ANATOLIAN ROVER CHALLENGE

2023

Design Report

TEAM INFO

ANATOLIAN ROVER CHALLENGE

- **Team Name:** IZTECH CENGAVER ROVER
- **Contact:** Senermehmet01@gmail.com & https://www.instagram.com/cengaver_rover/

TEAM INFO

ANATOLIAN ROVER CHALLENGE

Academic Institution:

Izmir Institute of Technology (İzmir Yüksek Teknoloji Enstitüsü)

- Gülbahçe, İzmir Yüksek Teknoloji Enstitüsü, 35430 Urla/İzmir

Academic Consultant:

Prof. Dr. Gökhan Kiper
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Tel: +90 232 750 6777

TEAM INFO

ANATOLIAN ROVER CHALLENGE

History of the Team:

- A paragraph of teams history including foundation date, attended competitions and experience.

In April 2022, Cengaver Rover was established within the framework of IZTECH IEEE. All members of the team are students who are students in different disciplines. Before CENGAVER ROVER, there was an attempt at a Rover student project, but there was no physical output for this project. Therefore, the team has no prior experience with a challenge. Still, it hopes to be the first team to make the rover project a reality and establish a cultural activity on the IZTECH campus.

TEAM INFO

ANATOLIAN ROVER CHALLENGE

- **Active Members List:**

Name66	Duty	Major
Mehmet Şener	Team Leader	Energy Systems Engineering
Yusuf Ahmet Çevik	Design Team Leader	Mechanical Engineering
Halil Kızılağaç	Design Team	Mechanical Engineering
Ahmet Can Turan	Coding Team Leader	Mechanical Engineering
Ufuk Serdar Çaybaşı	Coding Team	Mechanical Engineering
İsmail Kuru	Coding Team	Chemical Engineering
Selim İşcan	Electronics Team Leader	Electric and Communication Systems Engineering
Uğur Günalp Soydan	Science Team	Electric and Communication Systems Engineering

TEAM INFO

Team Photo

- A photo/screenshot of the whole or part of the team.

MANAGEMENT

ANATOLIAN ROVER CHALLENGE

Work Calendar:

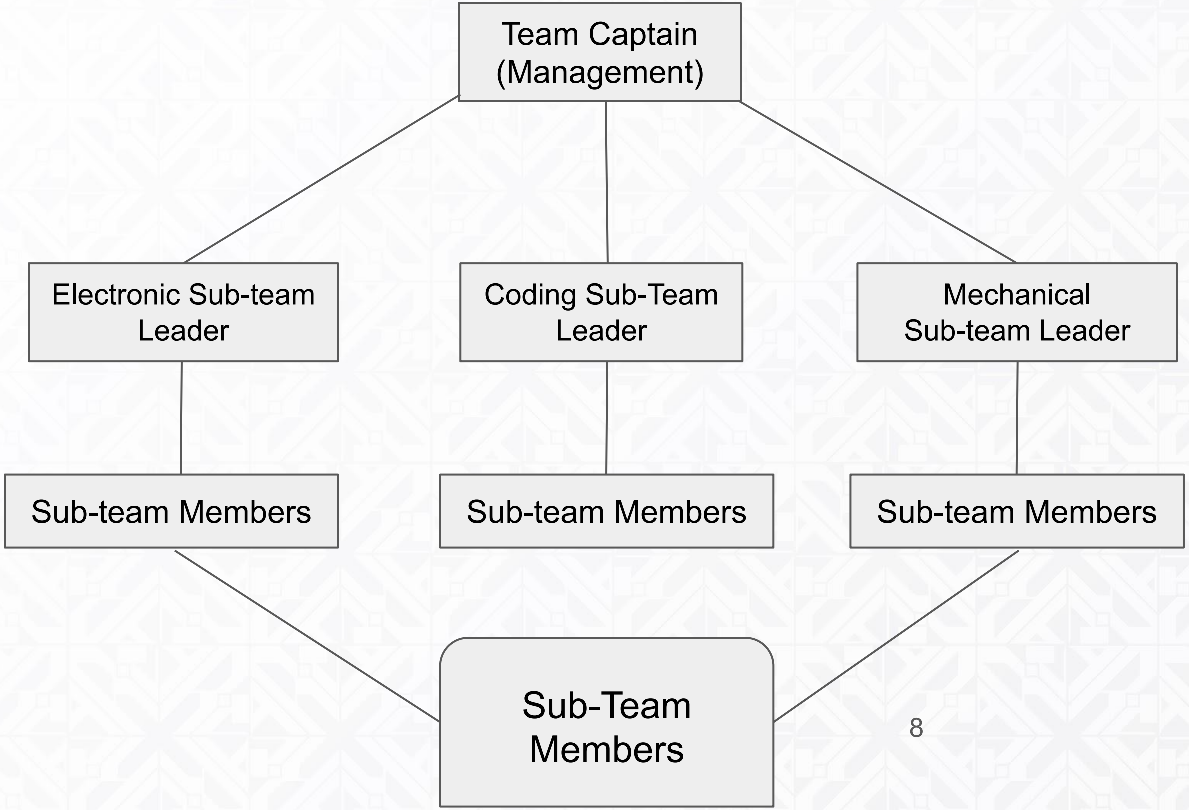
- Explain the work on the project by a Gantt chart. Include 10-15 items in the Gantt chart.

