ALEV Robotics

KF-1500S

ALEV HIGH SCHOOL
ISTANBUL, TURKEY
MATE ROV 2016

Members	Grade
Eren Aşkın (CEO)	11
Can Yelten (Programmer-Pilot)	11
Tuna Barış Ünal (Menager)	11
Cengizcan Nakıboğlu (Pilot)	11
Erdal Yılmaz (Menager)	10

Supervisor- Yeşim Keskinöz
Mentor-Aziz Özdemir Keskinöz

KARPOWERSHIP

Introduction

A. Abstract

This technical documentation describes the development process and design details of KF-1500S ROV which is built by 5 high school students who did know very little about building a robot when they started.

ALEV Robotics newest vehicle KF-1500S is designed to operate in deep sea levels.
KF1500S comes fully equipped to demonstrate:

1. To carry random things in the sea.
2. To measure the temperature of sea.
3. To measure the depth of the sea.
4. To get view under water using HD cameras.

Alev Robotics a company that includes 7 members has the capability to manufacture remotely operated vehicles (ROV) like KF1500S, custom designed to meet mission requirements. Our designs are completely produced in Computer Numeric Control (CNC) machine and 3d Printers. As control circuit board we used Arduino.

KF1500S is a result of months of planning, manufacturing, and testing in pools and in the sea. All items which were produced had many upgrades to complete all of the missions in the simplest and quickest way.

The most important thing which the company possesses is the team spirit. The team worked day and night to produce such a product while taking into consideration suitable safety protocols to assure crew safety. This documentation will explain the manufacturing of KF-1500S in details.

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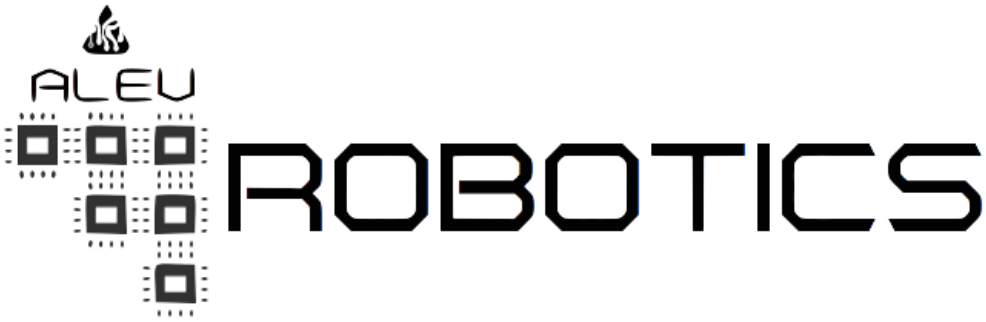


Design Rationale

A. Physical Design Process

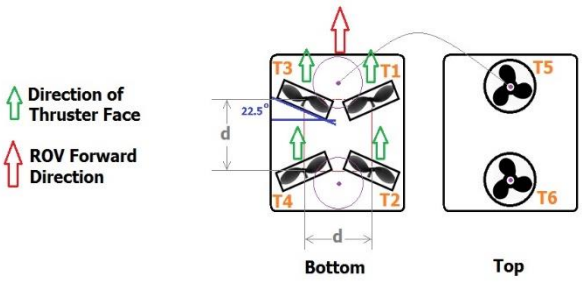
To streamline the design process, Alev Robotics used a multi-step approach to allow the team to envision the end result early in the design process, reducing the number of mistakes and revisions. The process began with a brainstorming session. We found multiple ideas for the materials we wanted to use. There were some factors which we had to consider such as amount cost and size of the ROV and the weight. We started to search at the internet for a light and low cost material which we could use for the frame of the ROV. We also looked for ROV designs which were done by other students before us.

B. Frames

After our research we decided to use plastic tubes for the frame. We made 3 different frames during our project first we created a frame which was in the size of 30x48x20. Our first plan was to locate the robotic arm on the 30cm edge. But then we realized that we needed the ROV to be as short as possible to gain extra points. Therefor we created a new frame which was 48x38x22. This frame was designed to fit our 6 Thrusters in it and to mount our robotic arm on the on the 48 cm edge. At the end we still were not happy with the result. We wanted to have a better look for the frame. We decided to use PFTE. Our first step was to design the frame on AutoCAD. We draw the side parts. After that we communicated with a company to cut our frame out of a PFTE board. We used a CNC machine to cut it out. Our frame has the size of 48x31x40. We used the same system by locating the motors and arm.

