

Company and Shareholders

Founded in September 2018 by five electrical engineering students from Middle East Technical University, DUAYENLER Ltd. Şti. is a visionary and promising new robotics start-up company. Project co-founders can be seen at *Figure 1*. Our mission is to design products for real life problems by creating innovative solutions.

Our vision is to be the frontier in robotics by intelligently automating the future world.

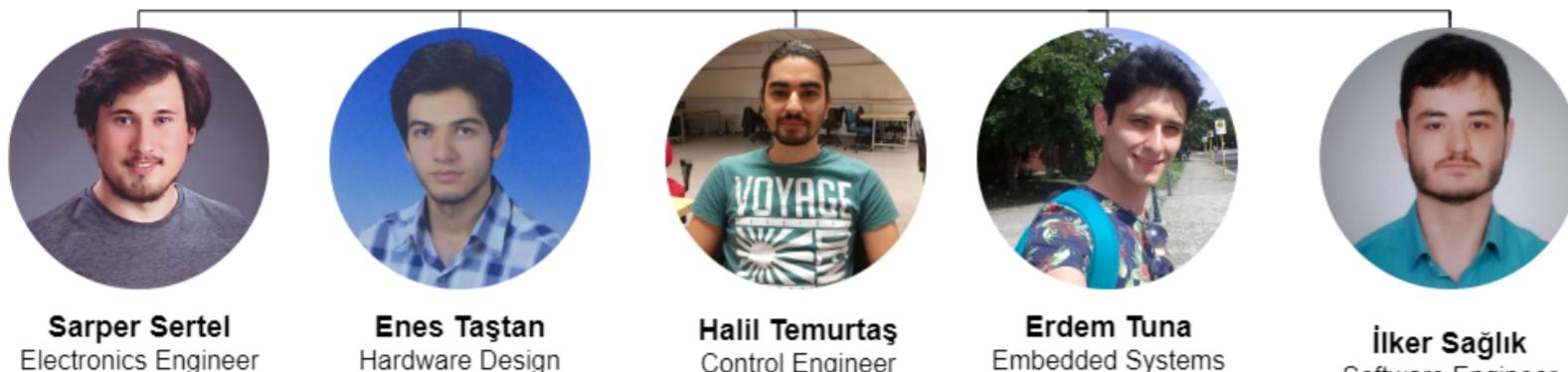


Figure 1: Co-Founders of DUAYENLER Ltd. Şti.

Project Description

The aim of the project is to design and produce a autonomous vehicle that can follow a path with varying properties.

Throughout the project we have followed an design methodology called Agile Methodology. Agile development approach relies on rapid development and prototype production. We have also divided the project into subsections according to V-model. V chart utilized in the process can be seen at *Figure 2*.