01	January 1 - February 10	• Process of prototyping and testing for all sub-teams.
02	February 10 - March 24	• Programming team working on testing and developing prototypes for Arduino and Raspberry Pi systems. • SolidWorks is used by the mechanical team to design all Rover parts. • For chassis connectors, 3D-printed materials are used. • Selected profile for chassis. • Selecting fabricated electronic systems and testing.
03	March 24 - March 30	• Differential Balancer and similar mobility system parts assembled by Mechanic sub-team. • Programming sub-team encoded mobility and control system of Rover. • Pins located on motherboard. • The connection between mobility and the control system was made by the electronic team.
04	March 30 - April 30	• Detailed design and production for manipulation system. • Sub-teams for Electronics and Programming worked on the communication system (Access point). • Set up the connection between the camera and the motherboard.
05	April 15 - May 3	• Design Report • Science Report • Financial Report • Video Presentation

MANAGEMENT

Team Formation:

- How is the team workforce structured? (2-3 sentences) Include a graphic to explain the structure as well.



MANAGEMENT

ANATOLIAN ROVER CHALLENGE

Workplace:

- How the team design, build and test the rover physically? Explain the workplace. (2-4 sentences) Include a photo/screenshot of the workplace.

The design of Cengaver was influenced by numerous concepts. During the construction of the rover, we used IZTECH IEEE workshop materials and, thanks to our university, lab materials. We are putting the rover through rigorous testing in the Mechanical Engineering Building of IZTECH.

MANAGEMENT

ANATOLIAN ROVER CHALLENGE

Funding :

- Present the funds of the project at the time of submission of this document? (In dollar currency)
- How much spending is expected for the development costs? How much spending is expected for the travel costs?
- What is the team's plan in an insufficient funding situation by the competition date?

Funders of Project:7
IZTECH IEEE Workshop Materials
IZTECH Mechanical Engineering Department
Teknopark Izmir (520 dollars)
Özgörkey Automotive-Canser Saydam (65 dollars)

Expected Development Cost: The team has almost purchased all of the necessary supplies for the rover. It's possible that electronic devices need additional differences. Therefore, development will require no more than 200 dollars. Students will make use of university-affiliated travel services. There will be no cost to the team.

The team captain will seek sponsorship as the initial course of action for such a circumstance. In the absence of a sponsor, team members will split the costs.

MANAGEMENT

ANATOLIAN ROVER CHALLENGE

Logistics:

- What is the team's plan to package and bring the rover to competition site by July? (4-6 sentences)

We will be using a service with a capacity of 20-25 people thanks to the IZTECH management team. There are a total of eight members on our team, including the captain and other leaders. Because of this, the team will have enough space to bring CENGAVER along. We're protecting CENGAVER from the elements by enclosing it in a massive speaker case.

ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Mobility System:

- What is used? Describe the system (3-5 sentences)
- Why the system is chosen? What are the considerations? What are weaknesses and strengths? (3-5 sentences)

The majority of our rover's body is composed mainly of aluminum profiles. Sigma profiles are used on the chassis, while box profiles are used on the legs.
6-millimeter bearings are utilized in all rotatable components.
PLA is used to connect the legs, motors, sigma profiles, and the vast majority of the joint parts. Flexible filament (TPU) is used in wheels to improve traction.
All of these materials in rover were subjected to impact, strain, and tensile tests at the Iztech Integrated Research Center following Ansys analysis.

CENGAVER's differential balancer handling system is a key component to its mobility. This system ensures that the CENGAVER's wheels remain on the ground in all landing conditions.

The side forces and overall size of the chassis are the CENGAVER's two primary weaknesses.

