Portfolio

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Scientific project at Bonch-Bruevich SPbSUT
Test Stand for Prospective Mobile Power-Supply Sources

Background: While studying for my master's degree at Bonch-Bruevich University, I worked in the Scientific Educational Center "TIOS". I was invited to a mixed variety of projects, which included many aspects of engineering. I entirely managed one of those projects.

Assignment: I was assigned to build stand and design program for control statements of charging and discharging two experimental supercapacitors.

Process: Building this stand did not take much time. I finished assembling electronic parts in one week. This stand included two cross connected channels. When the first channel was charging, the second was discharging. On the contrary, the main program took three months of programming in LabVIEW. This program had many types of functionality and had a logging into Excel file.

Results: This stand was used at testing degradate parameters of supercapacitors. Testing took a 6-month period. During that time charging and discharging did not stop. This type of test helped us conclude that the basically effective life cycle of this supercapacitors is 25 years. See pictures and annotation on the next slide.

Project at Bonch-Bruevich SPbSUT
Test Stand for Prospective Mobile Power-Supply Sources

A test stand was developed using DAQ NI USB-6001. A brief description of the program implemented in NI LabVIEW is given. The part of the program code is opened - the block diagram of correction of temperature coefficients. The interface of a virtual device for monitoring charge and discharge is shown. In the course of the test, on the test bed, the degradation of the capacity of the charge was proved. The test results showed that the ionistor capacitance dropped from 50 kF to 3.3 kF for two weeks of testing and continued to decrease with each charge and discharge cycle.
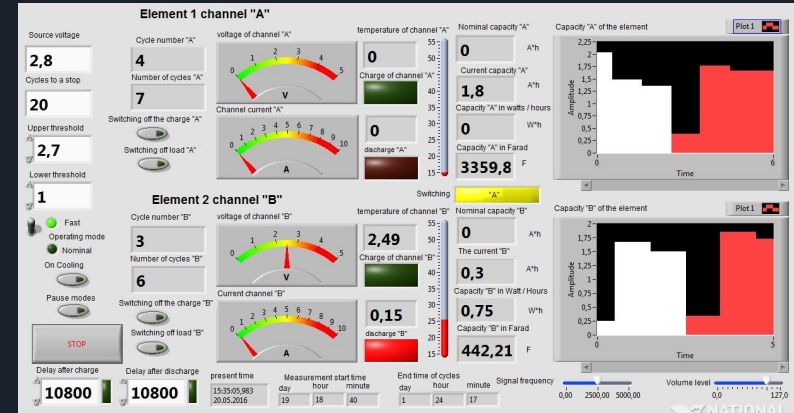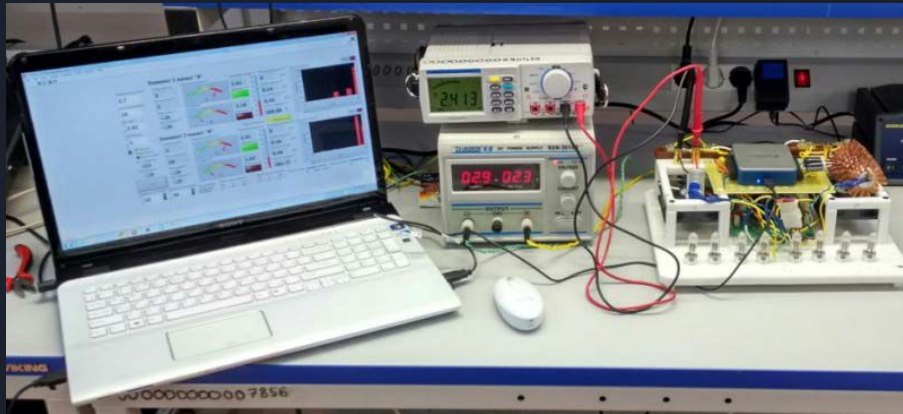
Scientific project at S.Seifullin University
Implementation of PPM Modulation and Demodulation using NI Digital Electronics FPGA Board

Background: During my bachelor's degree at S.Sefullin University, I took part in the Scientific Project. The main task was to measure a propagation in cylindrical tubes, such as drill pipes, and give pieces of advice for packet encryption. This project was an introduction to scientific world for me.

