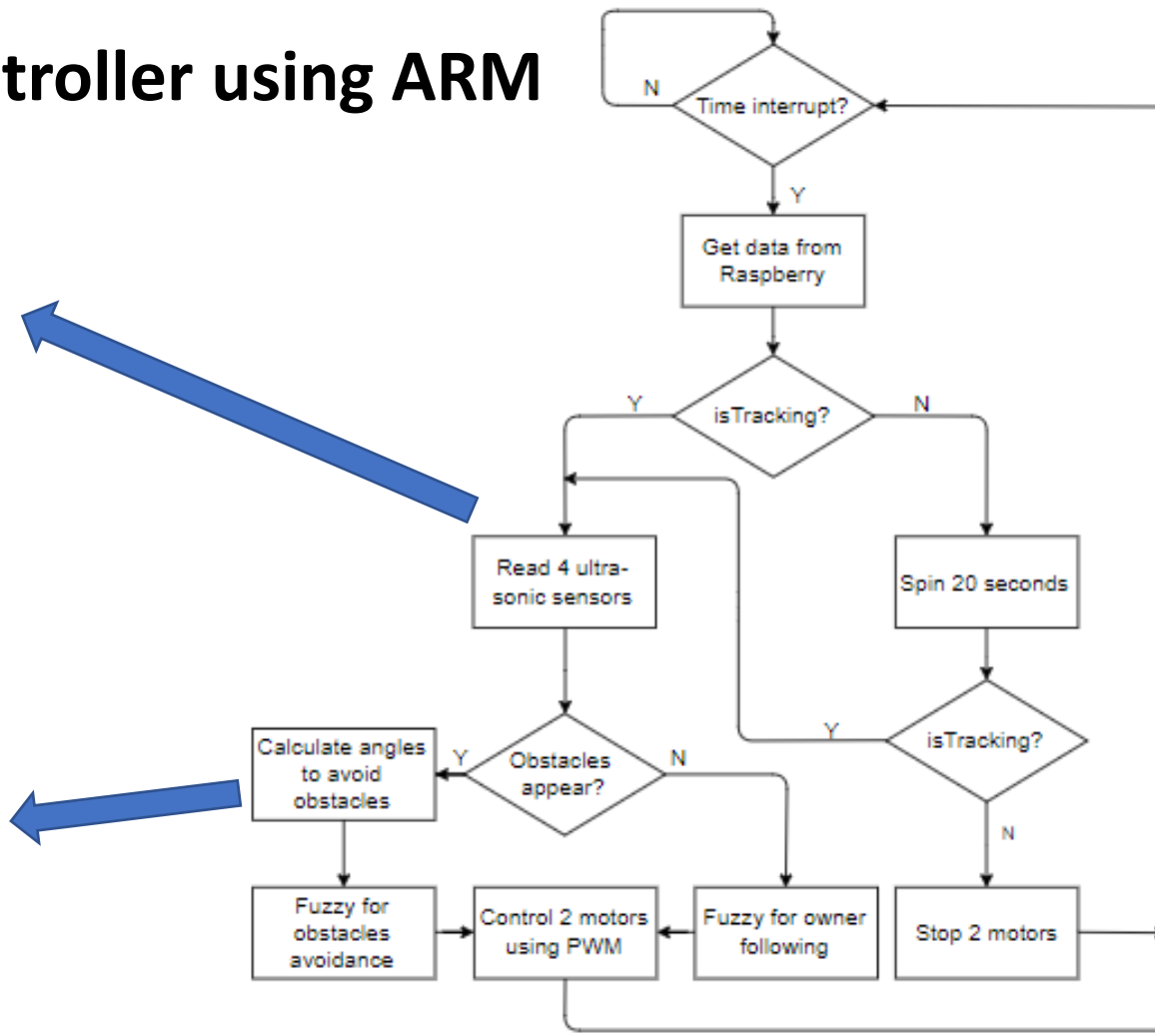
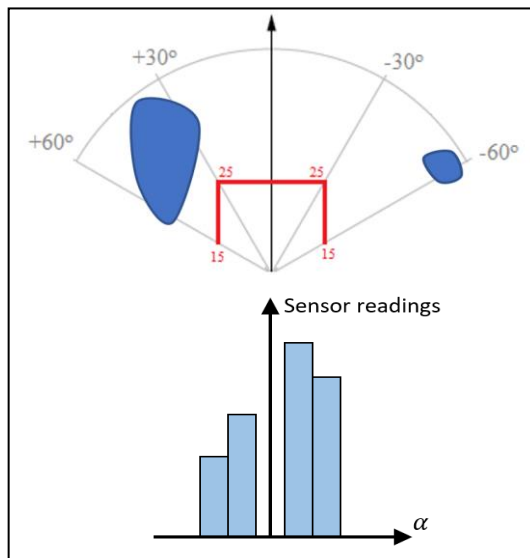
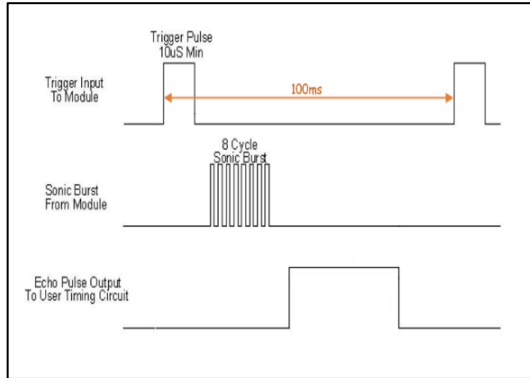