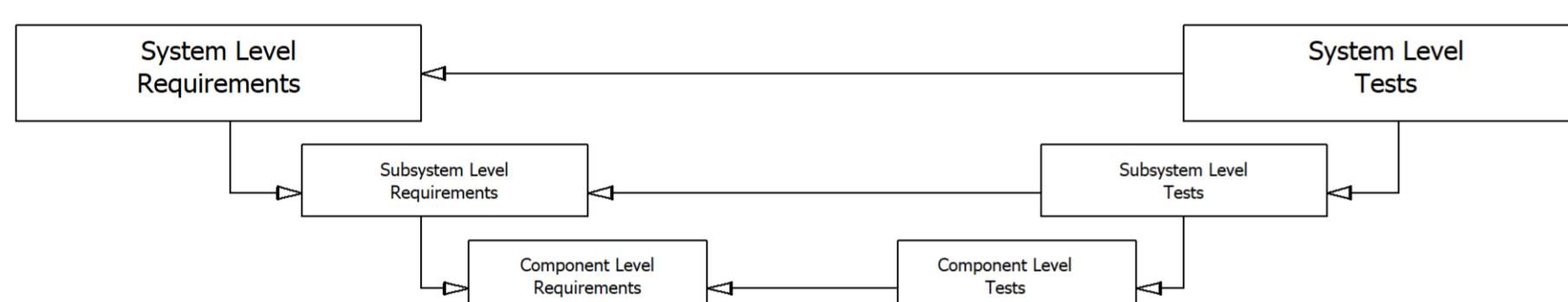


Figure 2: V Chart for the Project Development Phase

Project Specifications and Requirements

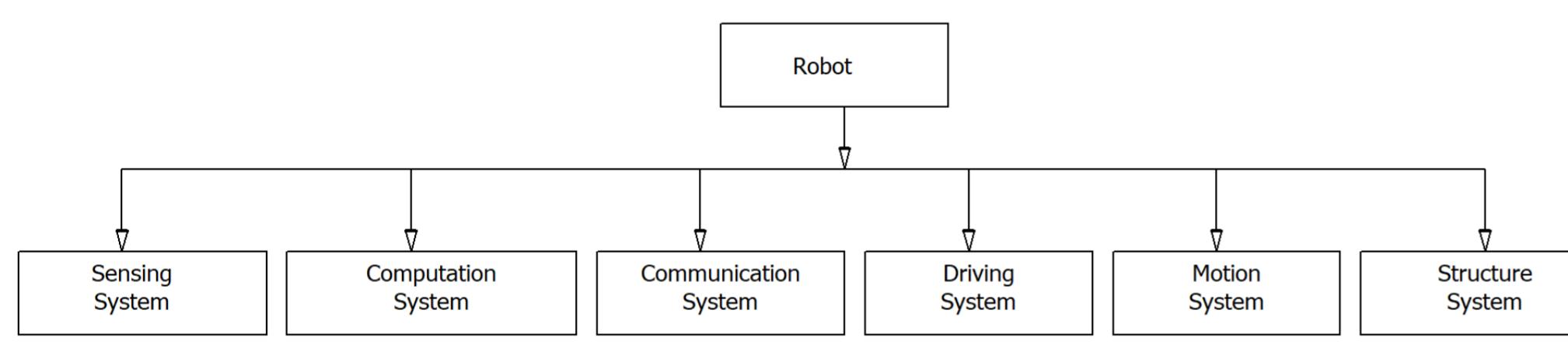


Figure 3: System Diagram of the Project

Table 1: Requirements of the Project

Project Requirements	System Requirement
Follow path in every condition	SenS: Detect lane in varying conditions CmpS: Eliminate obstacles
Complete path within 20 seconds	CmpS: Produce consistent error signal CmpS: Have robust controller performance
Not crash to opponent	SenS: Detect opponent atmost at 5 cm CmpS: Not be affected by the opponent
Communicate with opponents	CmnS: Follow the Handshake Protocol
Battery life at least 1 hour	StrS: Supply at least 1350 mAh MtnS: Consume at max 15 W
Production price less than \$200	StrS: Pyhsical materials cost at most \$200 MtnS: Cost less than \$35

