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Development of Eembedded System Courses with implementation  
of Innovative Virtual approaches for integration of Research,  
Education and Production in UA, GE, AM



Presentation of P04  
Zaporizhzhya National Technical University (ZNTU)  
Zaporizhzhya, Ukraine

**Work in Embedded Systems Laboratory.**  
**Best students practices.**

Anzhelika Parkhomenko  
PhD, Associate professor



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# Development of Embedded System Courses with implementation of Innovative Virtual approaches for integration of Research, Education and Production in UA, GE, AM

Moodle ZNTU Українська (uk) Ви заходите під ім'ям Kordiy Oleksandr (Вихід)

**СИСТЕМА ДИСТАНЦІЙНОГО НАВЧАННЯ MOODLE ЗНТУ**  
Vivere est cogitare

ГОЛОВНЕ МЕНЮ  
Новости сайта

НАВІГАЦІЯ  
На головну  
Моя домашня  
Сторінки сайту  
Мій профіль  
Мої курси

КЕРУВАННЯ  
Головна сторінка  
Редагувати  
Редагувати параметри  
Користувачі  
Файли  
Заявки  
Резервна копія  
Відновлення  
Банк питань

КАЛЕНДАР  
жовтня 2015

Категорії курсів

Пілотне навчання за планом міжнародного проекту TEMPUS DesIRE (1)

Moodle ZNTU Українська (uk) Ви заходите під ім'ям Kordiy Oleksandr (Вихід)

**СИСТЕМА ДИСТАНЦІЙНОГО НАВЧАННЯ MOODLE ЗНТУ**  
Vivere est cogitare

На головну Курси Пілотне навчання за планом міжнародного проекту TE...

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Мої курси  
Курси  
Пілотне навчання за планом міжнародного проекту TE...  
CAD/CAM/CAE для вбудованих систем  
Віддалені лабораторії та віртуалізація  
Вбудовані операційні системи  
Людино-машинна взаємодія  
Приклад  
Пілотне навчання за планом міжнародного проекту TE...  
Факультет комп'ютерних наук і технологій  
Факультет економіки і управління

Пілотне навчання за планом міжнародного проекту TEMPUS DesIRE

Пошук курсів:

CAD/CAM/CAE для вбудованих систем

Віддалені лабораторії та віртуалізація

Вбудовані операційні системи

Людино-машинна взаємодія

Приклад 15.10

Викладач: Varchenko Liliya

Керування курсами

Moodle ZNTU Українська (uk) Ви заходите під ім'ям Kordiy Oleksandr (Вихід)

**СИСТЕМА ДИСТАНЦІЙНОГО НАВЧАННЯ MOODLE ЗНТУ**  
Vivere est cogitare

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Людино-машинна взаємодія  
Приклад  
Пілотне навчання за планом міжнародного проекту TE...  
Факультет комп'ютерних наук і технологій  
Факультет економіки і управління  
Гуманітарний факультет  
Факультет радіоелектроніки та телекомунікацій  
Факультет інженерних наук

Керування курсами

Категорії курсів

Пілотне навчання за планом міжнародного проекту TEMPUS DesIRE / CAD/CAM/CAE для вбудованих систем

Пошук курсів:

Застосувати

CAD/CAM/CAE для вбудованих систем

Викладач: Parkhomenko Anzhelika

Викладач: Anzhelika Parkhomenko

CAD/CAM/CAE for Embedded Systems

Aim of the course: study of modern information technologies in the field of design and manufacture of Embedded Systems Hardware, as well as getting practical skills of using modern MCAD and ECAD systems.

Course language: English/Ukrainian

CAD/CAM/CAE для вбудованих систем

Мета курсу: вивчення сучасних інформаційних технологій в галузі проектування та виробництва апаратного забезпечення вбудованих систем, а також одержання практичних навичок використання сучасних MCAD та ECAD систем.

Мова курсу: українська/англійська

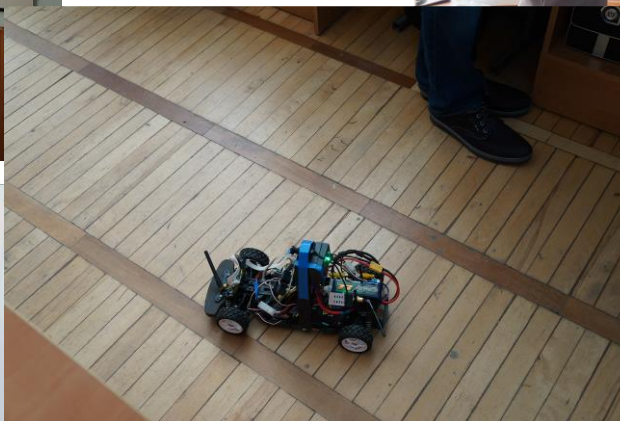
<http://moodle.zntu.edu.ua/>



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# FPV auto project



Zaporizhzhya,  
October 15, 2015





## Moving objects control systems

Basic software requirement:

- minimum response time for input parameters;

Basic hardware requirements:

- compactness;
- energy consumption minimization.




Basic system requirements

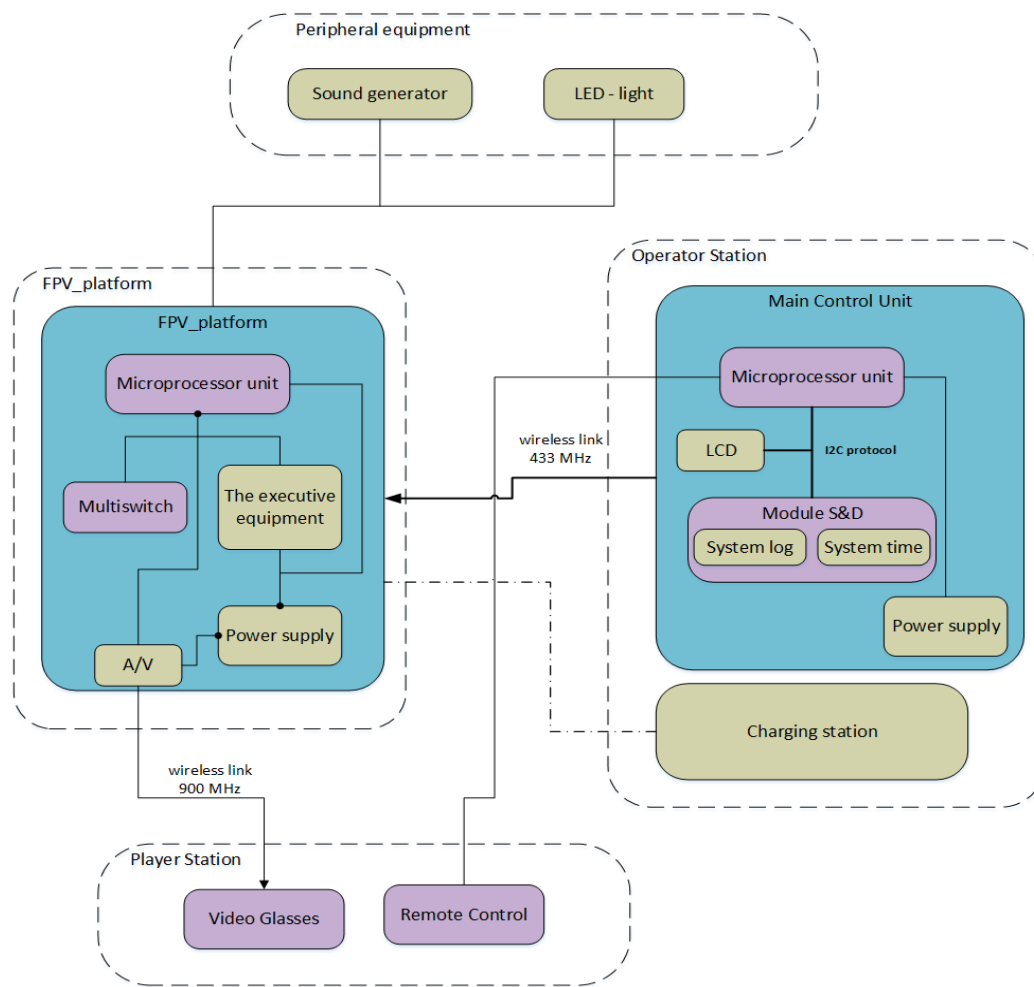
- expected behavior of the system;
- reliability;
- durability.