Tracking result transfer

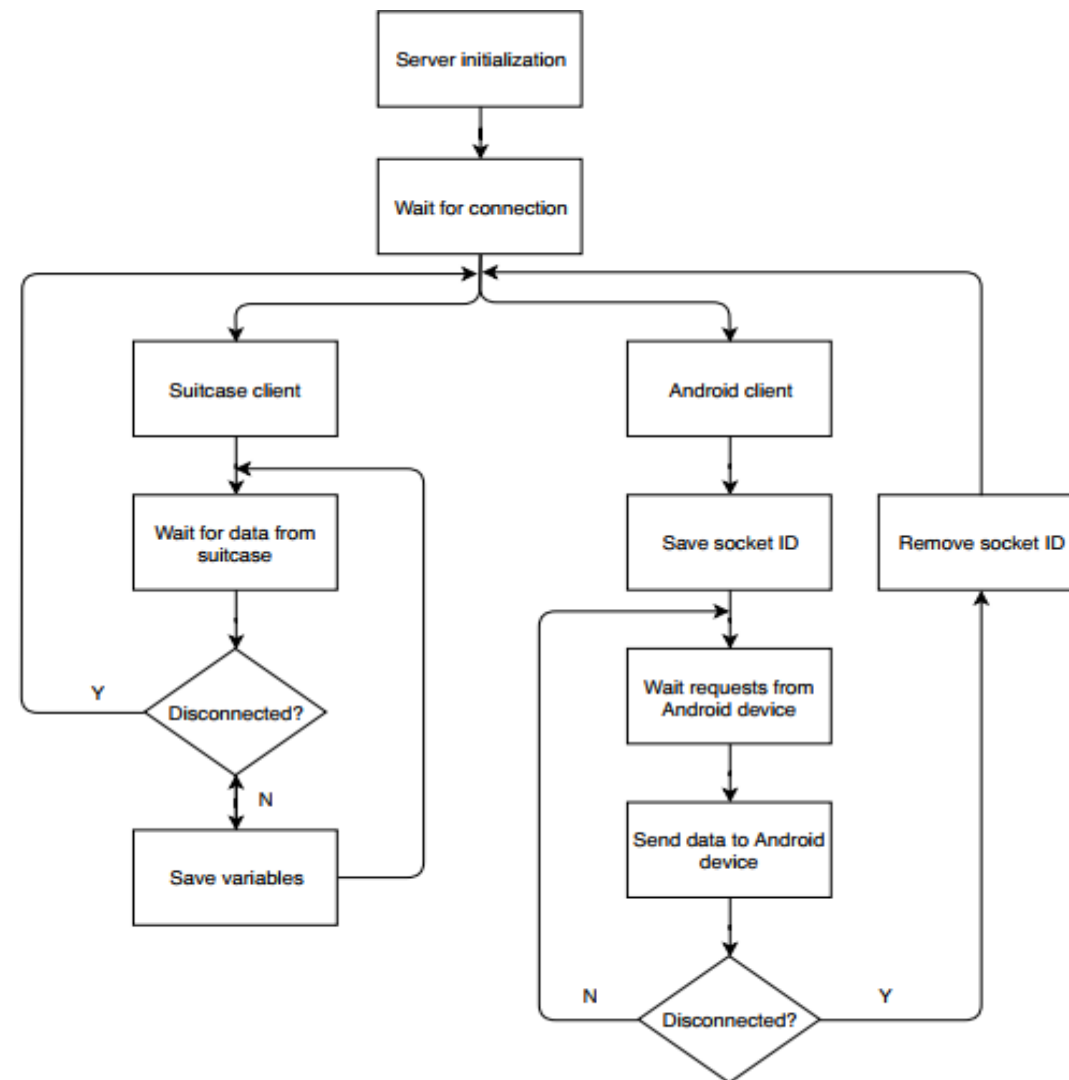
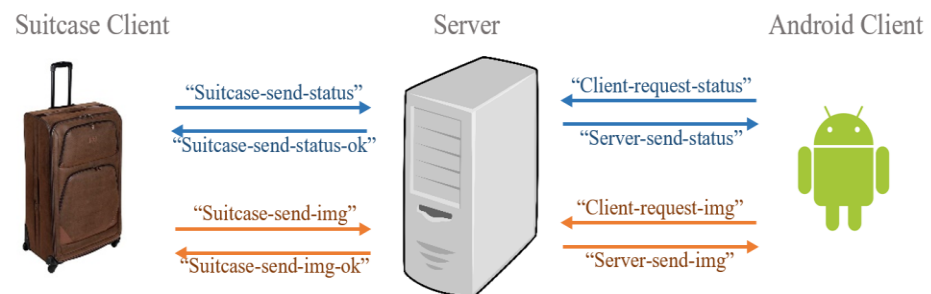