**Assignment:** I was assigned to build stand and to measure the propagation of microwave in cylindrical tubes.

Process: I took a plastic tube and wrapped the pipe with aluminium foil. Then, put inside it different soil types. In Mathematical model I took the propagation model and put inside the dielectric constant of clay, granite, sand, soil and water. The main element of data transmission was Gunn Diode. All of these measurements of stand were built on National Instruments equipment.

Results: Mathematical model and practical test gave similar characteristics in asymptotes. The results were included in my capstone project. A friend of mine Sanat built channel modulator on FPGA based on PWM. Link and abstract of the article on the next slide.

Scientific project at S.Seifullin University
Implementation of PPM Modulation and Demodulation using NI Digital Electronics FPGA Board

Main task of this project was to try to send data by Microwave from Gunn Diode. After that PPM modulated signal transmitted in round waveguide. Round waveguide separately filled by clay, granite and sand This project was conducted between 2015-2017 years.

Link: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7147331
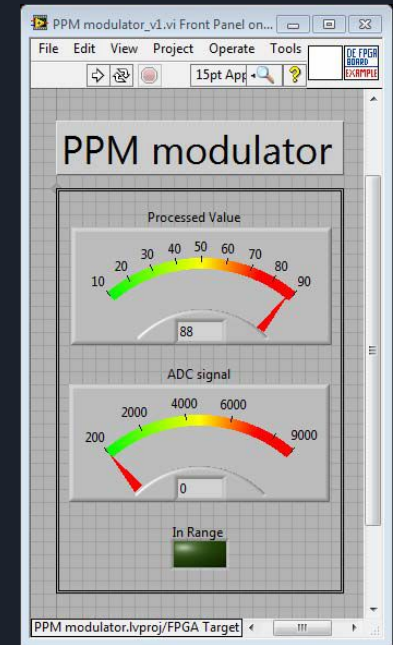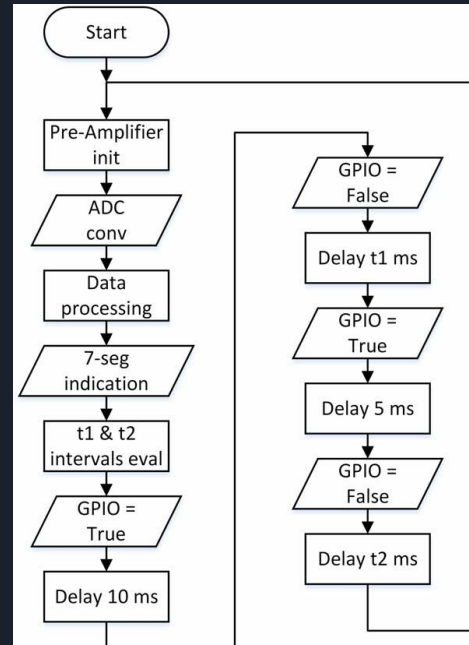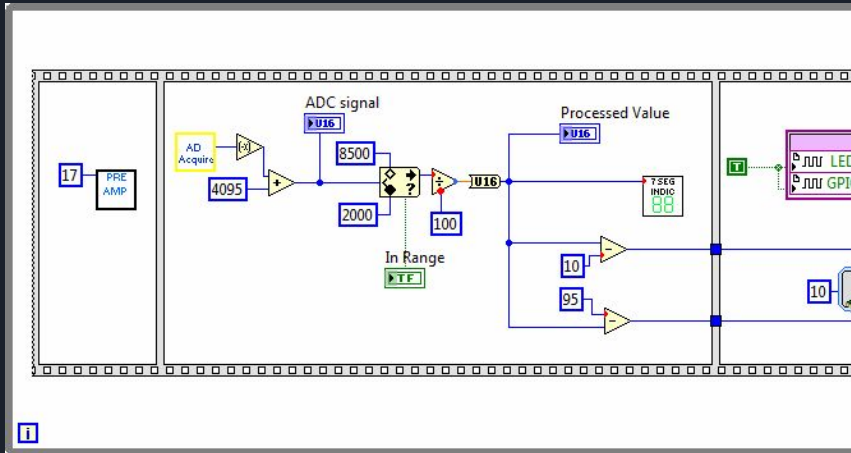
Supervisor of student team
Castelloli Smart Scooter Challenge 2019

Background: When I started working at Nazarbayev University as engineer, one of my students came to me with an idea of taking a part in international challenge in Castelloli, Spain.