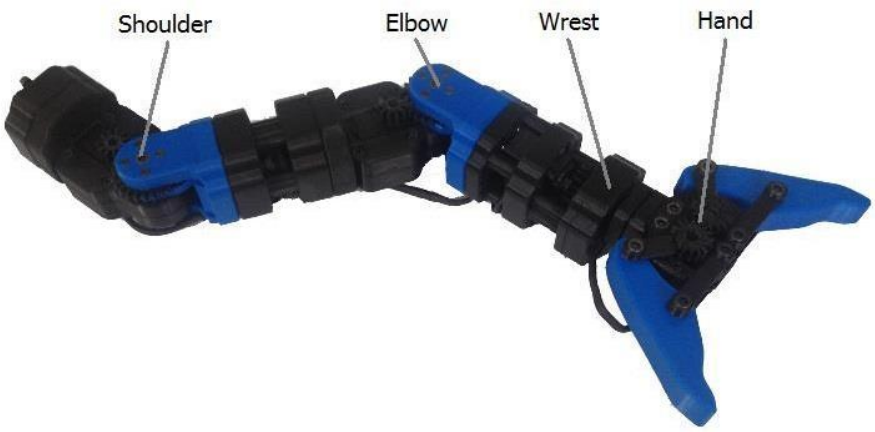
C. Thrusters

We used 6 thrusters to let our ROV move forward, move backward, rotate left, rotate right, shift left, shift right. We researched at the internet for the best available brands of thrusters in Turkey. We decided to buy 6 thrusters from the brand EngTechs ETR100. These thrusters had high performance and needed low energy to run at full speed. We mounted them to the frame similar to SAAB ROV settings at an ideal angle of 22.5 for major performance I the forward-backward motion and reasonable shifting motion. Each of our thrusters need 12 volts and 7 amperes of energy to run at full speed.



D. Robotic Arm

The robotic arm was the most exciting part of the robot for us. We choose the arm very carefully after looking into many alternatives. We used the JZ100 robotic arm of the brand EngTechs. Its low energy need and functional design where the key futures to our decision. We removed the elbow part to reduce its size. The arm includes 3 servos for the movement. We control the arm with PlayStation controller and used an Arduino board.



E. Camera and Monitor

One of the most challenging parts was to find a camera which was waterproof. After searching the internet we found some waterproof made cameras but they were too expensive for us. Therefore we started to look for an alternative way. We bought two 1.3 megapixels security cameras for our ROV and put it inside dry room made of PCV. We place them on the front of the robot and on the back of the robot. We used a simple video switcher to change our view point. We also connected a converter to connect the cameras to our monitor. We used a Samsung monitor.

F. Electronics Housings

We tried many things for the water-resist housing. Our first trial was using 48x11 PVC tube. We used epoxy to prevent water leakage inside the PCV tube. But there was a big problem; the tube was white could not see what was happening inside. We could not see if there is a leakage or not. Then we decided to make a new housing. We used a Plexiglas tube and PFTE made sides. We added an O-ring to each side to make the tube waterproof. Our housings contains 4 metal rods for maximizing tension on the O-rings for waterproofing guarantee.

G. Buoyancy

We used a lifter which is 0.08 in density to neutralize our ROV with the density of the water. Our goal was to make the robot stay at the exact place without any movements while the motors were not working. We located the lifter between two housings.