isTracking	error_Position [0]	error_Position [1]	error_Distance [0]	error_Distance [1]	0x0D	0x0A
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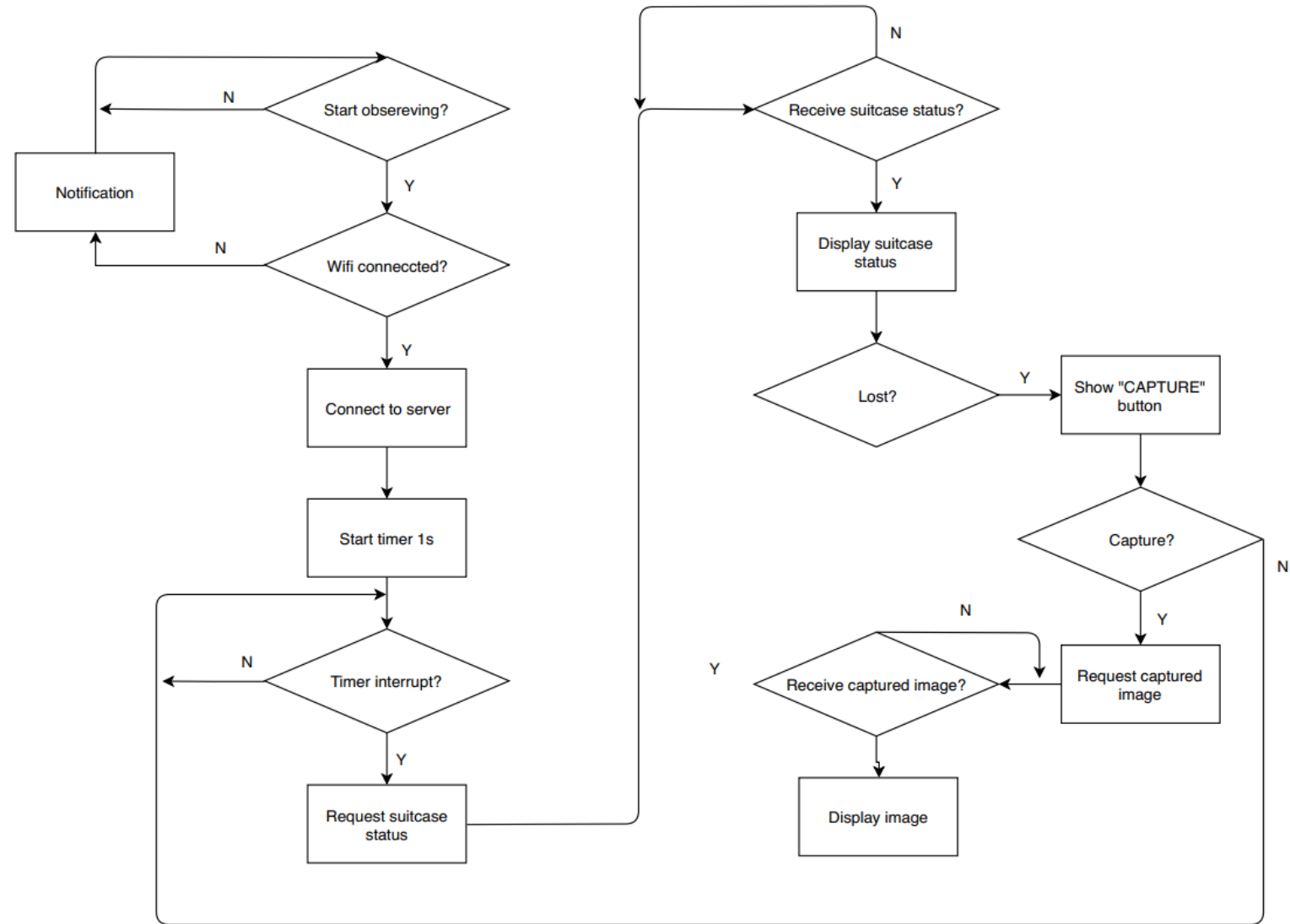
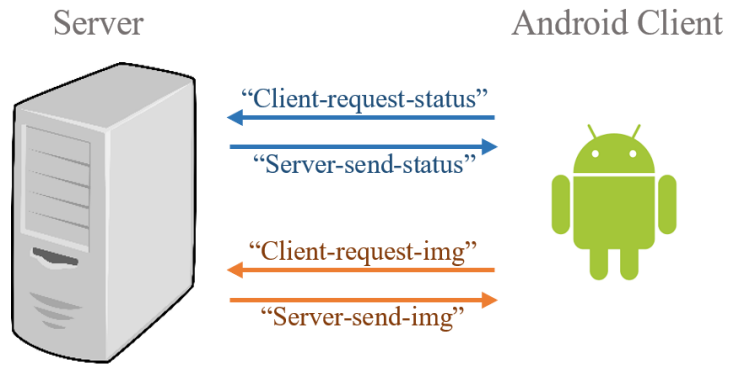
Motors controller using ARM