## System architecture

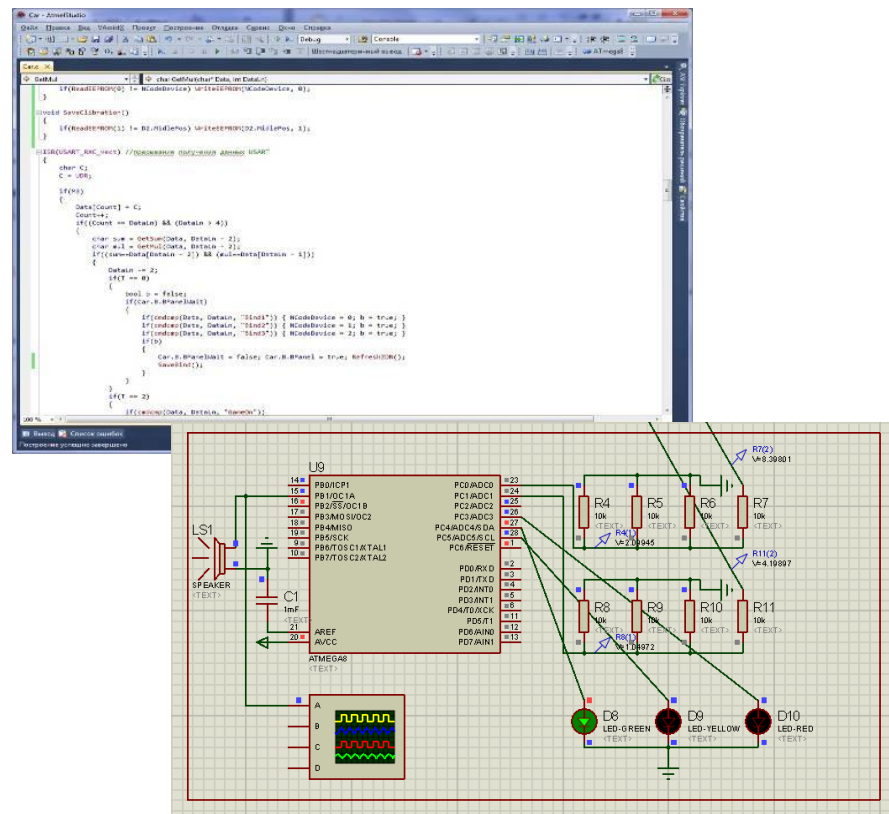
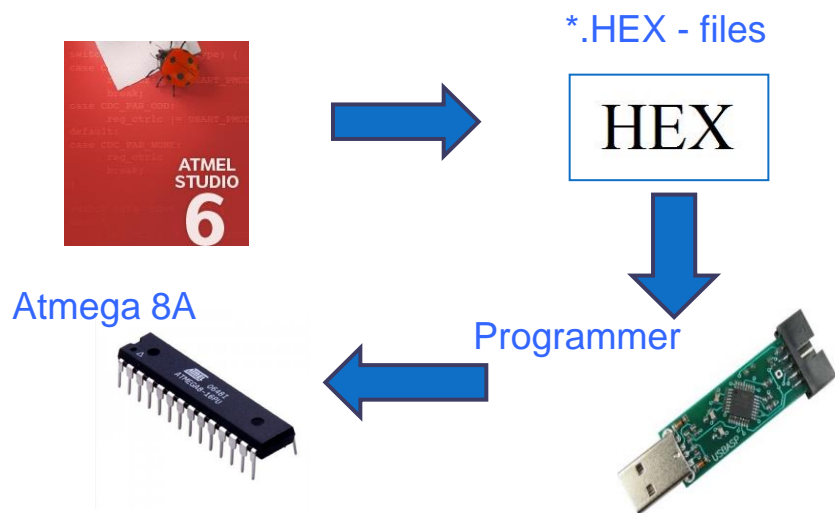
-  Programmable components
-  Completed solutions
-  Constructive components