H. Controllers

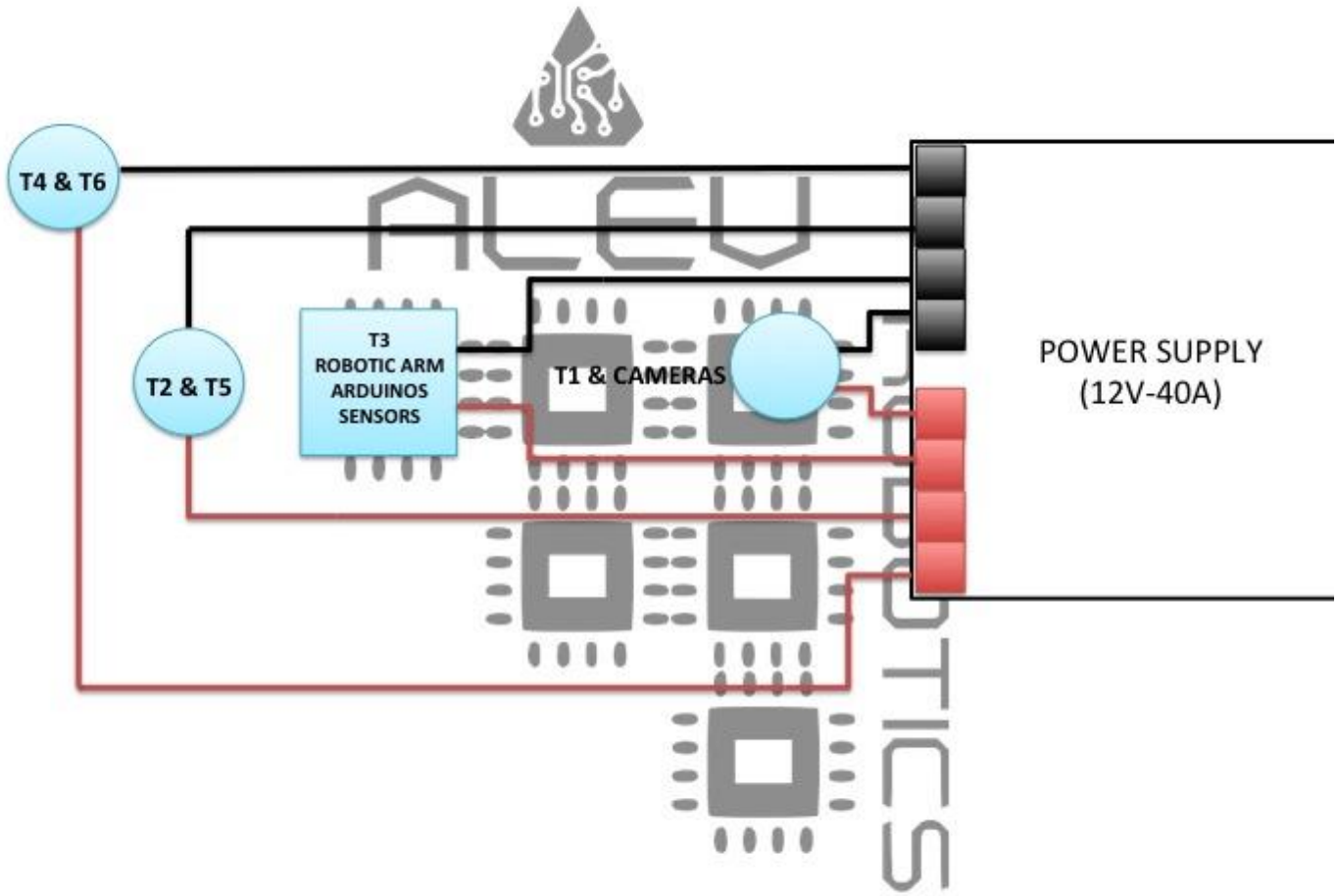
We designed our ROV to be controlled by Pilot for motion control and Co-Pilot for controlling the robotic arm and mange sensors reading. We used a PlayStation controller for the robotic arm and a Logitech brand joystick for motion control.

I. Sensors

KF-1500S requires 2 sensors for different missions. Our heat sensor is built using LM35 transducer and a small circuit. This sensor will be interfaced to ADC input of the Arduino and reading will be displayed on a LCD. Our depth sensor is based on pressure difference which is employed by a force derived resistor to measure the pressure with similar ADC interface and LCD display. The calculation of depth would be based on Bernoulli equation.