Server process



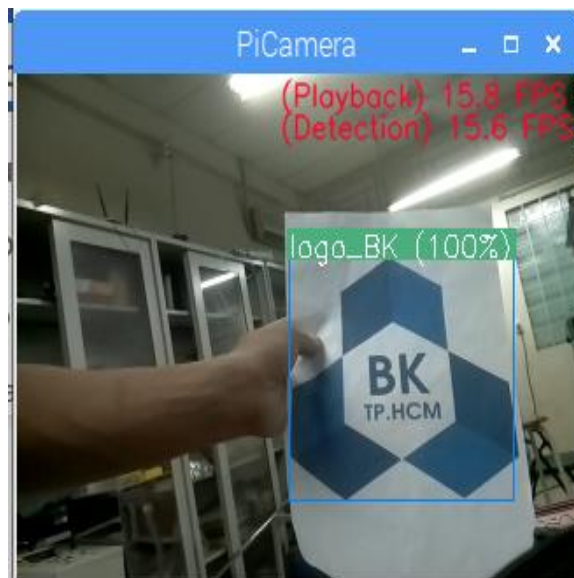
Android process



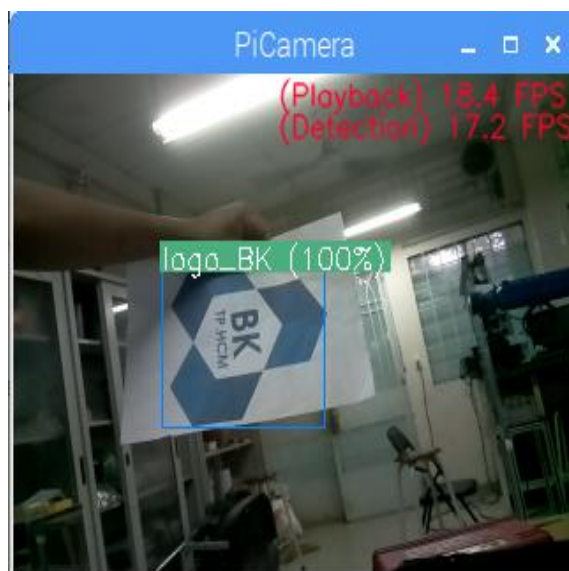


RESULTS AND ANALYSIS

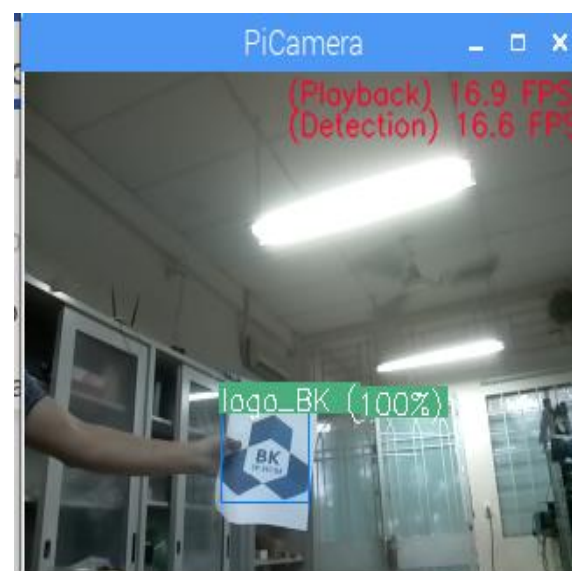
Real-time Tracking



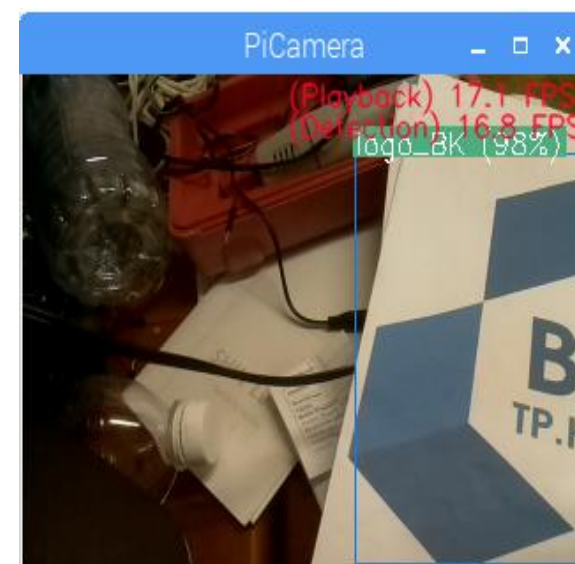
Normal condition