Process: In the evenings for 6 months, at the FABLAB of Nazarbayev University, we built an electric scooter using all-new components available on the Internet. During this project I learnt how to weld steel and aluminium. All electronic parts were developed by students. I just gave some pieces of advice and managed the procurement of parts using NU budget. All steps of assignment were done, and we went to Spain!

Results: We took a first place in challenge. The electric scooter design was featured in the magazine of Kazakhstan and a video report was shooted about us on the main TV channel.
Video(ru):https://www.facebook.com/nuedukz/videos/2495944707107464/

Supervisor of student team
Castelloli Smart Scooter Challenge 2019

For all the parts were developed and manufactured:

★ **Ergonomic design and electronic scheme;**

★ **Fast stop control system;**

★ **Android App for remote control;**

★ **Assembled and constructed in Prototyping Center.**

Link: https://www.instagram.com/p/B0NmNHoHFJO/

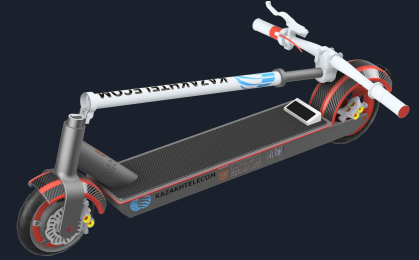Video(ru) https://www.facebook.com/nuedukz/videos/2495944707107464/

This team had 4 students.

2 Electrical Engineers

1 Software developer

1 Marketing Manager

NU Smart Scooter Team took the 1th place in the two categories of Castelloli Smart Scooter Challenge 2019 in Spain

Technical Supervisor of student team
Shell Eco-marathon Asia 2020 (in progress)

Background: Next, one of my student's projects was building an energy efficient car for Shell Eco-Marathon. Scientists all around the world were going to take part in this competition. However, Shell Eco-marathon Asia 2020 was canceled because of COVID-19. But we decided to finish building the Shell Eco-marathon car this year. The main idea of this project is to use minimum energy per kilometer while driving a car.

Process: At first, students started designing a monocoque structure. Monocoque was built from carbon fiber composites to improve the strength and to reduce weight of the car. The second one is electric drive. Control system were developed on NUCLEO-F302R8 based on STM32F302R8T6. This controller has a high precision PWM. Power drivers controls will be developed on MOSFETS.

Results: Nowadays we are on the way of constructing it. All information about the process and progress you could find by instagram link: https://www.instagram.com/team_sunqar/

Technical Supervisor of student team
Shell Eco-marathon Asia 2020 (in progress)
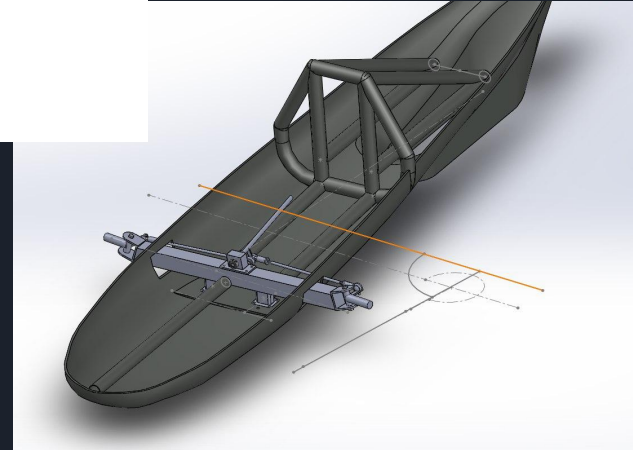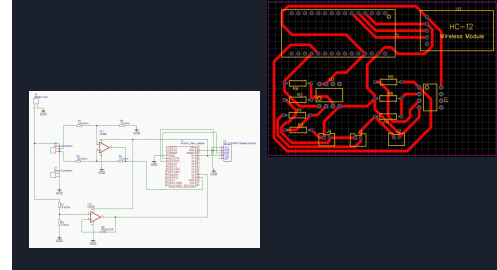
The team consisted of 10 students from Electrical Engineering School and Robotics School and 7 specialists from technical staff and administrative. Nowadays the students are on the way of preparing carbon fiber cover and motor driver.