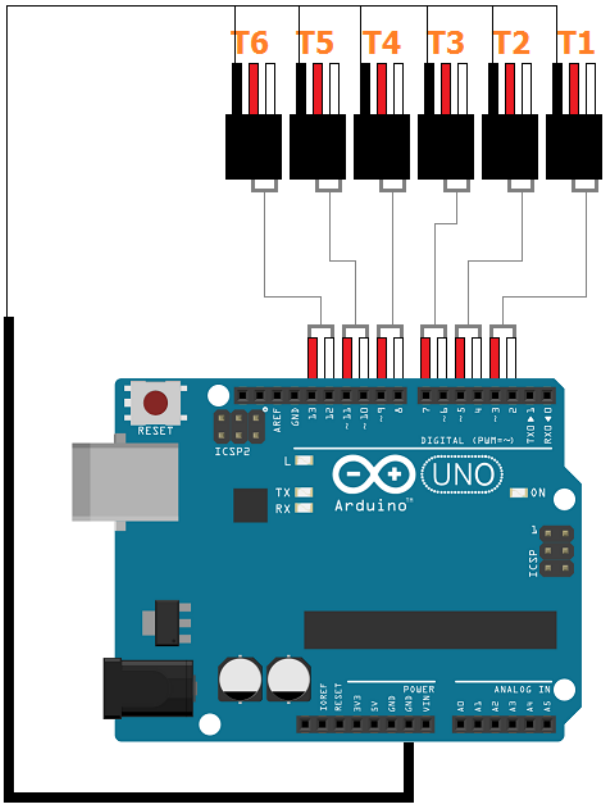
J. Electrical Systems

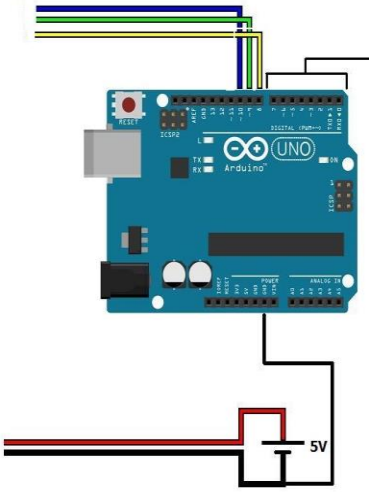
The power cables are connected into the housings. We also connected 2 Cat5 network cables for the connection of the controllers. Our power supply has 4 positive and 4 negative lines. Each one of them had 10 Amps and 12 volts of power. We connected each of our horizontal motion motors to the power lines one by one. Then we added the 2 vertical motors to the rear horizontal thruster power lines. So we had the front horizontal thrusters working with full power and the other ones working with reduced power. There were 5 more objects to connect. We connected our cameras to the place where we connected our T1 Thruster. The robotic arm, our Arduino boards and our sensors are connected into the port where the T3 thruster was connected.



K. Programing

KF-1500S is programed with Arduino software. We used 2 Arduino-Uno boards to control the robotic arm + sensors readings and the other is for ROV motion





buttons Remote Control

Hand	P6 Open	P7 Close
Wrest	P4 Rotate CW	P5 Rotate CCW
Shoulder	P0 Rotate CW	P1 Rotate CCW

Safety

A.Company Safety Philosophy

Employee Safety is Alev Robotics core value and our company's highest priority. We believe that all of our employees have to use latex gloves and gas masks while working with chemicals. Protection eye where and thick working gloves are also provided by our company.

I. Conclusion

A. Challenges

Many technical challenges were present when constructing and operating *KF-1500S*, but none as difficult as those encountered with the electronics housings. It is very important that there is no leakage. We used epoxy and fast drying hot silicone to solve this problem. We also had problem while programing the Arduino. After sleepless nights we solved all of our problems.

B. Lessons Learned and Skills Gained

Before this project we had no experience to do a project like this. We have learned everything step by step with little to none help. Our main problem was that we didn't have a real mentor who would have been with us all the time. We learned how to program Arduino, some basic physics rules and a lot more stuff.

C. Future Improvements

There are a lot of improvements that we want to do. We also want to improve the design of KF-1500S. We will add 3D printed parts to make it look better. One of our other targets is to do the electronic housing work without chemicals to have a cleaner view at the end.