Being rotated

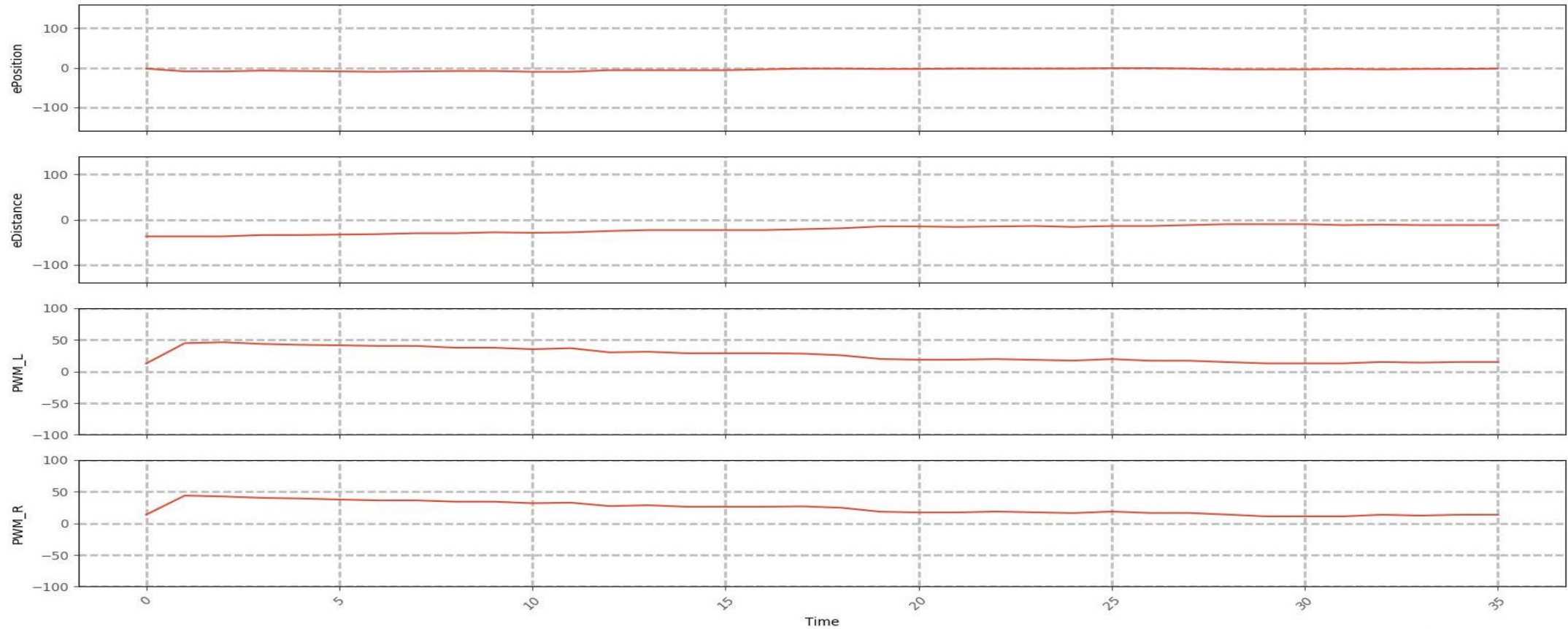


In far distance



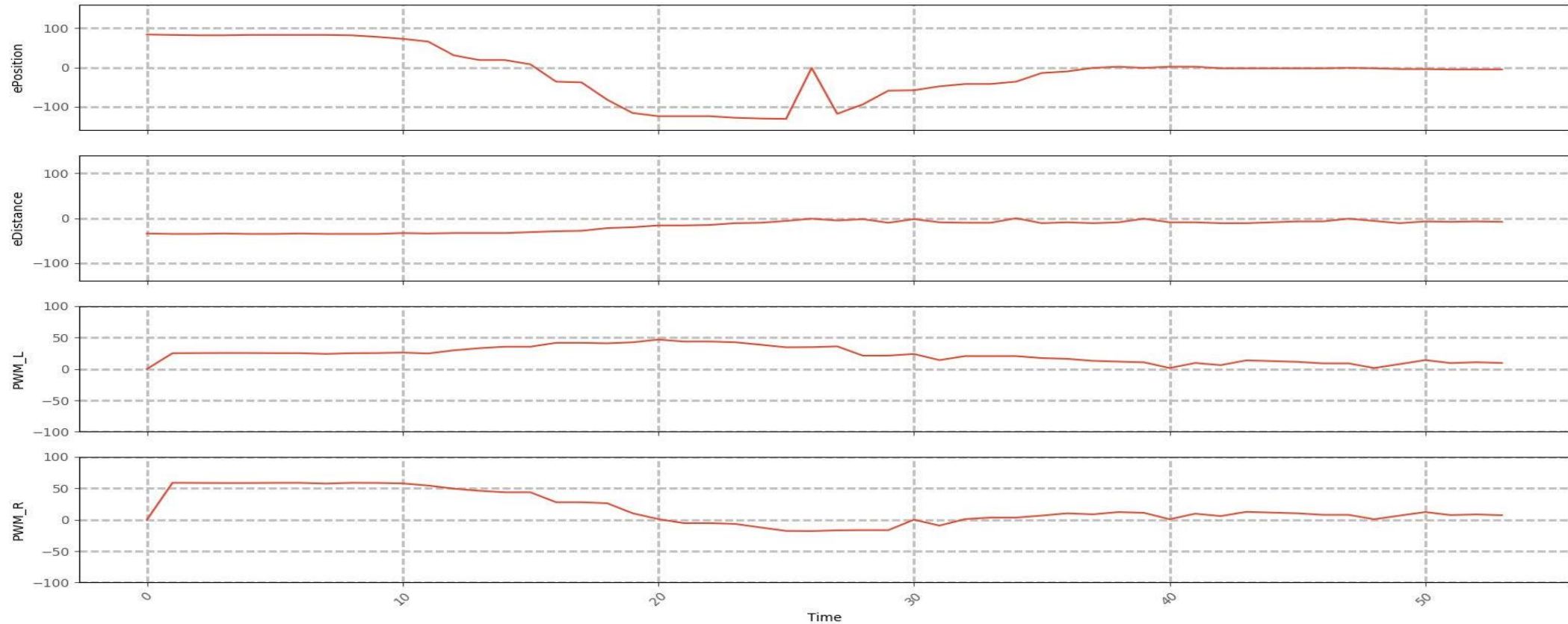
Being partly hidden

Fuzzy Controller for Tracking



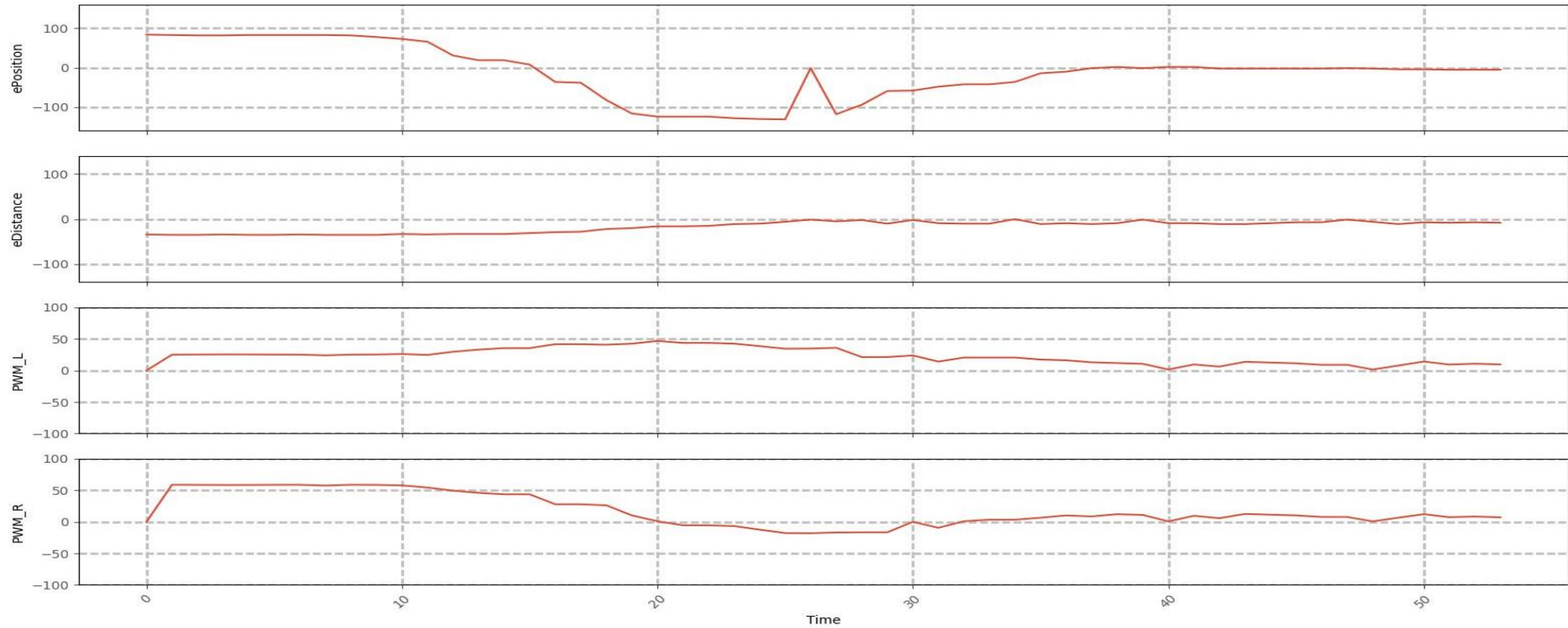
Logo is a little far and around the middle