New team near old car

New design. Vehicle has a carbon fiber body and aluminium steering rack

Link:https://www.instagram.com/team_sunqar/

Contribution to the team projects under professor supervision
## Vibration and weight-optimized material of metal-matrix cell with shape memory effect for space satellite structures.

Background: This project was ordered by Professor Christos Spitas from School of Engineering and Digital Sciences to prototyping center of Nazarbayev University. This task included several aspects of engineering, and required different engineering skills from the team. I was electrical engineer in the team and responsible for control part.

Process: At first, all professors' requirements were written down into requirements sheet and then we composed technical specification of stand. Then, parts of this project were separated between competencies of engineers. My part was based on simple electrical scheme of power control by automatic switcher and temperature sensor PT-100. Thermal regulation was based on Siemens controls.

Results: This stand could produce bimetallic, aluminum and titanium, sheets with shape memory effect. This kind of materials are used in construction of satellite structures. Two sheets of material squeezed. Then, heating elements increase temperature up to 600 Celsius degree. After 15 minutes these materials are glued together. One of the most difficult parts of the project was controlling temperature, because metals and heating elements have residual temperature effect. Design of this stand on next slide.

Contribution to the team projects under professor supervision
Vibration and weight-optimized material of metal-matrix cell with shape memory effect for space satellite structures.
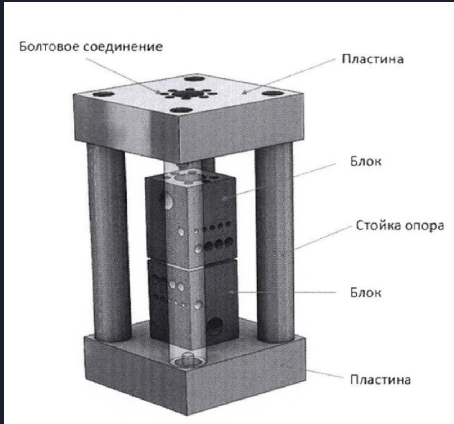
- Design documentation for further manufacturing;

- Find out materials and components
- Electronic circuits;
- Selection and testing of hydraulic systems and heating systems
- Final assembling of the all mechanical and electronic parts.
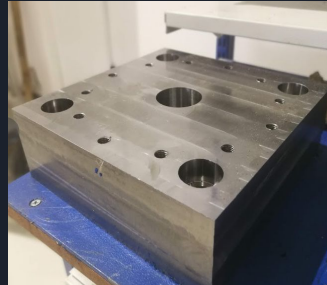
Установка в подключенном виде

Contribution to the team projects under professor supervision
Improving the fatigue calculation of offshore structures.

Background: This project was ordered by PhD student of Nazarbayev University. In this project I developed by myself all parts of stand. The goal of this stand was to measure in practice how ice could hit the oil platforms on the North Sea. The student developed a computer simulation. Then, I constructed this stand.

Process: This stand was built on simple parts, such as Arduino Mega platform, Gate actuator and strain gauge sensors. Around the steel model of platform I put the sensors and connected this to controller. Information from 16 sensors were processed in controller. Then, information by serial port got into computer with MATLAB. Script had a vizual panel and all data was collected into .csv file.

**Results:** All results of this project in next slide.

Contribution to the team projects under professor supervision
Improving the fatigue calculation of offshore structures.

Ice-resistant construction with underwater module, which consists of a mono-tower structure with an underwater module and a suction base fixed to the seabed. At this stand, it is planned to conduct long-term studies, up to 6 months, to calculate the fatigue of the structure with regular loads.