Proposed Solution

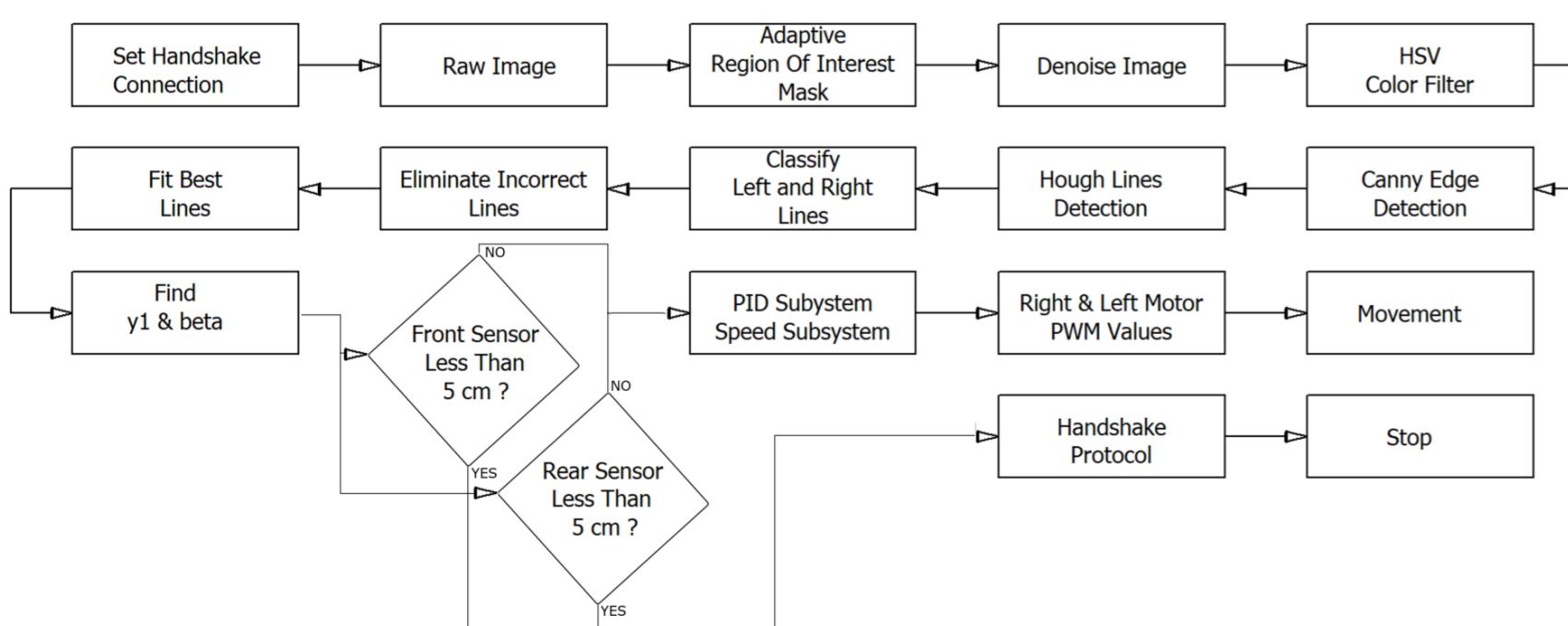


Figure 4: Overall Flow Diagram of the Project

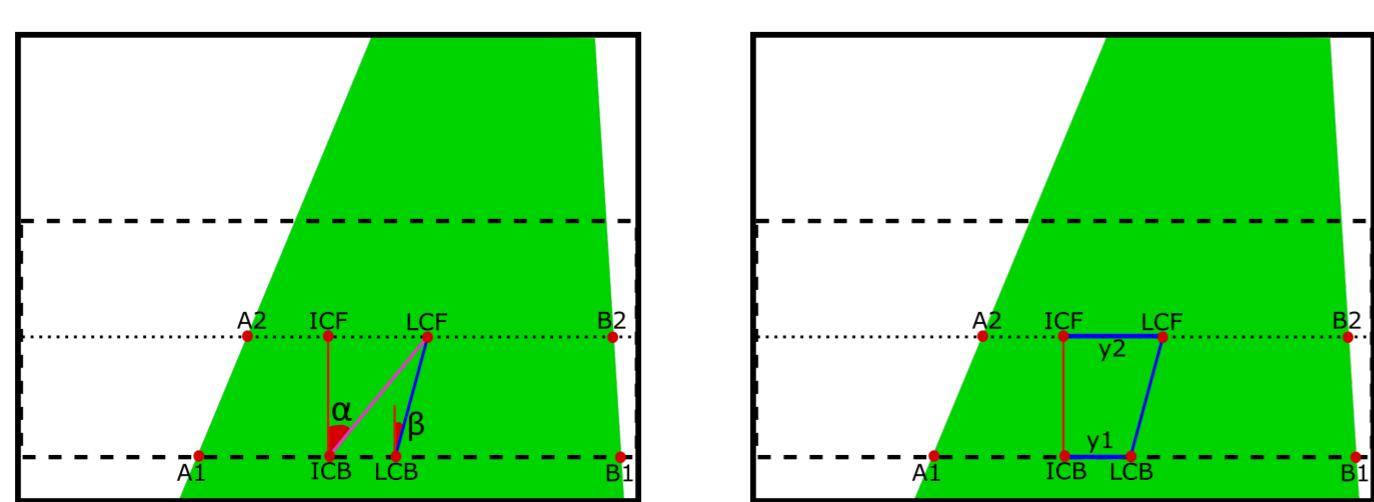


Figure 5: Controlled Variables of the System

Test Results

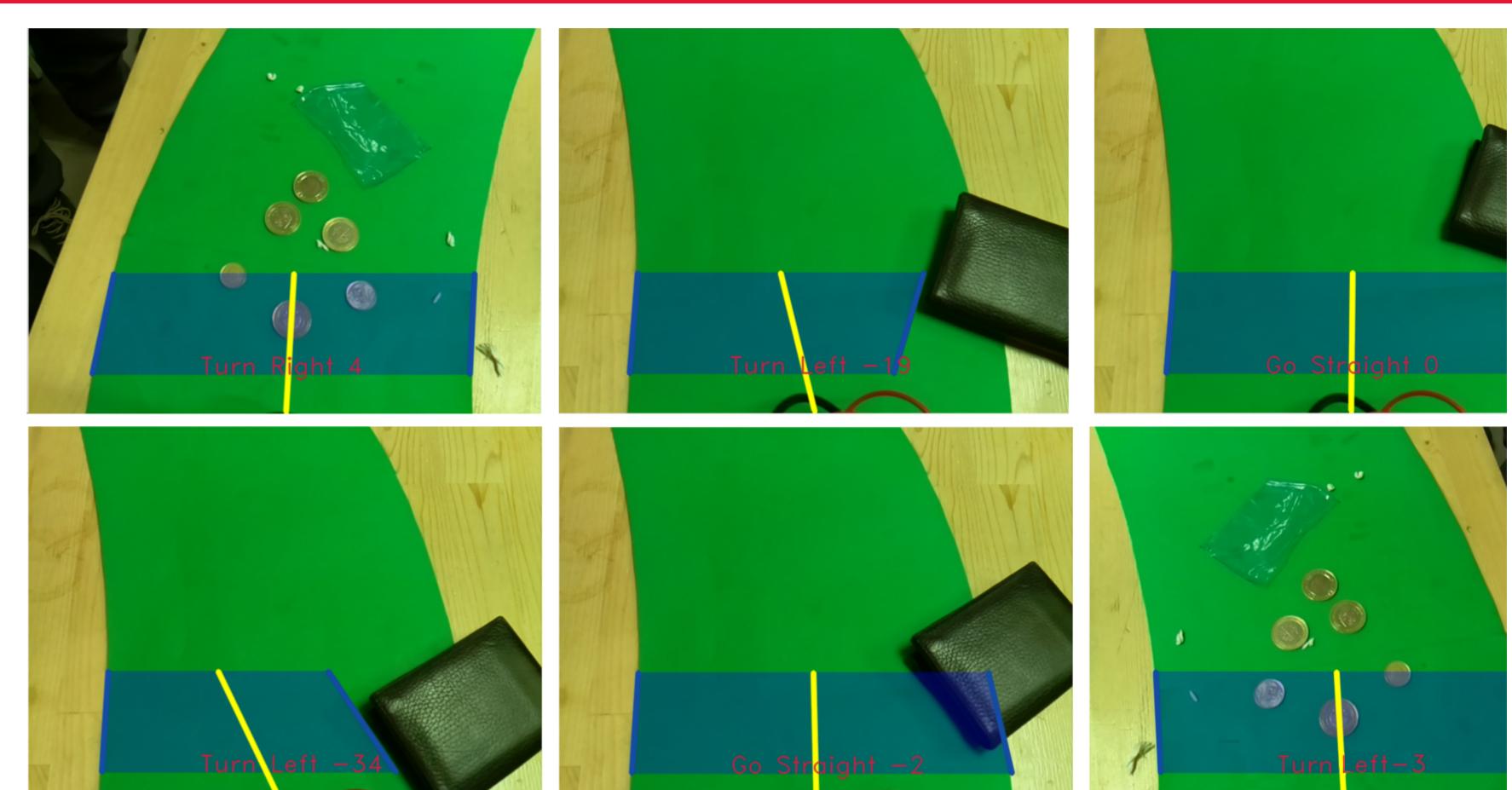