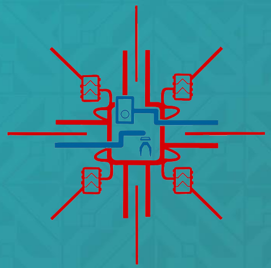
Due to the single-joint connection between the legs, our rover is susceptible to side forces. Compared to our robotic arm and legs, however, the size of our chassis remains small.

ROVER DESIGN

Mobility System:

- Unique points and inspirations (3-5 sentences)

CENGAVER has multiple distinctive points. The differential balancer is one of these. As a group, we evaluated numerous rover designs, but the NASA Perseverance Rover had the greatest impact on us. We have used Perseverance as an example while developing CENGAVER. We referred to field trip vehicles for tires.



ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Mobility System:

- Visuals of the system (2 photos/screenshots)

ROVER DESIGN

Mobility System:

- Technical Specifications including mass and size (3-5 sentences)
- Discuss the system's adequacy for its role in competition missions. (3-5 sentences)

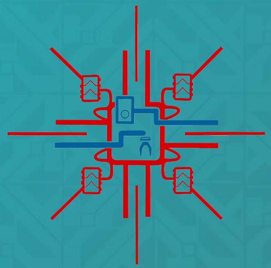
Our rover is economical and weighs approximately 10 kilograms without its robotic arm. Because it is lightweight, our DC motors can produce more torque. The size of the Rover is 95 cm x 60 cm. Height is 70 cm without a robotic arm.

Mobility of CENGAVER is designed by examining latest competitions in the world. Our rover is capable of climbing slopes of up to 50 degrees. The rover is able to easily overcome obstacles in the field thanks to the TPU-printed elastic tires and differential balancer that it is equipped with. The rover can be easily operated during night missions due to our 50 W and 10 W lights.

ROVER DESIGN

Electronics and power system:

- What is used? Describe the system (3-5 sentences)
- Why the system is chosen? What are the considerations? What are weaknesses and strengths? (3-5 sentences)



One lithium polymer battery with a capacity of 3050 mah was used for the entire system, along with ten of 450 mah. Each component's ideal voltage was regulated by power distribution board. The robotic arm and the rover both had lights installed during night missions. The rover was equipped with one warning light with different colors.

Two separate LED driver circuits were used. These are made so as to avoid high current. Some peripheral systems may not be protected against high currents due to a possible short circuit, but critical systems always are. As a safety measure, the rover's emergency stop button was located at the top of our rover.

ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Electronics and power system:

- Unique points and inspirations (3-5 sentences)

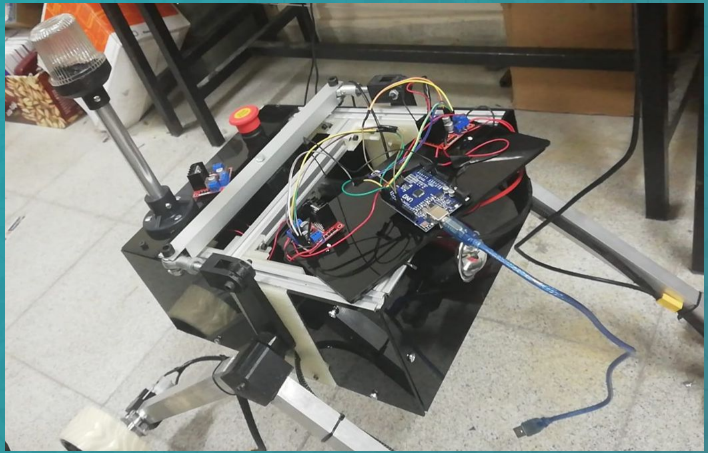
While designing the electronic system, we aimed to use the electronic systems of a land vehicle and space shuttle in a hybrid way. We evaluated the possibilities that may occur when the land conditions on Earth are blended with the space conditions. The system was designed by foreseeing the possible problems.

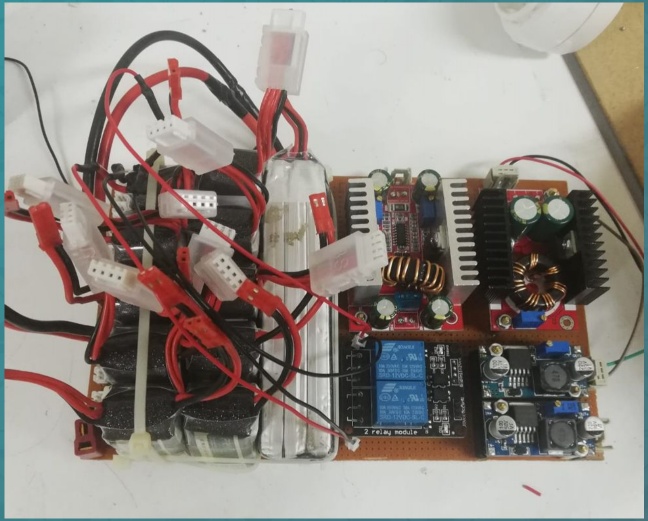
ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Electronics and power system:

- Visuals of the system (2 photos/screenshots)

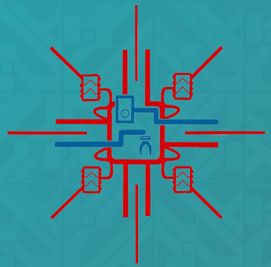




ROVER DESIGN

Electronics and power system:

- Technical Specifications including mass and battery duration (3-5 sentences)
- Discuss the system's adequacy for its role in competition missions. (3-5 sentences)



The entire electronic system weighs approximately 1,2 kilograms. With the motors, the overall weight is approximately 5,3 kilograms. The maximum amp draw of the system is 7.2 amps. Under normal conditions, 4.3 amps are drawn by the system. DC motors frequently draw 2.6 amps, with a maximum of 5.1 amps, whereas the Basic lighting led draws 1 amp of constant current. The total power consumption is approximately 47.73 Watts. The maximum power output is approximately 79.92 Watts.

The Cengaver rover is designed specifically for environments without light. The camera's angle of view and lighting were meticulously executed. Due to the versatility of its lighting options, it is capable of completing any task.
As a result of the calculations and tests carried out, the working time of the rover is on average 60 minutes, continuously running without charging. This time can reach about 90 minutes with economical use.

ROVER DESIGN

Manipulation system:

- What is used? Describe the system (3-5 sentences)
- Why the system is chosen? What are the considerations? What are weaknesses and strengths? (3-5 sentences)

In 5 axis manipulation system; 3 Step motors, 1 servo controller motor, 1 linear dc motor, and 2 DC motors have been used. 2 Step motor provides us to manipulate our robotic arm up and down. Another step is to control the rotation of the robotic arm with a pulley system. A linear motor controls the 2nd arm of the system up and down. The Servo Controller Motor rotates the gripper with 360 degrees of freedom. 2 DC motor is placed with fine calculations to the gripper base used to open and close the gripper with a spline and parallelogram system.
We will try to improve our manipulation system with a new sixth axis by the competition date.

This system was selected because it employs a variety of mechanical systems, such as parallelograms, splines, pulley systems, etc which make our work more practical. In robotic arms carbon fiber pipes is used in terms of decreasing mass and increasing resistance over the expected forces. Stepper motors are this manipulation system's weak point. Stepper motors can perform based on our calculations, but it works with difficulty. As a design team, we plan to replace the steppers and develop the entire robotic arm by July.

ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Manipulation system:

- Unique points and inspirations (3-5 sentences)

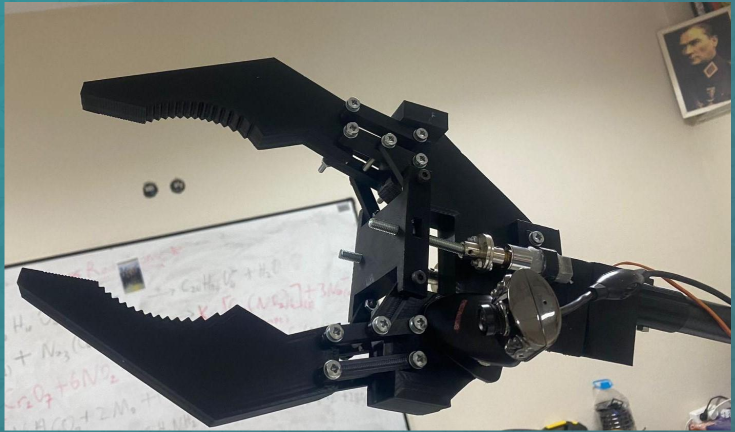
Our inspiration is derived from construction machinery, specifically linear motors. Our manipulation system operates like a construction machine. In our gripper, we inspired pliers. Because it resembles a claw and a gripper. Our gripper is unique due to its spline system. To aid in the operation of our spline system, we created a parallelogram mechanism.

ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Manipulation system:

- Visuals of the system (2 photos/screenshots)



ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Manipulation system:

- Technical Specifications including mass, max payload and size (3-5 sentences)
- Discuss the system's adequacy for its role in competition missions. (3-5 sentences)

Our manipulation system weighs roughly 4.5 kilograms. The dimensions are 80cm wide by 75 cm in height. According to inverse kinematic equations, our Manipulation system is capable of transporting up to 3 kilograms. However, our linear motor has a maximum resistance of 1000N.