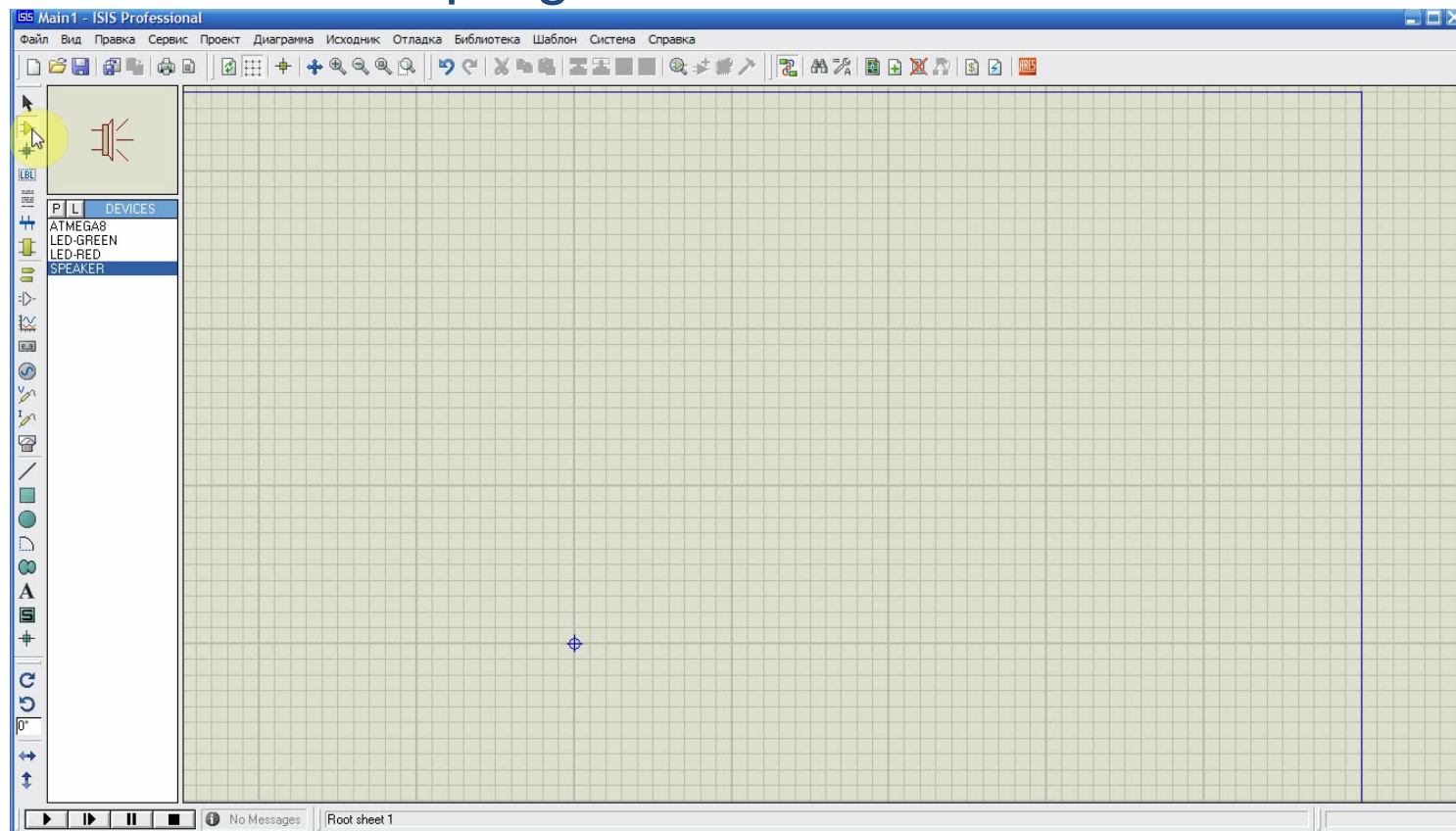


## Development of programs for the microcontroller





## Simulation of programs for the microcontroller

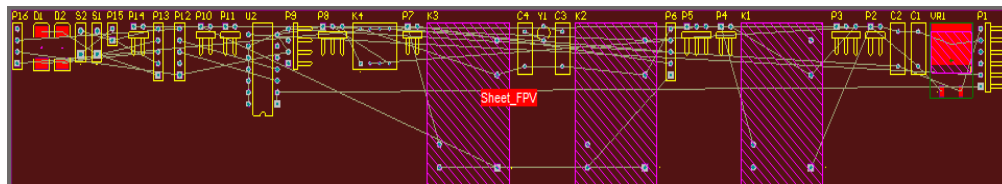
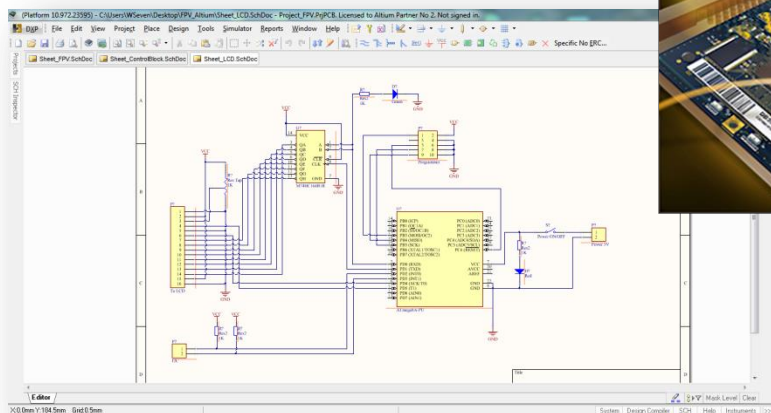
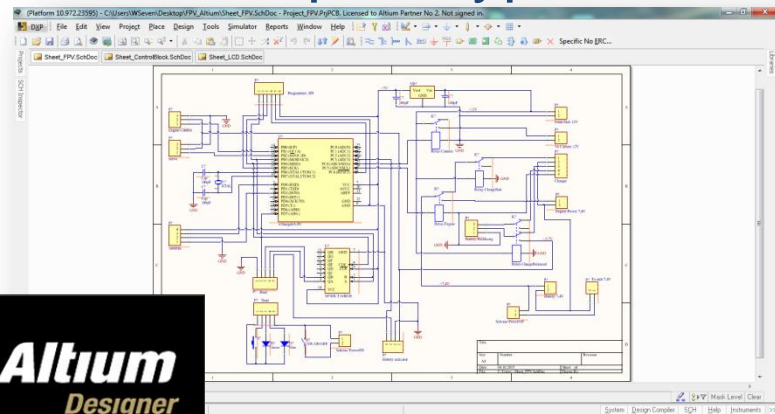
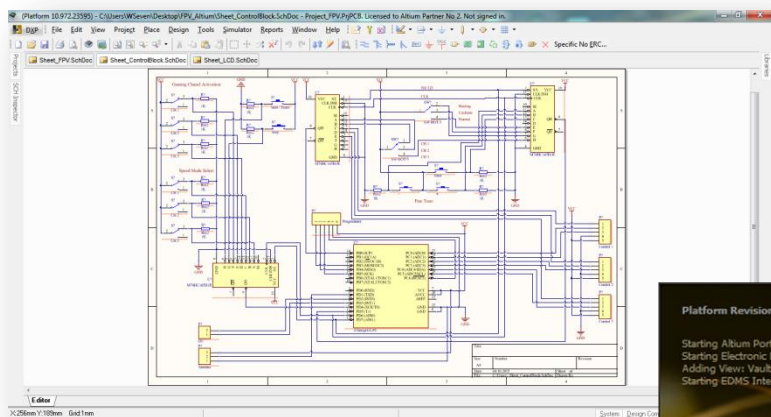




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## Creation and investigation system virtual prototype



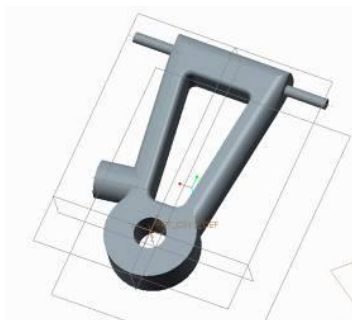
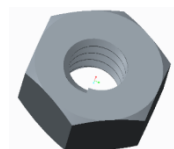
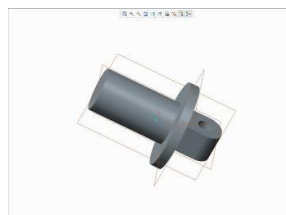




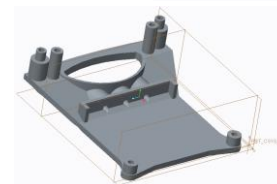
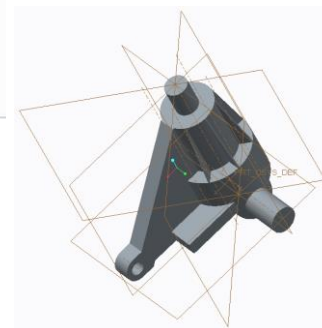
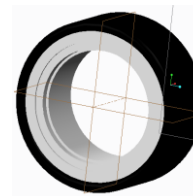
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## Creation and investigation system virtual prototype



PTC<sup>®</sup> PRODUCT & SERVICE  
ADVANTAGE<sup>®</sup>





## Modern hardware and software platforms



Arduino



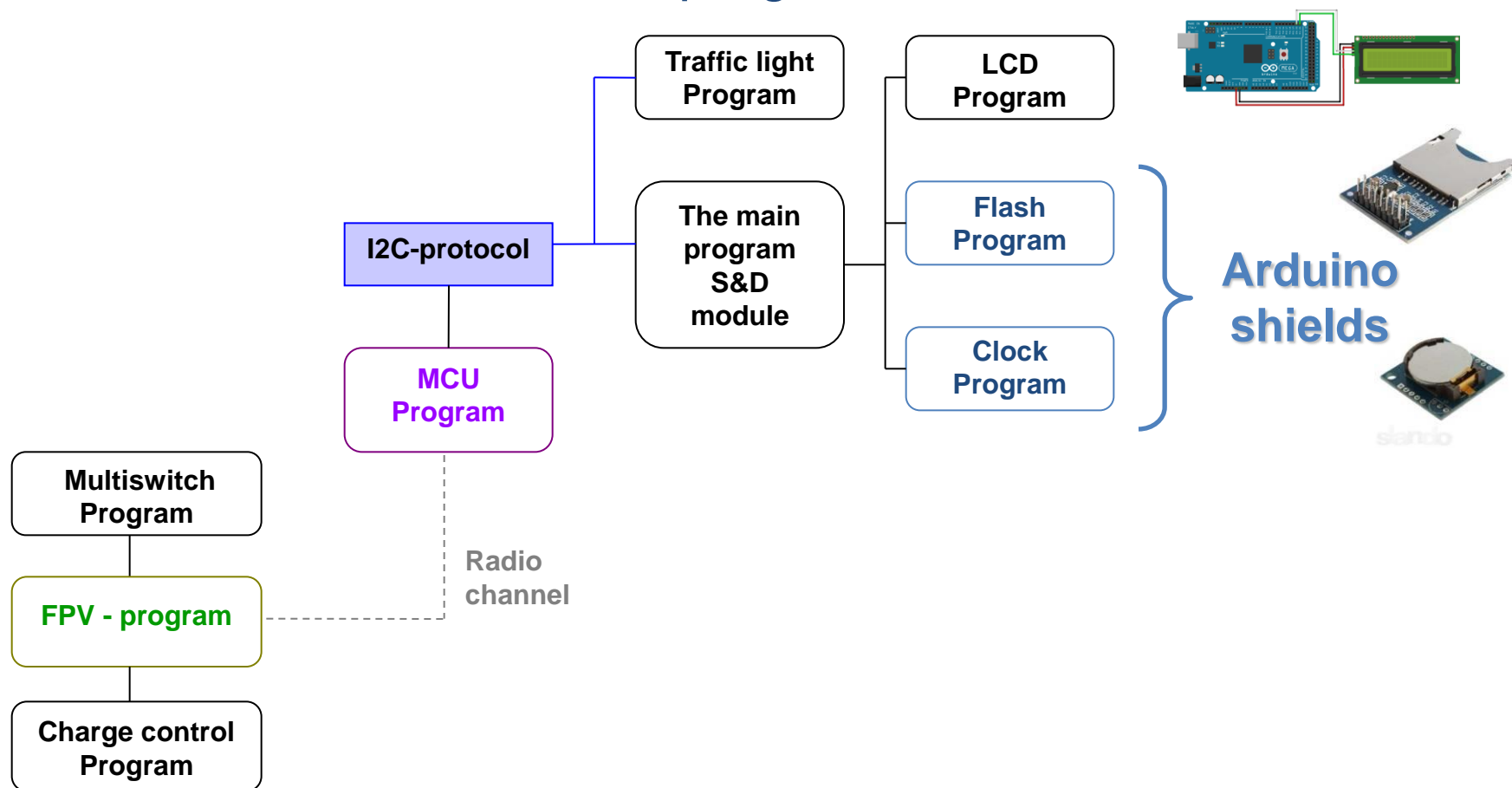
Raspberry Pi



Altera Cyclone

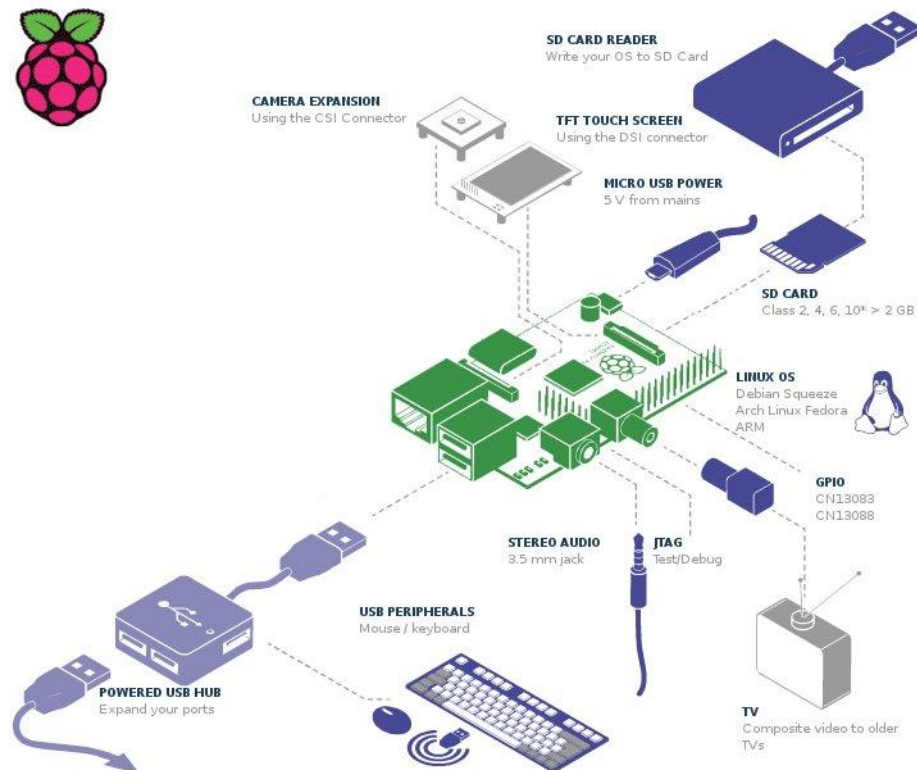
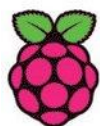