Figure 6: Test Results for the Vehicle Vision with External Disturbances

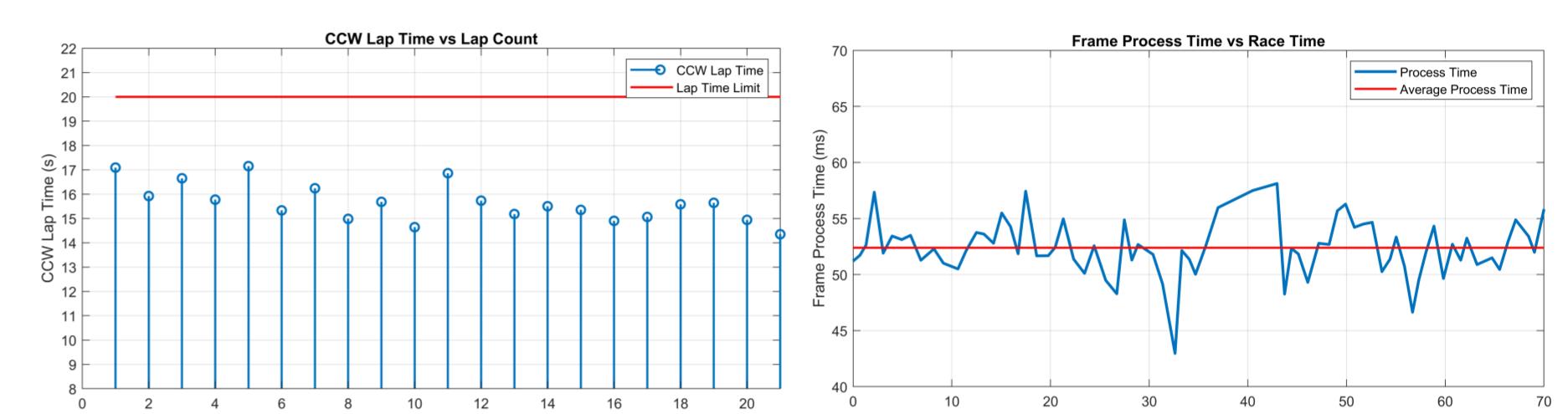


Figure 7: Left Half: CCW Lap Times for 20 Successive Laps
Right Half: Frame Processing Test Result