Fuzzy Controller for Tracking



Logo is far and to the left

Fuzzy Controller for Tracking



Logo is near and to the left

● Obstacles Avoidance



One obstacle avoidance



Two obstacles avoidance

● Obstacles Avoidance



Obstacle is right in the middle of the way

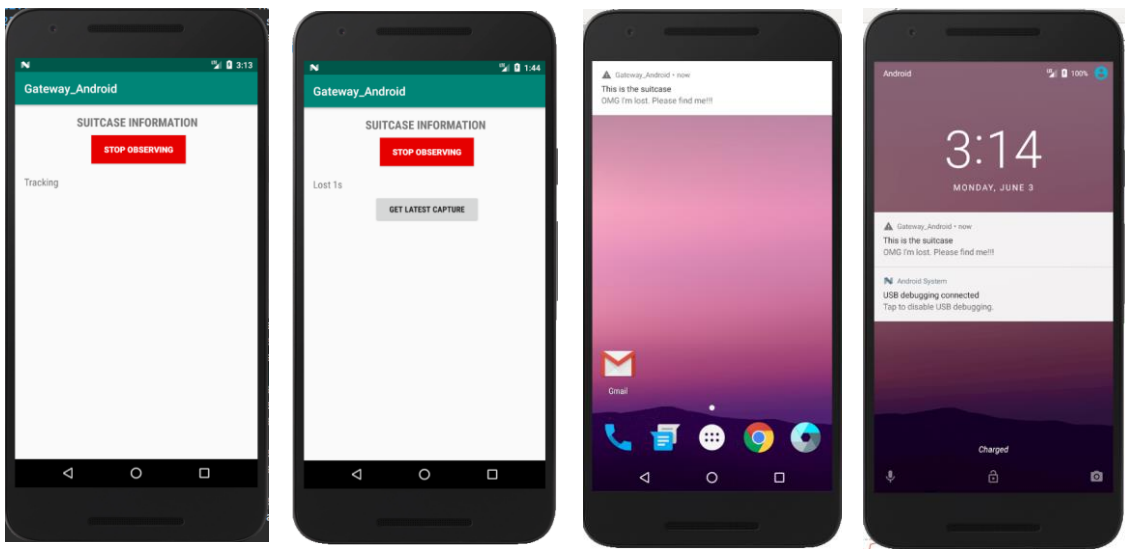


RESULTS AND ANALYSIS

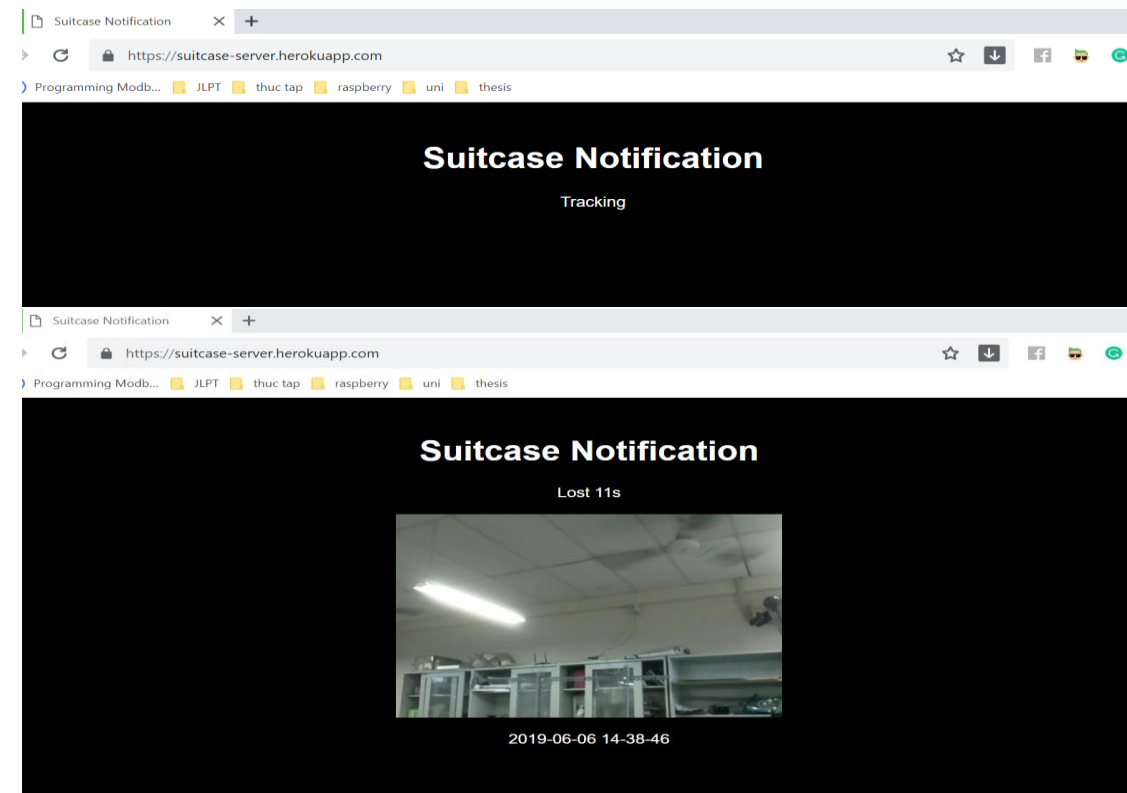
Server and Android application

```
C:\Windows\System32\cmd.exe
2019-06-03T08:31:41.273116+00:00 app[web.1]: Sending suitcase status to Android
2019-06-03T08:31:41.361010+00:00 app[web.1]: Server has received status of suitcase!
2019-06-03T08:31:41.421335+00:00 app[web.1]: Server has received image! > Server >
2019-06-03T08:31:42.284562+00:00 app[web.1]: Sending suitcase status to Android
2019-06-03T08:31:42.392456+00:00 app[web.1]: Server has received status of suitcase!
2019-06-03T08:31:42.399887+00:00 app[web.1]: Server has received image!
2019-06-03T08:31:42.861085+00:00 app[web.1]: Sending image information to Android
```

The server receives messages and responses accordingly



User interface on Android device



The website interface allows the user with non-Android device to keep track of the suitcase.