## Bachelor work in progress based on Arduino





## Bachelor work in progress based on Raspberry Pi



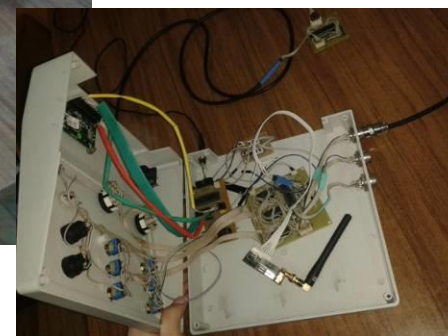




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## Real prototype



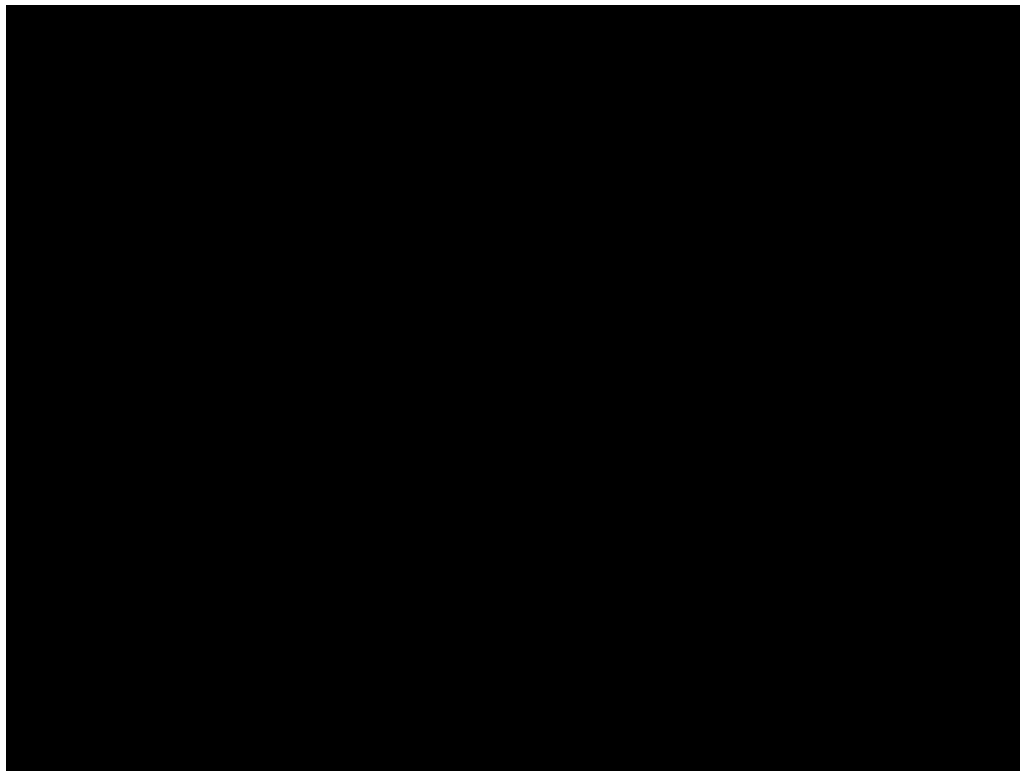




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## Video demonstration

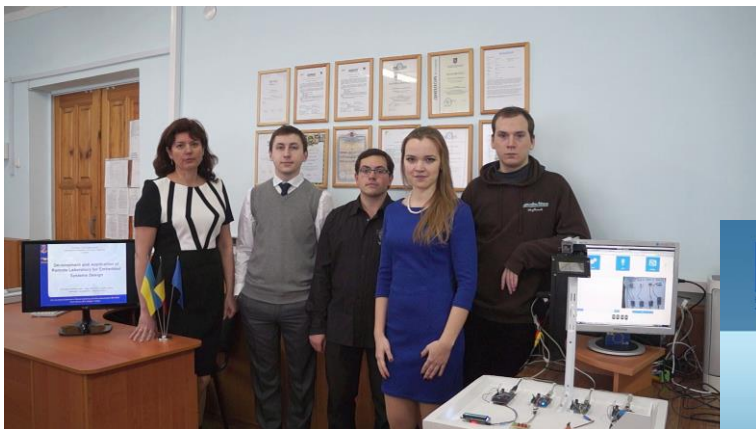




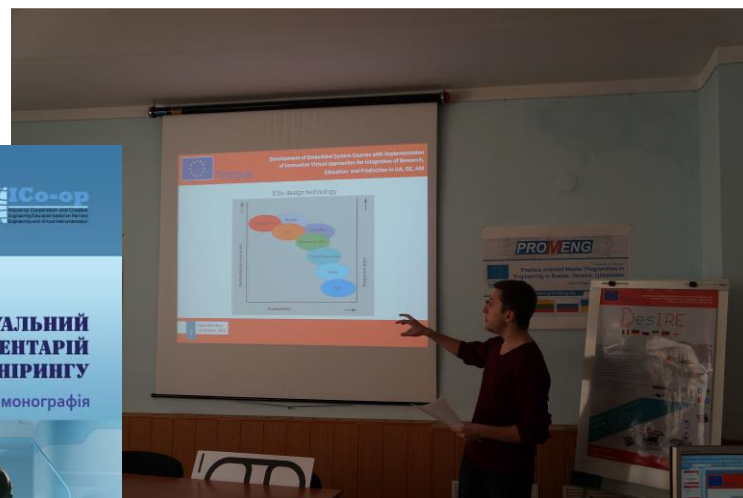
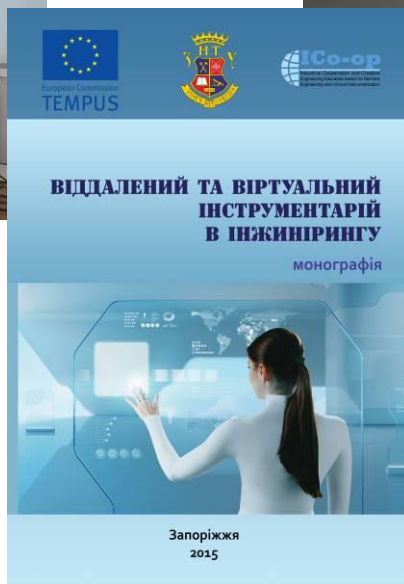
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## Development and Application of Remote Laboratory for Design of Embedded Systems (RELDES)



