



MIDDLE EAST TECHNICAL UNIVERSITY

DEPARTMENT OF  
ELECTRICAL AND ELECTRONICS ENGINEERING

EE493 ENGINEERING DESIGN I

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## Business Statement Report

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**Supervisor** : Assoc. Prof. Emre Özkan (Section 6)  
**Company Name** : Duayenler Ltd. Şti.  
**Members** : Sarper Sertel, 2094449 (Contact Person)  
Enes Taştan, 2068989  
Erdem Tuna, 2617419  
Halil Temurtaş, 2094522  
İlker Sağlık, 2094423

October 19, 2018

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# 1 Introduction

In this report, we will give the general information about our company, DUAYENLER Ltd. Şti., and us as co-founders of the company. This report, also contains our basic understandings of the four possible Capstone projects in brief details.

## 2 About the Company

Founded in September 2018 by five electrical engineering students from Middle East Technical University, DUAYENLER Ltd. Şti. is a promising new robotics start-up company.

### 2.1 Our Mission

Our mission is to design products for real life problems by creating innovative solutions.

### 2.2 Our Vision

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

## 3 About Us

**DUAYENLER Ltd. Şti.** was founded in September 2018 by 5 Co-founders ,namely, Sarper Sertel, Enes Taştan, Erdem Tuna, Halil Temurtaş & İlker Sağlık. Although all of the co-founders are from similar backgrounds and some of them even have long-lasting pair-relationships, the efforts of the Sarper Sertel brought the group together to establish the company. In this section, we will introduce ourselves as the co-founders of DUAYENLER.



Figure 1: Sarper SERTEL

As a person bringing group together, Sarper Sertel was laboratory pair with Enes for EE214 & EE313 and was pair with İlker for EE314 laboratory course. He was also project partner with Erdem & Halil for EE302 Project in which they called themselves Group Duayenler. As a graduation student, he chose the **Electronics** option. And as an engineering student, he has specialized in number of topics such as:

- Analog Circuit Design
- Digital Circuit Design
- Expert LtSpice User
- Advance Matlab User

More information about Sarper SERTEL can be accessed from his curriculum vitae at APPENDIX.

Enes Taştan, an Electronics and Physics double-major students, interested in physical & theoretical aspects of electronics engineering as well as real-life applications of them thanks to his summer-practice knowledge. Due to his physics courses, he is planning to graduate next year but he is planning to chose **Electronics** option. As an engineering student, he also has specialized in number of topics such as:

- PCB Production
- Programming Background: Python, C
- Expert LtSpice User
- Arduino User



Figure 2: Enes Taştan

More information about Enes TAŞTAN can be accessed from his curriculum vitae at APPENDIX.



Figure 3: Erdem TUNA

Erdem TUNA can be considered as the name father of the DUAYENLER Ltd. Şti. since He was the one naming their EE302 project group as "Group Duayenler.". Erdem is also long-lasting laboratory and homework partner with Halil since Physics 106 Laboratory. As a graduation student, he chose the **Computer** option. And as an engineering student, he has specialized in number of topics such as:

- Static Image Processing (Text Detection etc.)
- Programming: Python, C, HTML, CSS
- Interfacing with sensors
- Wireless Communication

More information about Erdem TUNA can be accessed from his curriculum vitae at APPENDIX.

Halil TEMURTAŞ, a graduation student, is the fourth co-founder of the DUAYENLER. He is also homework/laboratory partner with Erdem since 2016 and was project partner with Sarper in EE302 project group "Group Duayenler". As a graduation student, he chose the **Control** option. And as an engineering student, he has specialized in number of topics such as:

- Micro-controllers : Raspberry Pi, Arduino
- Device Testing
- Programming Background: Python, C
- System Engineering



Figure 4: Halil TEMURTAŞ

More information about Halil TEMURTAŞ can be accessed from his curriculum vitae at APPENDIX.



Figure 5: İlker SAĞLIK

İlker Sağlık, a graduation student, is the fourth co-founder of the DUAYENLER. He was also a partner with Sarper in one of the third-year laboratory courses. As a graduation student, he chose the **Computer** option. And as an engineering student, he has specialized in number of topics such as:

- Plug-in Writer
- Programming Background: Python, C
- Expert LtSpice User
- Advance Matlab User

More information about İlker SAĞLIK can be accessed from his curriculum vitae at APPENDIX.

## 4 Description of the Projects

The analysis of each projects including possible challenges and solutions are given in this section.

### 4.1 Devices Competing to Catch Falling Balloons

In this project, we are supposed to design and construct two robots that try to catch falling balloons before they touch the floor. However, we have some limitations with this design. Firstly, the sizes of the robots must not exceed the upper limit provided us. Secondly, robots are not allowed to touch, push or contact each other. Thirdly, the protection from the interference from robots' sensors is required.

There are two major problems related to this project. First problem is moving the robot to the direction of the balloon. To solve this, a built-in camera on the robots can be utilized. We can take a reference point on the camera, and try to make it aligned with the balloon. However, image processing is highly required. Second problem is the way of catching the balloons. Robot arms or vacuums can be utilized in this step. However, we think the vacuums would be much easier. In overall, image processing and algorithm to make robots tend the direction of balloons avoiding collusion are required.