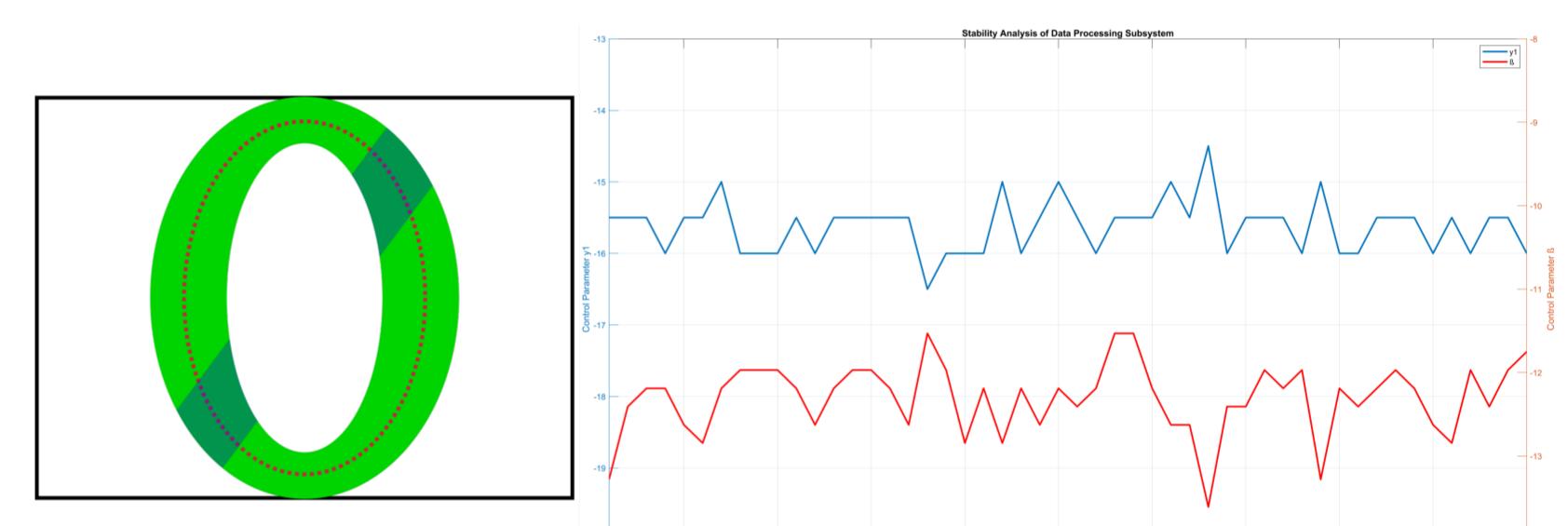


Figure 8: Image Processing Stability Test

Cost Breakdown

Table 2: Cost Analysis for the Project

Component	Number	Total Price (in Dollar)
Raspberry Pi 3B	1	47
Waveshare Raspberry Pi Camera (D)	1	22
Chassis Components	1	13
Arduino Nano	1	4.8
Pololu 150:1 6 V 200 RPM DC Motor	2	42
Bond Silicon Wheel	2	8
Motor Driver and Voltage Regulator	1	4
Xiaomi 10000 mAh Mi Powerbank (Ver 3)	1	12
ProFuse 11.1 V 1750 mAh Li-po Battery	1	23
Polulu VL6180X ToF Distance Sensor	2	17
LED headlight/LED	-	0.2
Styrofoam, Glue & Cardboard	-	6.5
Total Project	-	199.5

Power Analysis

Table 3: Estimated Cost Analysis for the Project

Component	Current (Avg),A	Power (Avg),W	Current (Max),A	Power (Max),W
Raspberry Pi 3B	0.85	4.25	2.5	12.5
Arduino Nano	80m	0.4	0.2	1
DC Motors & Motor Driver	0.35	4.2	0.95	11.4
Distance Sensor	19m	62.7m	40m	132m
Total	1.349	8.9127	3.69	25.032

Deliverables

Deliverables of the product are listed as follows;

- ▶ KOBRA 6.5
- ▶ Race Track
- ▶ Flash stick with software
- ▶ User Manual
- ▶ Micro USB Cable

Acknowledge

DUAYENLER would like to thank METU Physics Society and Ali Aslantürk for their valuable contributions.