CONCLUSION

Merit:

- Succeeding on real-time tracking to logo.
- Server and Android application informs lost tracking.
- Easy switching between Auto and Manual mode.
- Anti-lost smart alarm.

Defect:

- Hard detection in the dark environment.
- Wi-Fi connection requirement to update to server.
- Slow movement.
- Noise appears while detecting obstacles.



FUTURE WORK

- Optimize inner hardware and enhance whole suitcase's appearance.
- Use weight sensor to scale the whole suitcase.
- Design easily removable battery combined with other convinences.
- Improve computer vision algorithm for user's body shape tracking only (with skeleton detection).
- Develop computer vision algorithm that allows side-following rather than behind-movement.



THANK YOU FOR YOUR LISTENNING!



APPENDIX

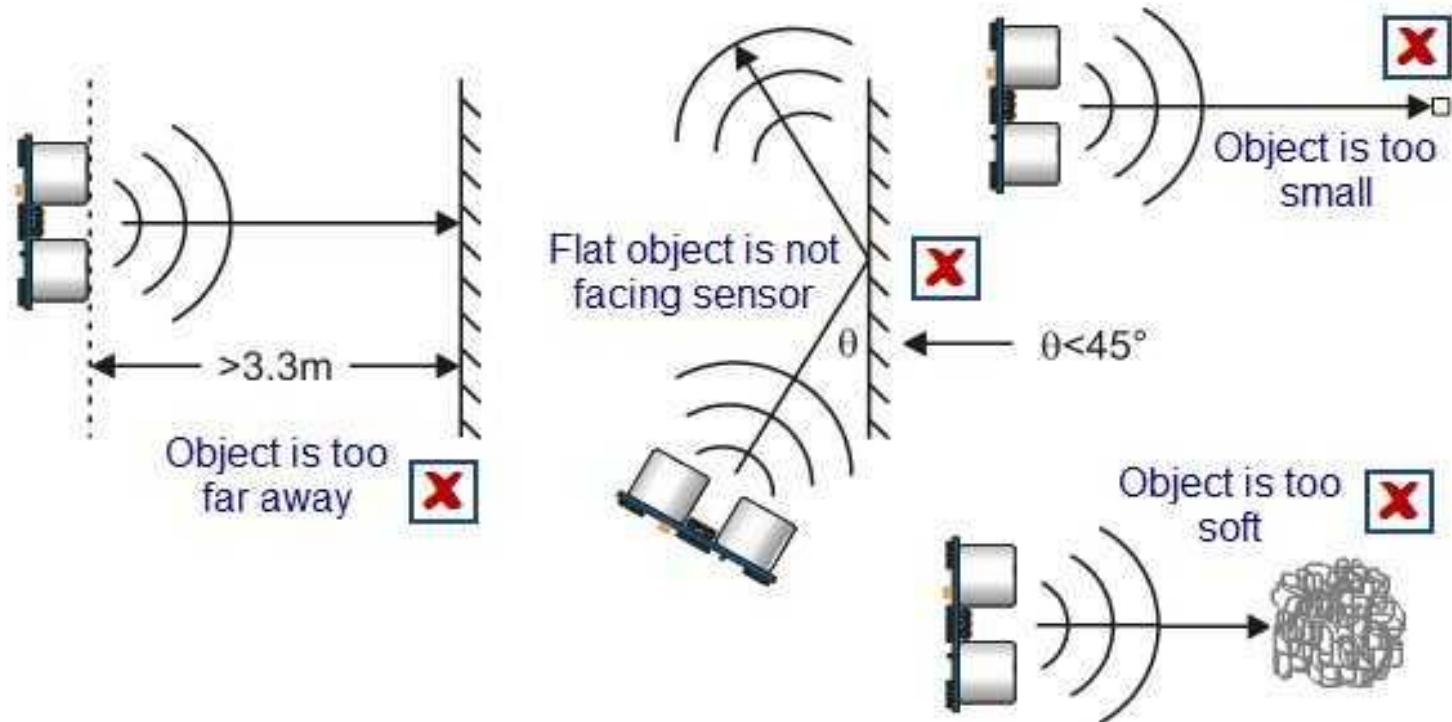


ULTRASONIC SENSOR

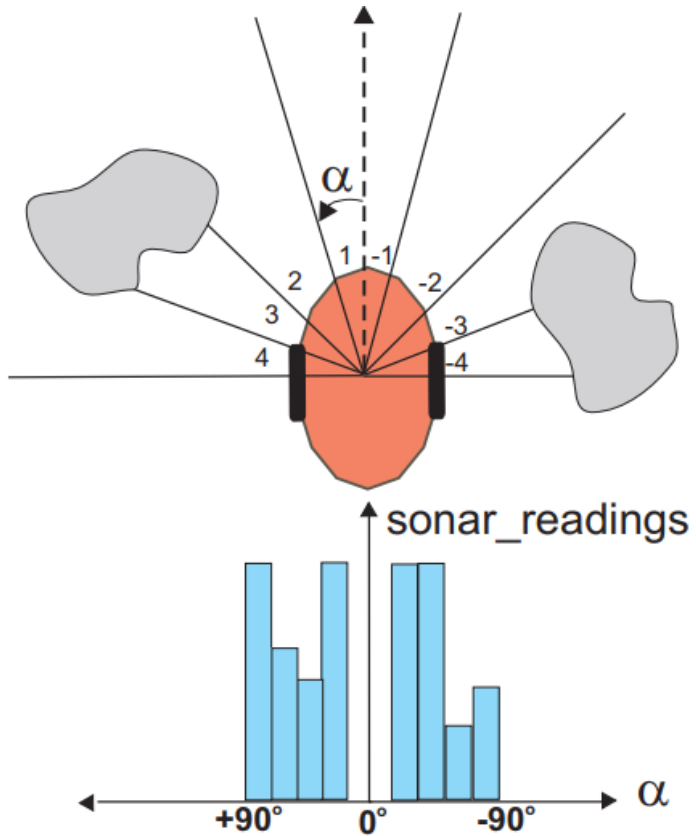
Steps to read an ultrasonic sensor:

- Send a 10us pulse to the sensor on the Trigger Pin, the sensor will automatically send out an ultrasonic wave
- Begin monitoring the Echo Pin
- When the Echo Pin goes high, begin a timer.
- When the Echo Pin goes low, get the elapsed time and measure distance using the formula:

$$distance (cm) = \frac{elapsed\ time(us) * 0.0001 * 340}{2}$$



Examples of situations where an ultrasonic sensor fails to detect objects



$$\alpha_R = \frac{\sum_{i=-\frac{N}{2}}^{\frac{N}{2}} \alpha_i D_i}{\sum_{i=-\frac{N}{2}}^{\frac{N}{2}} D_i}$$

- N : the total number of the ultrasonic sensors
- $\alpha_i = i \frac{\pi}{N}$, $i \in \left[-\frac{N}{2}, \frac{N}{2}\right]$
- D_i : the distance found by the sensor i



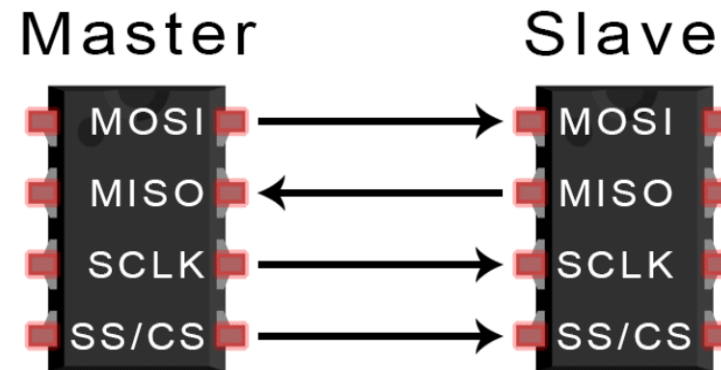
THE SIMPLE REAL-TIME OBSTACLE AVOIDANCE ALGORITHM

- **Advantages:**

- It demands low computational load
- It can avoid both static and moving obstacles
- It can be implemented for many kinds of sensors

- **Disadvantages:**

- The motion is not smooth
- Motion is done even if there is no path to the goal
- It requires a high-level path planner to perform well



- **MOSI:** Line for data from master to slave
- **MISO:** Line for data from slave to master
- **SCLK:** Line for clock signal, which determines the speed of data transfer by sending one bit of data per clock cycle.
- **SS/CS:** Line for master to select which slave to send data to. The master chooses its slave by setting the slave's CS/SS to a low voltage level.



- **Advantages:**

- Data can be transferred continuously without interruption
- Data can be sent and received at the same time

- **Disadvantages:**

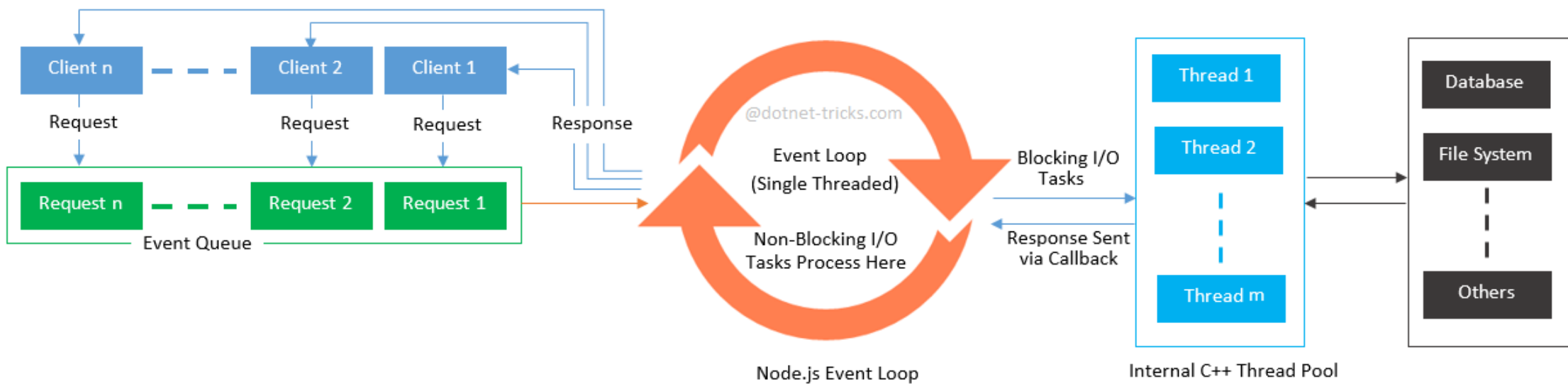
- Uses more wires than other communication protocols like I2C, UART
- Cannot perform data checking



TCP PROTOCOL

TCP	Source Port			Destination Port		
	Sequence Number					
	Acknowledgment Number					
	Offset	Reserved	TCP Flags C E U A P R S F		Window	
	Checksum			Urgent Pointer		
	TCP Options					

TCP Packet



Node.js execution model



- For obstacle avoidance

RIGHT		Angle				
		NB	NS	ZE	PS	PB
Current_PWM	LO	NS	ZE	PS	PM	PB
	ME	NM	NS	ZE	PS	PM
	HI	NB	NM	NS	ZE	PS

LEFT		Angle				
		NB	NS	ZE	PS	PB
Current_PWM	LO	PB	PM	PS	ZE	NS
	ME	PM	PS	ZE	NS	NM
	HI	PS	ZE	NS	NM	NB