## 4.2 Devices Trying to Score in Each Other's Goals

In this project, we need to design a device which can play basically air hockey by remote control (no Wi-Fi) in a hexagonal playground. This project is focusing on RF communication and real-time process. No naked eye and onboard camera requirement video transmission should have no lag and right angle. There are, also, some mechanic problems which are how to respond a ball and how to handle with the stuck ball. Our approach to camera angle is using a servo motor and adding a camera control button to controller, so in every condition of the device, player can observe field properly. For hitting the ball, our consideration has two part using momentum of the ball to respond during the game, so orientation problem can be solved. On the other hand, to solve stuck ball problem and the beginning of the game, we need to push the ball. Therefore, we can add impulsive component to one side. To handle with real-time process, we should have fast algorithm in communication and movement.

## 4.3 Vehicles Chasing Each Other Around a Closed Course with Varying Properties

In this project, we are required to build a vehicle that can travel around a closed elliptical route as fast as possible. Furthermore, it should stay on the elevated path. At first glance, the main requirement of the vehicle is to have a reliable and quick responsive motion control system. To handle the turns on the path, a differential drive principle can be used as well as direction changing wheels. However, the latter one is hard to build and need to be tested if it is capable of handling the specified path. Another factor that needs to be put attention is the speed of the vehicle. Since it is a race between two vehicles, it is better to come up with the most practical and feasible solutions for the controls system so that the processing load is minimized. After all, the vehicles are required to complete the path in less than 20 seconds.

The winner is defined to be the vehicle that can approach to other one from the back less than 5 cm. Therefore, the vehicle should have a function that when the winning event occurs, it can stop the race by so called handshake protocol. The overlooking cameras are not allowed but it is not a feasible way either. It is because processing the image and sending the necessary informations to vehicle so that it performs accurately is too much process and would take longer compared to data coming from sensors onboard. Also, a suspension system might be needed to achieve stability against rough surfaces or disturbances. In addition, there needs to be protection system on the vehicle so that the collision with the other one never occurs.

## 4.4 Devices Trying to Extract the Plan of Their Surroundings

The project requires a mobile vehicle that can travel in a meaningful path such that the device neither crashes any of the obstacles nor the exterior walls but can map the whole playfield accurately. The main limiting factor in the solution is the use of same color for both the obstacles and the exterior wall. This limitation prevents the implementation of a simple color thresholding solution for the object detection with the help of a imaging system such as a camera. A possible way to handle the object detection problem would be to use “shadow games” so that light shades of the color indicate a possible object whereas the dark shades of the color might mean exterior wall. Certainly, mapping the playfield is important as much as object detection. The vehicle should be able to get the distance of it to its environment.

The overall solution requires a combination of many steps, mainly, image processing, direction automation with respect to surroundings, an algorithm to create map.

## 5 Conclusion

Appendices:

Time table for the tasks including the assignment of responsibilities until the submission of the proposal report



# Enes Taştan

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## PERSONAL PROFILE

An aspirant and diligent physics undergraduate who currently makes double major with electrical and electronics engineering with the aim of integrating principles of science with practicality of engineering. Demonstrates high interest in experiments with resourceful and creative profile. Enjoys sharing academical knowledge with colleagues.

## EDUCATION

- 2016–2020 **Electrical and Electronics Engineering (BSc)**, *Middle East Technical University (METU)*, Double major .  
(expected)  
2014–2019 **Physics (BSc)**, *Middle East Technical University (METU)*, Major.  
(expected)  
2010–2014 **Bartın Hasan Sabri Çavuşoğlu Science High School**, *Bartın*.

## LANGUAGES

Turkish Native  
English Advanced  
Arabic Beginner

## COMPUTER SKILLS

Office	Intermediate	Altium Designer	Beginner
Python	Intermediate	Java	Beginner
Matlab	Intermediate	LaTeX	Advanced
ROOT	Beginner	SolidWorks	Beginner

- Able to solve an arbitrary encountered problem using appropriate language
- Matlab and Python for mostly scientific computation purposes

## EXPERIENCES

- Internship Summer Practice at *Institute of Accelerator Technologies, TARLA Facility*
- 20 days mandatory summer practice
  - gained PCB design and production skills
  - worked on linear power supply and multimeter design

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## MEMBERSHIPS

Physics Society	Management board member, conducted L <sup>A</sup> T <sub>E</sub> X seminars
Machinery Innovation Society	Attendance to introductory courses and projects

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## ACHIEVEMENTS

TUBİTAK 2205	Bachelor Scholarship	<i>given for those who register science departments with the degree within the first 5000 in university entrance exam in 2014</i>
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## REFERENCES

Available upon request



# Halil Temurtas

## Curriculum Vitae

### Education

2014–Present **BSc**, *Middle East Technical University*, Ankara, *CGPA – 3.05*.  
Electrics and Electronic Engineering

2010–2014 **High School**, *Ankara Ataturk Anadolu Lisesi*, Ankara, *GPA – 90.3/100*.