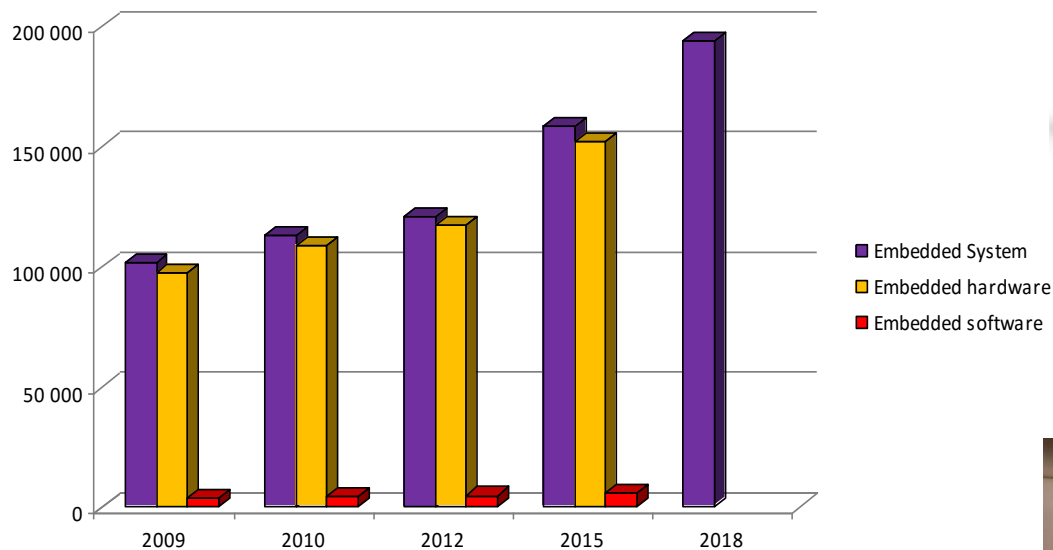
**RELDES team**



**Presentation of RL  
Zaporizhzhya,  
October 15, 2015**

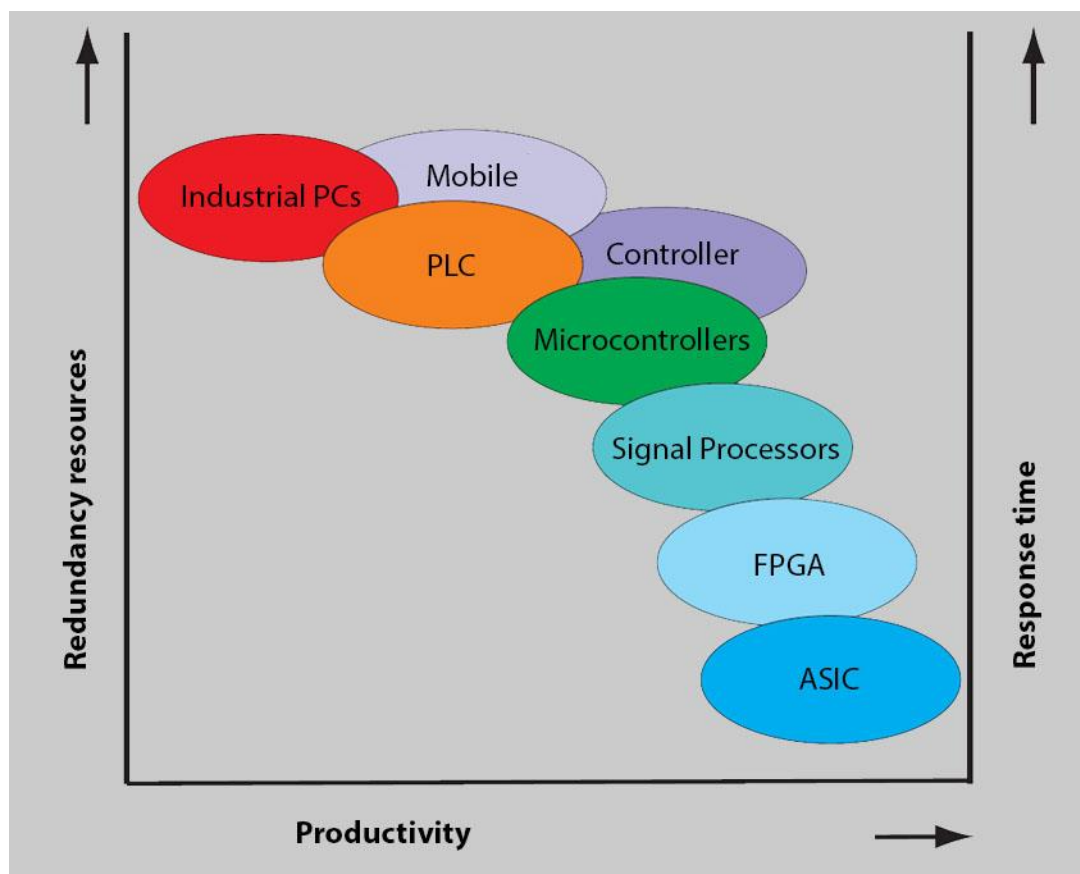


## ES today





## ESs design technologies



Platunov A.E, 2012



# Hardware/software platforms for ES design



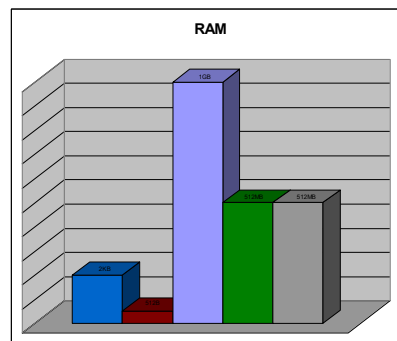
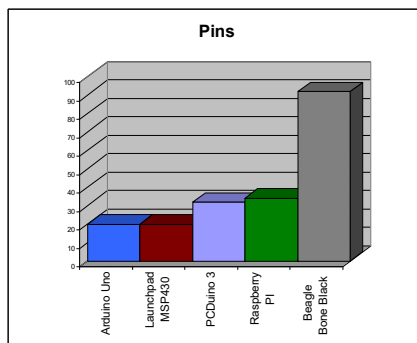
Launchpad  
MSP430



Freeduino



Raspberry Pi



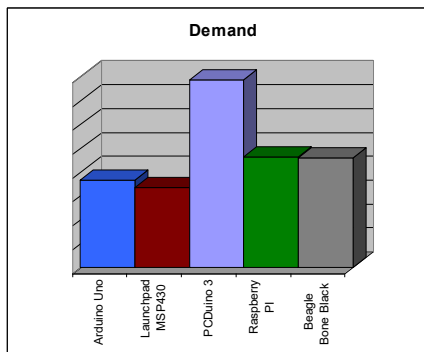
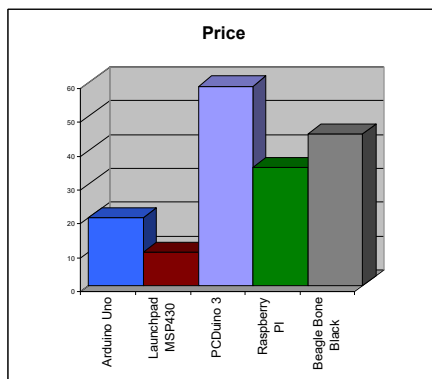
Beagle Bone Black



Arduino



Altera Cyclone



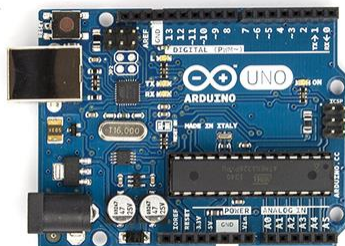
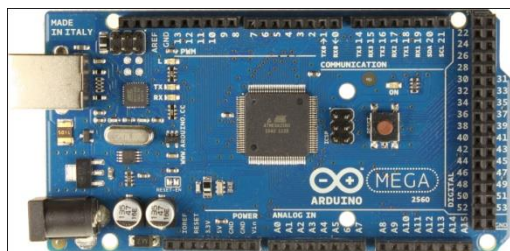




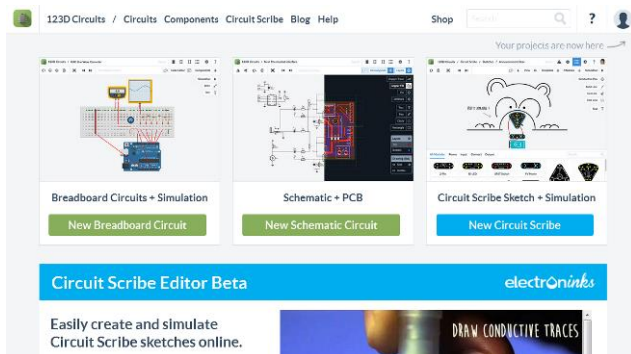
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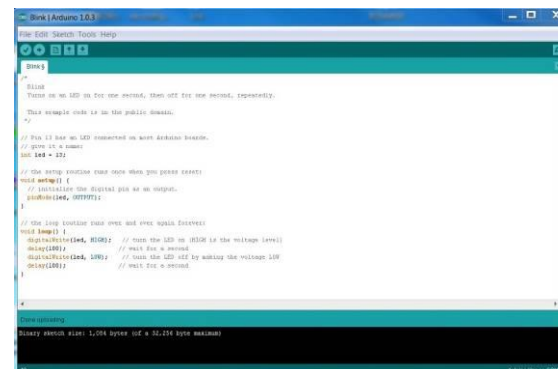
# Hardware/software platform Arduino



## Arduino boards and shields



## Arduino simulator

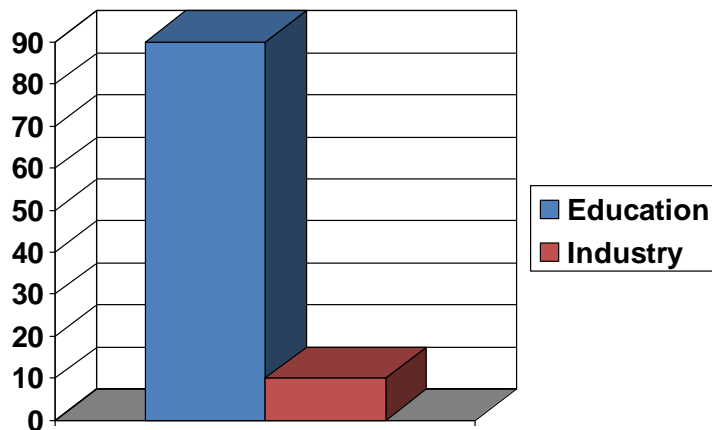


## Arduino IDE



## Applications of remote laboratories

- Electronics
- Robotics
- Physics
- Chemistry
- Biology
- Earth Science
- etc..