Developed:

- **Structural diagram** of the test stand for prototype;
- Installation **design documentation**;
- **Electronic circuits;**
- **Data collecting program** (C++)**;**
- Real time **visualization** in MATLAB.
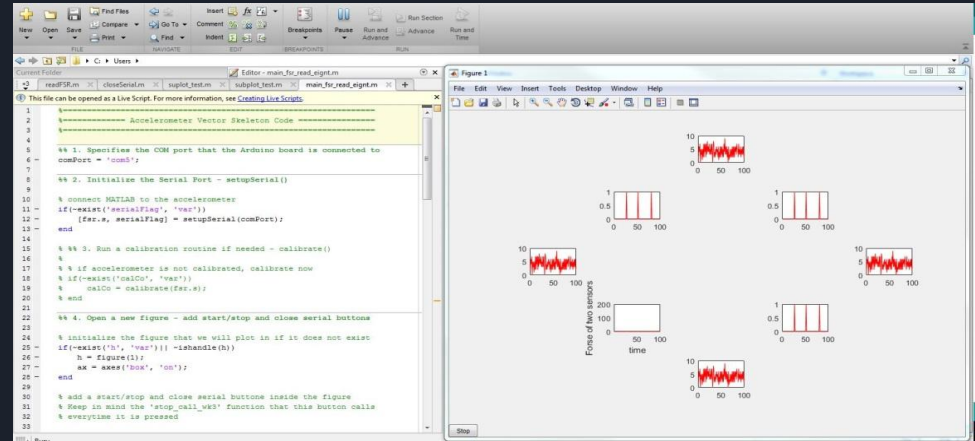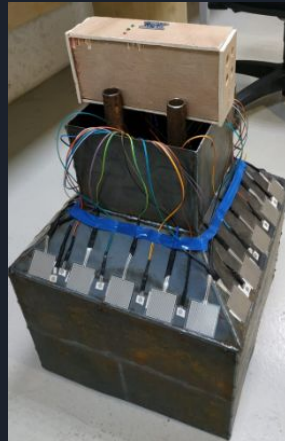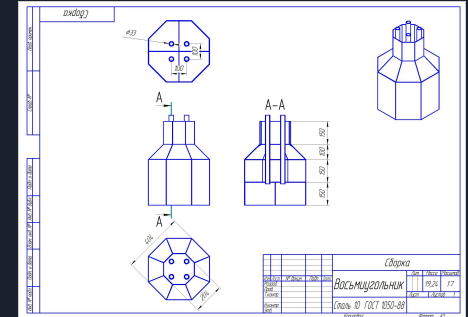
Contribution to the team projects under professor supervision
Stand for controlled convective drying of apple rings.

Background: This project was ordered by Professor Sergey Spotar of Nazarbayev University, School of Engineering and Digital Sciences. A long-term storage of apple rings has several problems. The first is the preservation of all useful properties and vitamins. The second one is an efficient use of energy and control of drying system.

Process: Professor Spotar came up to us with structural scheme of future stand. He was a consumer of this stand. We developed the main cover and cassette structure from stainless steel. After that, thermal and drying elements were constructed outside of the box.

Results: Photos of final product of this project in next slide.

Contribution to the team projects under professor supervision
Stand for controlled convective drying of apple rings.

On the exemplary draw:

- **1** – Air drying module (with integrated fan),
- **2** – Air heating module,
- **3** – Desiccator,
- **4** – Product (apple rings),
- **5** – Fan,
- **6** – Scales.
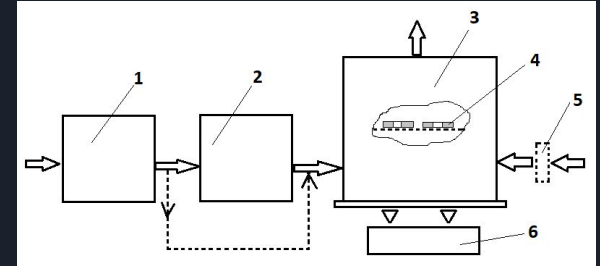
Link: https://www.instagram.com/p/BxMfEpUHnvO/

Contribution to the team projects under professor supervision
Project managed by Ministry of Agriculture of the Republic of Kazakhstan: Automatization of Cattle breeding control

Background: This project given by Ministry of Agriculture. Main goal is automatization of weight measure of Cattle in dairy farm. Growing period of cattle takes around 13-14 month. The idea of project is make it shorter by finding time when growing go slow and necessary to increase nutrition.