### Projects

- VLA A Student Researcher at an Independent Research and Development Project for Development of Very Light Aircraft (VLA) by Middle East Technical University (METU) and Turkish Aircraft Industries Corporation (TAI)
- EE213 Analog Air Conditioner System, 3<sup>rd</sup> Semester Laboratory Term Project
- EE214 Flute Controlled Car, 4<sup>th</sup> Semester Laboratory Term Project
- EE313 FMCW Based Distance Measuring System, 5<sup>th</sup> Semester Laboratory Term Project

### Experience

#### Summer Practice

2017 **Summer Intern**, TURKSAT UYDU HABERLESME KABLO TV VE ISLETME A.S., Ankara.

20 days mandatory summer practice. Worked on project management systems on a project about sun tracking solar panel system.

Between July and August 2017

Detailed achievements:

- Raspberry Pi / Python
- Arduino
- Introduction to project management systems

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🌐 [haliltemurtas.com](http://haliltemurtas.com)

### Intern Engineer

2018 **Intern Engineer**, TURKISH AIRCRAFT INDUSTRIES CORPORATION (TAI) , Ankara.

One day per week engineering program from TAI for engineering students.

- Between March and May 2018

### Summer Practice

2018 **Summer Intern**, ASELSAN A.S., Ankara.

20 days mandatory summer practice. Observed and participated on environmental test of products at HBT,ASELSAN and conducted research work on components

- Between July and August 2018

### Computer skills

Basic PYTHON, VERILOG

Intermediate GIT MATLAB ,HTML,  $\text{\LaTeX}$ , MICROSOFT OFFICE, MICROSOFT WINDOWS, C

### Languages

Turkish **Mothertongue**

English **Upper Intermediate**

*Conversationally fluent*

German **Basic**

*Basic words and phrases only*

### Exams

YDS 2015 **95/100**

METU EPE **87.5/100**  
2015

*English Proficiency Exam done my METU*

### Interests

Taekwon-do **Green-Blue Belt**

*Metu Taekwon-do Club*

# İlker Sağlık

## Curriculum Vitae

+90 (541) 722 9573  
✉ [ilkersaglik.ee@gmail.com](mailto:ilkersaglik.ee@gmail.com)  
📄 <https://github.com/isaglik>



### Education

- 2014–2019 **BSc**, *Middle East Technical University, Ankara*, .  
Electrical and Electronics Engineering
- 2009–2013 **High School**, *Macit Zeren Fen Lisesi, Amasya*, .

### Projects

- EE213 *Analog Air Conditioner System, Laboratory Term Project*
- EE214 *Fire Alarm System, Laboratory Term Project*
- EE313 *FMCW Based Distance Measuring System, , Laboratory Term Project*

### Experience

#### Summer Practice

- 2018 **Summer Intern**, *ASELSAN A.Ş., Ankara*.  
20 days mandatory summer practise. Observed and participated some works at REHİS, Gölbaşı between August and September 2018.

### Languages

- Turkish Native
- English Advanced
- German Beginner

### Computer skills

- Basic Git, Verilog, Arduino, Latex
- Intermediate Microsoft Office, Microsoft Windows, MATLAB, LTspice, C, C++

### Interests

- Hobby Strength and durability training

## **SARPER SERTEL**

**Çankaya Mah. Kaktüs sok. Kayapark sitesi 10/7 (F blok) Eskişehir / Turkey**

**Üniversiteler Mahallesi, Dumlupınar Bulvarı No:1, 06800 Çankaya/Ankara**

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**e209444@metu.edu.tr**

**Mobile: +90 542 515 6039**

### **Personal Profile**

Goal oriented senior Electrical and Electronics Engineering student. Dedicated and fastidious group member or professional, organized group leader with great interpersonal skills. Demonstrates required performance even under highly stressful conditions. Reasonable Perfectionist.

### **Education**

2014- present	B.S. Electrics and Electronics Engineering Middle East Technical University, Ankara, Turkey
2010-2014	Fatih Anatolian Highschool Eskişehir/Turkey

### **Experiences**

August 2017 – September 2017	Intern 1'inci Hava Bakım Fabrika Müdürlüğü (First Air Maintenance Factory Management) Eskişehir/ Turkey  Maintenance, repair, test and calibration of benches and electronic systems
June 2018 – July 2018	Intern ASELSAN A. Ş. Ankara/ Turkey  Analog design

## **Language**

Turkish (Native)

English (Fluent)

German (Beginner)

## **Computer Skills**

LTspice

Vee Pro

Beginner: C, Matlab

## **Personal Interests**

New technologies in Car and Military Industry

Hardware parts of mobile devices

Strength and durability training

- Item
- Item



Figure 6: Logo





(a) Logo1

(b) Logo2

Figure 7: Small Logos

Table 1: table

A	B	C
1	2	3
2	3	4
3	4	5
4	5	6

$A \backslash a$	Average deviation after subtracting out the frequency error	C
1	2	3
	3	4
3	4	
4	5	6

Table 2: table