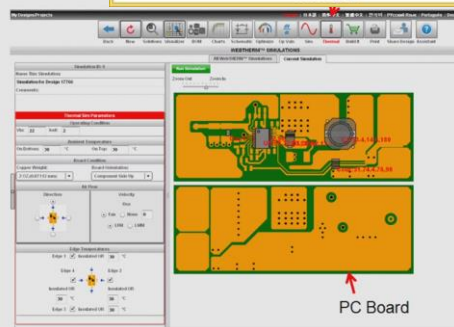


## Remote laboratories in the fields of electronics



- GOLDI
- DEUSTO
- WEBENCH<sup>®</sup> Design Center
- Intel Remote.Lab
- iLabs

WebTHERM<sup>®</sup> – Board



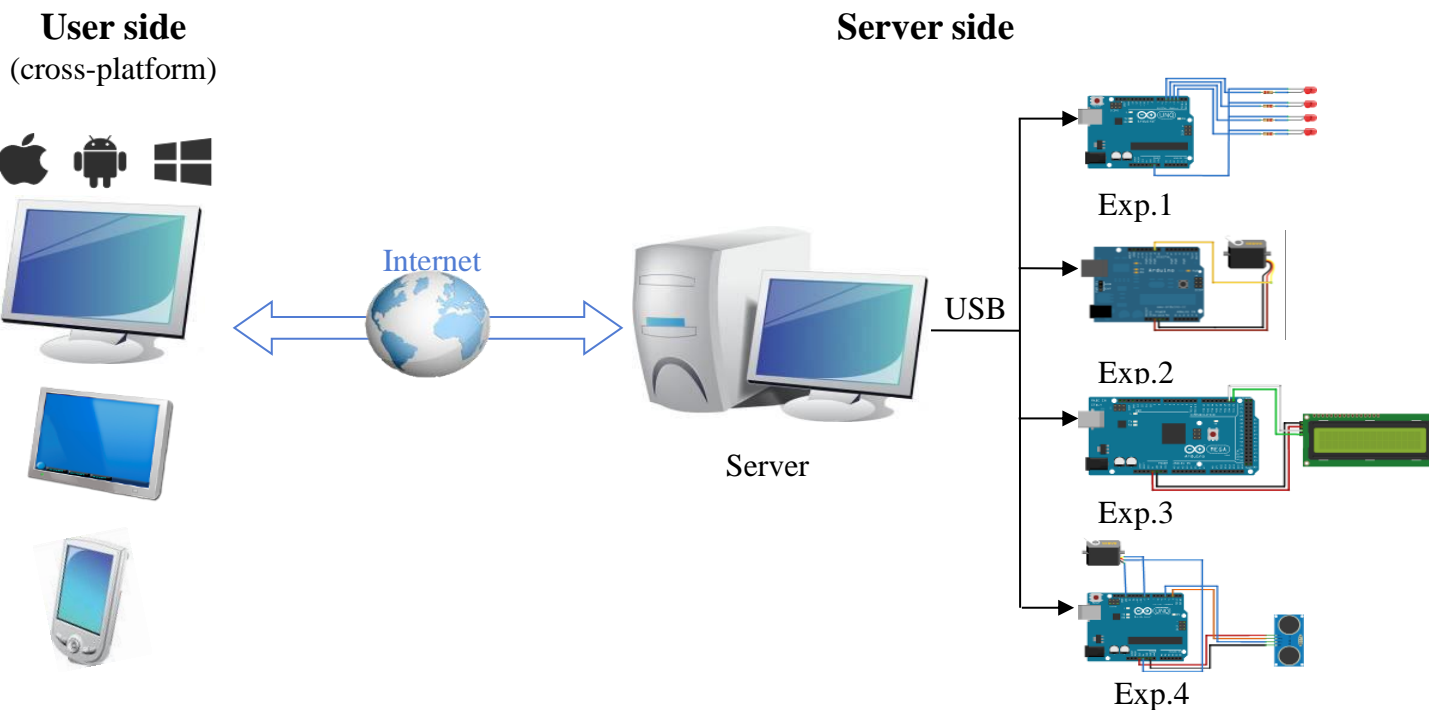
WebTHERM Results

- View interactions between components
- Diode and IC both generate heat
- Effect of backside copper and vias