D. Acknowledgments

Alev Robotics would like to thank the following benefactors:

1. **Alev Highschool-for all their help, for the class room they provided us**
2. **Naksan Co.-for their sponsorship**
3. **Köster Waterproofing Systems-for their sponsorhip**
4. **Avusturya Liseliler Eğitim Vakfı-for their help finding sponsors**
5. **Mr. İsmail Boztay-for his technical support**
6. **Dr. Ihab Elaff-for his patience, for all of his helps**
7. **Karpowership-for their main sponsorship**
8. **Mr. Ahmet Alaş-for his technical support**
9. **Emak Makina-for their help to do the frame**
10. **Bayegan-for their sponsorship**

11. **Turkish Military Forces-for their technical support**
12. **Engtechs Ltd.-for their sponsorship**
13. **BIS-for their sponsorship**

PROJECT COSTING

		Reporting period
School Name:	ALEV High School	From: 10/1/2015
Instructor/Sponsor:	Naksan co./ Köster Waterproofing Systems/Karpowership/Bayegan/Engtechs Ltd./BIS	To: 5/25/2016

Funds

Date	Type*	Category	Expense	Description	Sources/Notes	Amount	Running Balance
4/29/2016	Purchased	Hardware	PFTE	PFTE material	Used for vehicle frame	$ 245.00	$ 245.00
2/2/2016	Purchased	Electronics	Joystick	PS2 controller+Logitech Joystick	Used for control system	$ 60.00	$ 305.00
3/25/2016	Purchased	Electronics	Camera x2	underwater camera and cable	Used to see under water	$ 71.00	$ 376.00
2/13/2016	Parts Donated	Electronics	Monitor	Samsung 21,5' monitor	Used to see under water	$ 135.00	$ 511.00
2/15/2016	Purchased	Electronics	Servos Engtechs Ltd.	8x Engitechs Thrusters	Motor	$ 708.00	$ 1,219.00
4/30/2016	Purchased	Hardware	Housing	O rings and screws	O rings and screws	$ 9.00	$ 1,228.00
3/25/2016	Purchased	Electronics	Power Supply	Camera connection	Used to connect the camera to the HDMI of the monitor	$ 19.00	$ 1,247.00
3/11/2016	Purchased	Electronics	Cable	Power Cable	Power Cable	$ 18.00	$ 1,265.00
2/19/2016	Purchased	Electronics	Power Supply	Power Supply	Power Supply 12V 40A	$ 51.00	$ 1,316.00
1/7/2016	Purchased	Hardware	Tools	Tools	Hand Tools	$ 205.00	$ 1,521.00
2/15/2016	Purchased	Electronics	Robotic Arm Engtechs Ltd.	JZ100	Robotic Arm	$ 250.00	$ 1,771.00
1/7/2016	Purchased	Safety Kits	Safety Kits	Gloves-eyeware-masks	Gloves-eyeware-masks	$ 19.00	$ 1,790.00
4/15/2016	Purchased	Hardware	Epoxy	Epoxy x 4	Waterproofing	$ 26.00	$ 1,816.00
2/2/2016	Purchased	Electronics	Arduino	3xArduino board/cables	Programming	$ 23.00	$ 1,839.00
1/7/2016	Purchased	Hardware	Tool cases	Tool Cases	x2	$ 58.00	$ 1,897.00
3/11/2016	Purchased	Electronics	Cable	Cat5 Cable	90m	$ 30.00	$ 1,927.00
5/10/2016	Purchased	Electronics	Heat Sensor	Digital Termometer	Heat sensor with LCD	$ 12.00	$ 1,939.00
4/29/2016	Purchased	Hardware	Housing	Plexiglass Tubes	60cm-1mm thicknes	$ 160.00	$ 2,099.00
4/29/2016	Purchased	Hardware	Housing	Metal Sticks	3 meters	$ 7.00	$ 2,270.78
5/10/2016	Purchased	Electronics	Depth sensor	Depth sensor	To meassure the depth	$ 10.00	$ 2,280.78
5/20/2016	Purchased	Team Kits	Poster, T-shirt and documents	Poster, T-shirt and documents	KF-1500S sheet, poster, T-shirt and roll up	$ 230.00	$ 2,510.78
2/20/2016	Purchased	Hardware	Tubes for the old frames	PVC Tubes	PVC Tubes	$ 30.00	$ 2,540.78

***Items must fall into one of the following:**

Purchased - defined as items that are purchased new or services paid for.

Re-used - defined as items that were purchased in previous years. Amount MUST be listed as the current market value.

Parts donated - defined as equipment, materials, and time that were contributed to your company. Do NOT include items given to your school for general use.

Cash donated - defined as funds contributed to your company. Do NOT include funds given to your school for general use.

Total Raised	$ 2,376.00
Total Spent	$ -
Final Balance	$ 2,376.00