Process: In these project I created a main structure of system than start to collect all electrical components. When I bought all parts then I started to design main program of collecting and processing data.
Main program composed from several functions. First, receiving information about ID of cow and weight. After processing these data, program send JSON package to web server. Test control unit realized on Raspberry Pi platform. Control program for measuring and collecting data developed on Python. Database created in SQLite.

Results: In two year we build automated measuring system with web server. Next stage is process data with machine learning

Contribution to the team projects under professor supervision
Project managed by Ministry of Agriculture of the Republic of Kazakhstan: Automatization of Cattle breeding control

Link to source code: https://github.com/AidarAlimbayev/pcf_lora_project
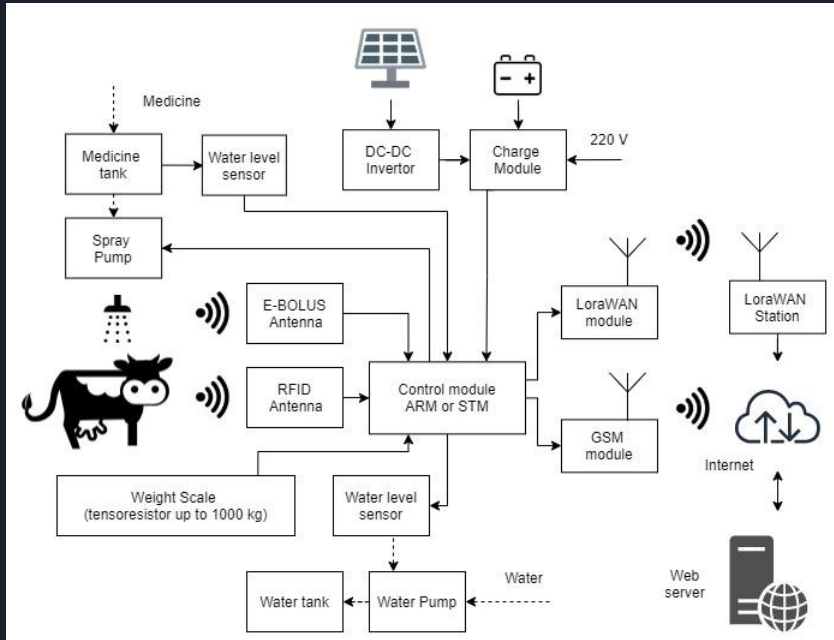
Courses and Masterclasses

- MATLAB for beginners in Nazarbayev University 2019 y. Course taught for free listeners.

- Arduino Courses for Robotics Teachers' Club 2018 y. Course included starting work with Atmega microcontrollers and basic sensors and actuators work.

- Workshop "Modelling PCB in Altium Designer"

- Workshop "Creating PCB on Laser Engraver Epilog Fusion M2"

- Workshop "Work on Shopbot CNC Milling Machine"

- Workshop "3D modelling in Autodesk Fusion 360"

Photo and video posted here: https://www.instagram.com/nuris_fablab/
and from Saint-Petersburg here:https://vk.com/albums-88722263

Taught at University

- "Digital Signal Processing" at Seifullin University (Nur-Sultan), 2017-2018 y. for sophomore students. This course included 7 laboratory works with image and video processing in MATLAB. Course was practice oriented field.

  Link: https://github.com/AidarAlimbayev/Digital_Signal_Processing

- "Computer Modelling of Radioengineering Systems" at Seifullin University, 2017-2018 y. LabVIEW introduction for first year students. This course was related to preparing dissertation work of scientific chief Mirmanov A.B.