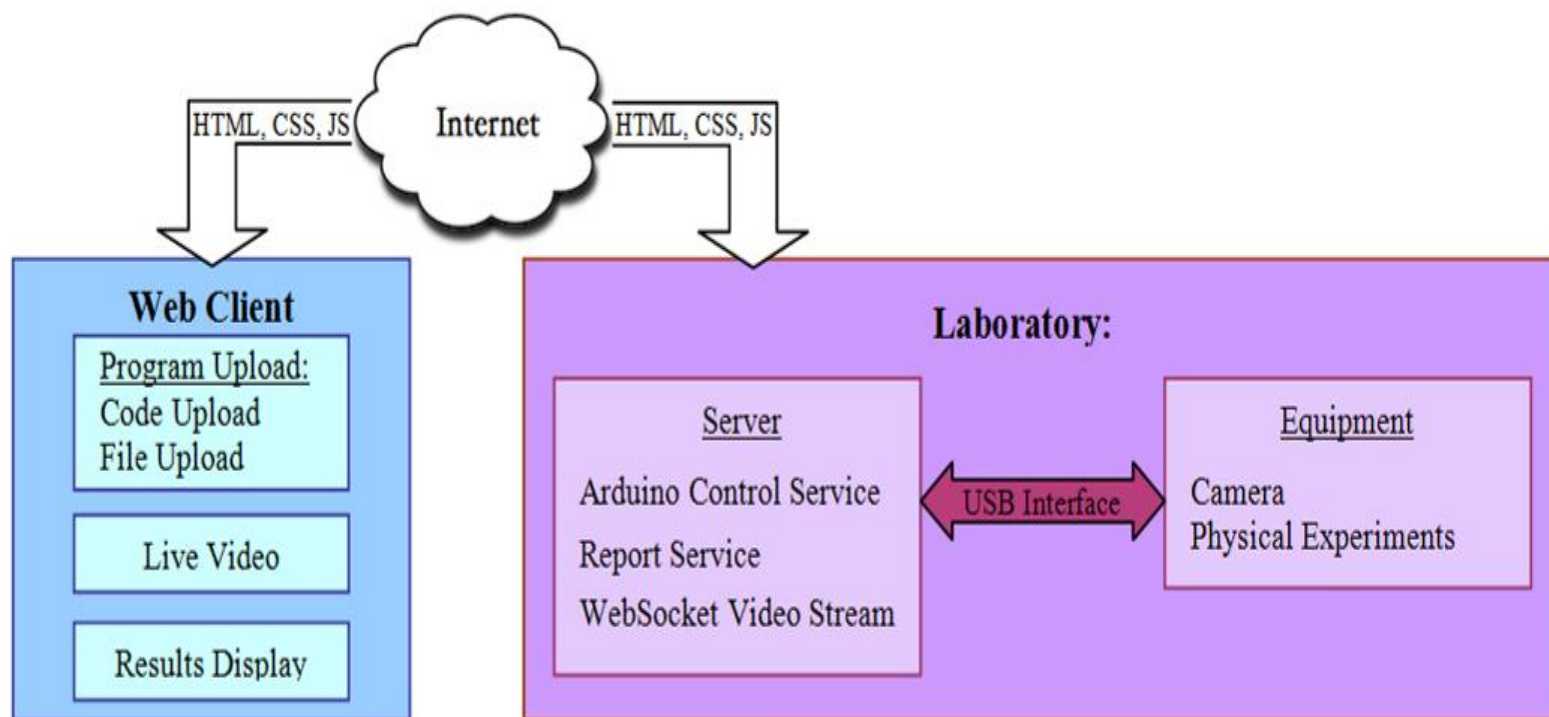
# RELDES Hardware architecture







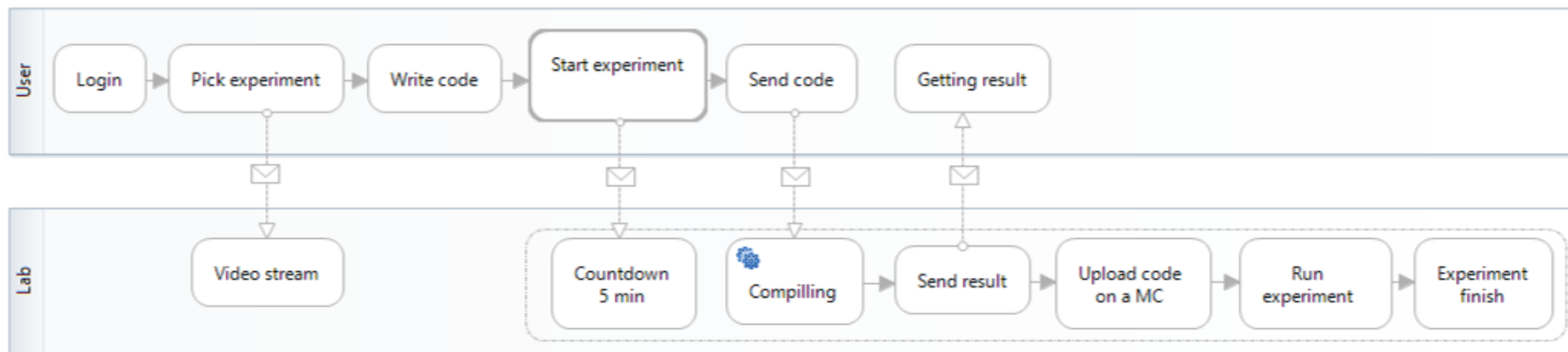
## RELDES Software architecture







## Laboratory process diagram

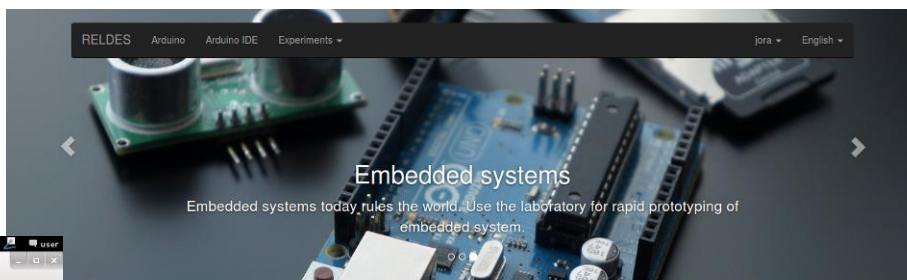
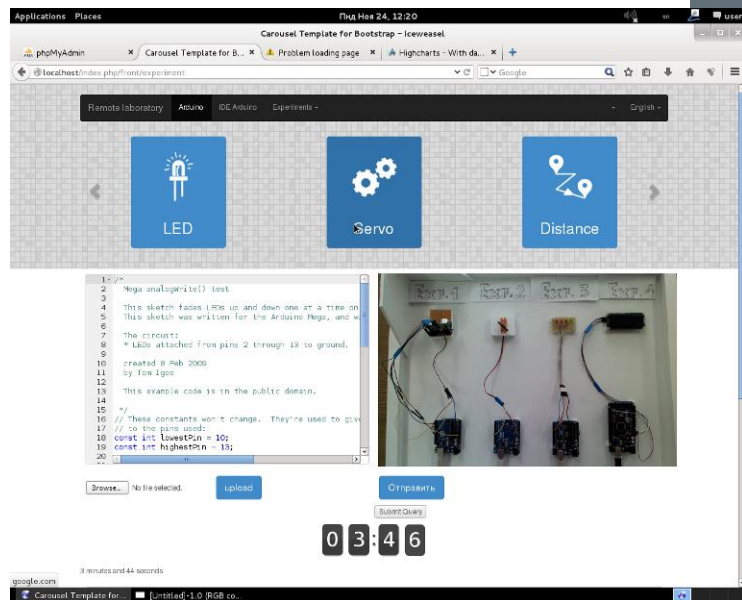




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## RELDES interface



<http://youtu.be/u2anq--UYFg>



## Work in progress

Future work will be focused on :

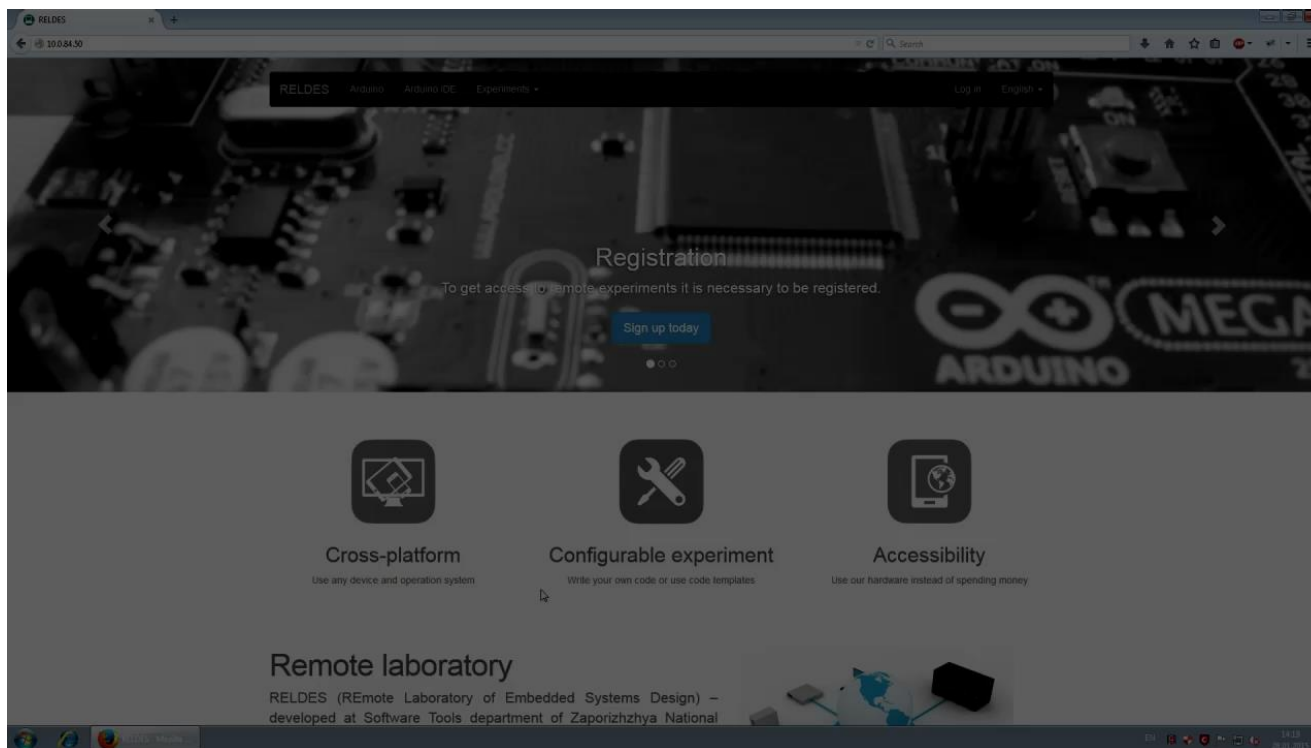
- expanding the range of provided hardware-software platforms;
- adding the set of experiments for solution of different tasks of embedded systems of mobile objects control design;
- development of special mechanism of lab reservation;
- creation of statistical data processing module for control of laboratory using.



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# Video demonstration





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# CNC machine

for training students



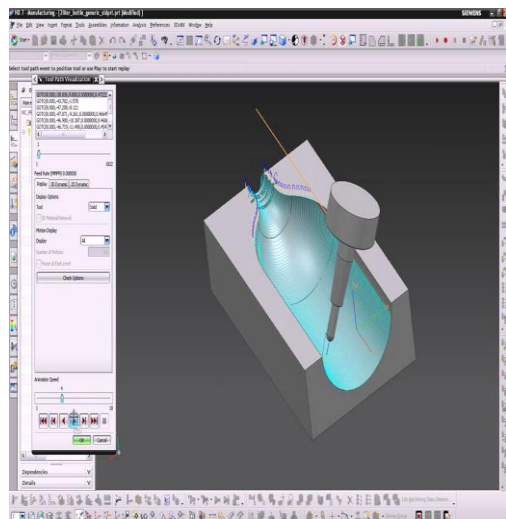
Presentation of project  
Zaporizhzhya,  
October 15, 2015