The manipulation system is capable of performing well in competitions. To rotate potentiometers etc, we rotate our gripper 360 degrees by using a servo controller motor. For science missions, we designed the gripper as a claw that can be removed and the scoop can be placed for sample collection. With a linear motor manipulation system, different types of pins can be switched.

ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Science Payload:

- What is used? Describe the system (3-5 sentences)
- Why the system is chosen? What are the considerations? What are weaknesses and strengths? (3-5 sentences)

We used a test kit which is capable of measuring the pH and N,P,K and Cl elements in the soil.We used it by taking samples from the soil gathered by the Rover. And we put the sample into four different little tube and we poured some water and a special reagent into it for pH measurement but we poured the water to the tubes that the soil sample waited in it for a while for element measurements.And after a while,we compare the colour of the liquid in the box and colours on the scale which each one of colours represents a sufficiency level.Also we measured the humidity level of the soil and the temperature of the environment with digital devices.

This system is chosen because it’s easy to use and it’s also cost-efficient.We consider to measure the pH of the soil and the sufficiency level of Nitrogen,Potassium and Phosphorus elements to determine whether we can grow plants on Mars soil **in terms of these elements only.**Because we can’t measure all of the elements that soil must contain in order to grow plants.This is our limitation.But we can measure at least pH and these elements and we can determine whether we can grow plant **at least according to these elements,pH and humidity.**And this datas are also important for growing plants and which plant can we grow.

ROVER DESIGN

Science Payload:

- Unique points and inspirations (3-5 sentences)

The unique point can be the kit that we are using to measure the pH and the minerals because it seems that this method is not very commonly using as we know and it’s an easy method compared to x-ray element detection methods.We inspired from the studies and curiosity about whether we can grow plant on mars.Also we inspired from the attempts to determine the which elements exists on the Mars’ soil by the rovers that was sent to the red planet.

ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Science Payload:

- Visuals of the system (2 photo/screenshots)

ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Science Payload:

- Technical Specifications including mass and battery duration (3-5 sentences)
- Discuss the system's adequacy for its role in competition missions. (3-5 sentences)

The reactions requires a few tens of milliliters of water (or soil-water solution) for each one of the tests.And the masses of each reagent is about 20-30 milligrams.As a result of the calculations and tests carried out, the working time of the rover is on average 60 minutes, continuously running without charging. This time can reach about 90 minutes with economical use.

The system is adequate for this competition because it is very capable to meet the measurements required to verify a hypothesis which is a very adequate hypothesis for this competition.And this hypothesis is being tested by rovers sent by NASA to the Mars.And this test is quick enough to do the tests and get results in the competition.

ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Ground station equipment and communication system:

- What is used? Describe the system. (3-5 sentences)
- Why the system is chosen? What are the considerations? What are weaknesses and strengths? (3-5 sentences)

Rover is computer-controlled. Communication of the rover is provided with an access point connected to the computer. Based on the base, Ubnt rocket m2 access point was utilized. In the rover part, the raspberry pi 2's built-in wifi system was utilized. Generally, communication occurs through these two devices.

A high-quality access point was used to prevent any mission area location from causing connection issues. A primary criterion for selecting an access point is the presence of an encrypted interface and support for high band speeds. WiFi encryption is of high quality. Therefore, it is extremely challenging for foreign software to access the system. With omnidirectional antennas, wifi signals can be transmitted in all directions. If a substantial obstruction exists between the rover and the antenna, the connection may break.

ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Ground station equipment and communication system:

Since the computer is utilized in the control, keyboard shortcuts have been added. Because of these shortcuts, we can perform simple tasks with almost no effort. Each key on the keyboard can be programmed with an unlimited number of combinations. We developed this feature with computer games as our inspiration. On the rover, we intended to perform all functions that are realizable in the virtual environment.

- Unique points and inspirations (3-5 sentences)

ROVER DESIGN

Ground station equipment and communication system:

- Visuals of the system (2 photos/screenshots)

ROVER DESIGN

ANATOLIAN ROVER CHALLENGE

Ground station equipment and communication system:

- Technical Specifications including resilience to noise and communication range (3-5 sentences)
- Discuss the system's adequacy for its role in competition missions. (3-5 sentences)

The band speed has been made more specific, by reducing the data transfer rate. Generally, 2.4 GHz wifi connectivity is provided. The orientation of antennas is determined by simulating field conditions.

The focus was on a system that could perform its duty regardless of the conditions presented by the competition. Different terrain conditions were tested successfully with success. Possible differences in altitude were examined.