  Link: https://github.com/AidarAlimbayev/AB_diss

Organizing electronic laboratories

On the next two slides I provide information about two electronic laboratories created by me. I spent half year from drawing first concepts then ordering and installing equipment. I also went all over Nur-Sultan to understand and document where electrical and mechanical components can be sourced by students; the ability to obtain components is essential in creating a maker culture and it was largely unknown. A ~140 m^2 facility at the temporary campus with tools such as a 3D printer, soldering stations, oscilloscopes, multimeters, electric tools and hand tools, etc. Students continued projects we had initiated and formed clubs/teams. All of budgets and procurement managing was organized by me and nowadays most of the projects on slides above were developed in these electronic laboratories.

Electronic workshop at S.Seifullin University

- anti-static furniture;
- basic equipment and electronic devices;
- oscilloscopes, generators;
- soldering station, laboratory power supplies;
- storage for radioelectronics components;

In this laboratory now we produce many projects oriented on IoT, LoraWAN technologies. In addition, this laboratory has unique equipment for SMD place components.
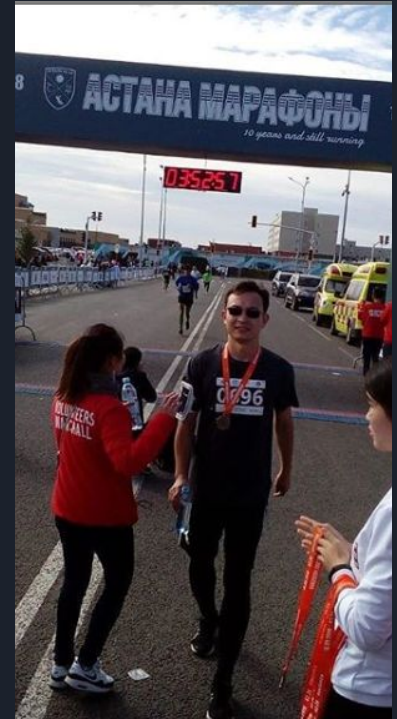
Electronic workshop at Nazarbayev University

- anti-static furniture;
- basic equipment and electronic devices;
- oscilloscopes, generators;
- soldering station, laboratory power supplies;
- storage for radioelectronics components;
- health and safety requirements respected;
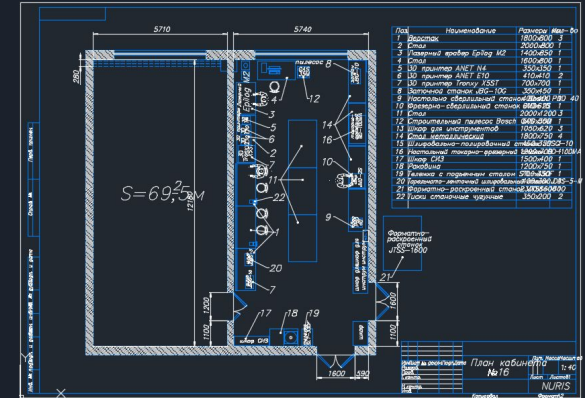
Biography

Aidar Alimbayev was born in Kzyl-tu village in North Kazakhstan and raised in Shuchisk, Akmola region. After school he studied in Almaty college of Communication at KAU. Then, after graduation he served in the military in 97617 military Air Defence base in 2010-2011. I then studied at S.Seifullin University in Radioengineering, Telecommunication and Electronics department. At university he started to take part in a scientific project. The main topic of the project was to try to use wireless communication system in round waveguide. After bachelor's degree, he enrolled master's program in Bonch-Bruevich Saint-Petersburg State University of Telecommunication on Faculty of Radio Technologies of Communication. In 2015-2017 he worked in Scientific Educational Center "TIOS". Then, Aidar arrived to Kazakhstan and started working at S.Seifullin University as a teacher assistant at alma-mater department. One year later he got a job at Nazarbayev University as a FABLAB engineer and then after their own electronic laboratory was organized, he got promoted to an Electronic engineer.

Outside of family and engineering. Aidar's loveliest hobbies are rowing and running. 42 km Marathon time is 3:53:39

Kudos for your attention!)