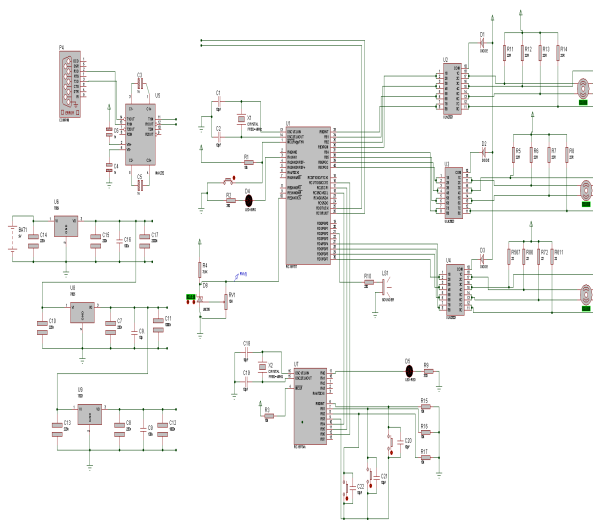




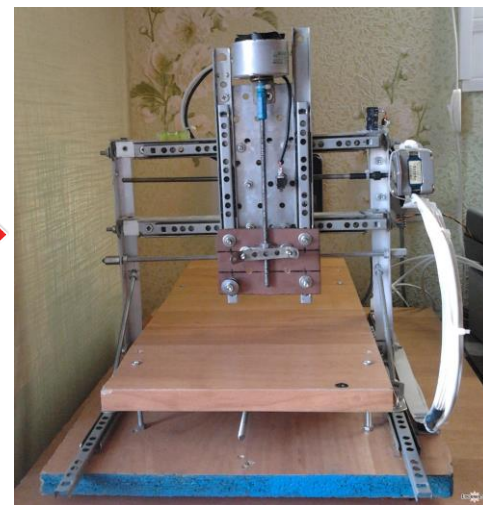
## Project Overview



**CREO 2.0**



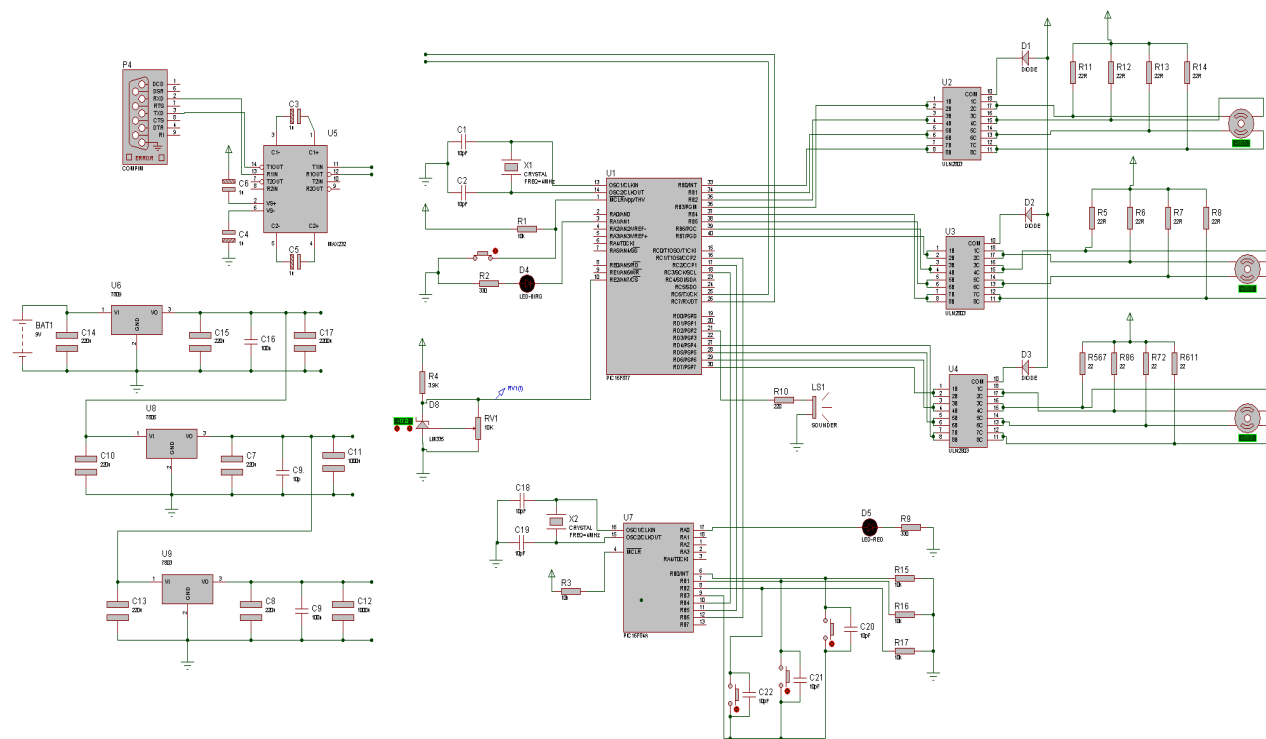
**Embedded  
Control System**



**CNC Machine**



## CNC Machine Control Unit

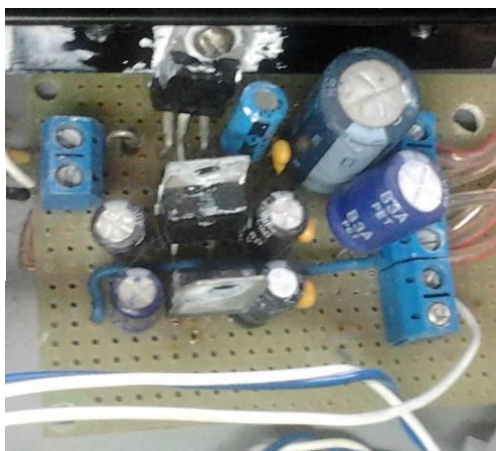
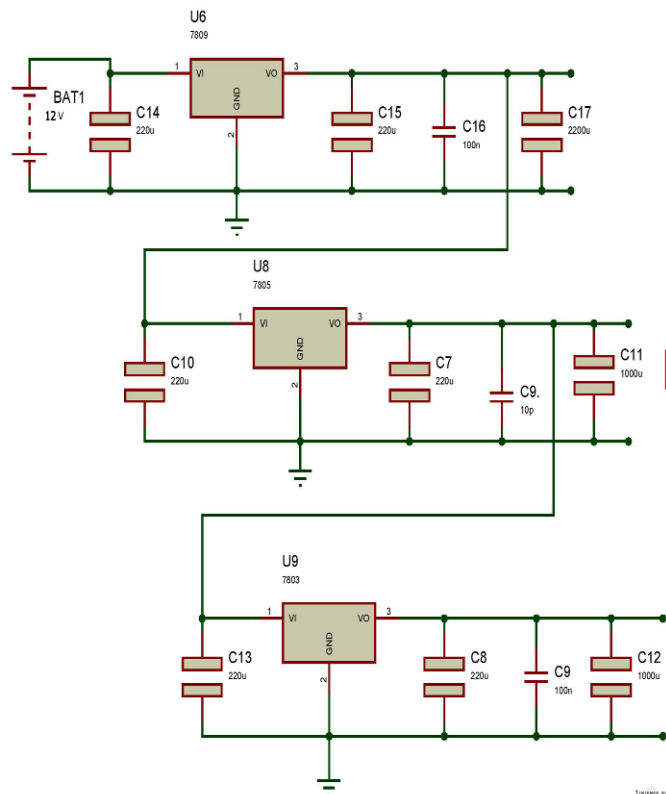


1. Power supply module
2. Commands transformation module
3. Motor control driver
4. Sensor control module

1.INZENER.RU



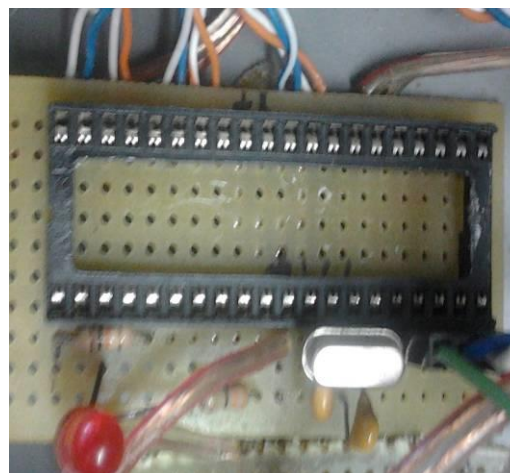
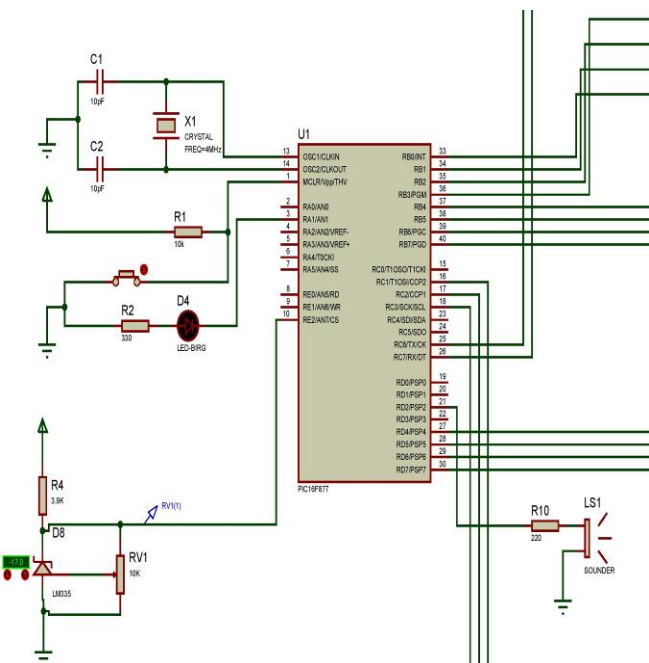
## CNC Machine Control Unit



1. Power supply module
2. Commands transformation module
3. Motor control driver
4. Sensor control module

The main components: LM7805, LM7809, LM78033

# CNC Machine Control Unit

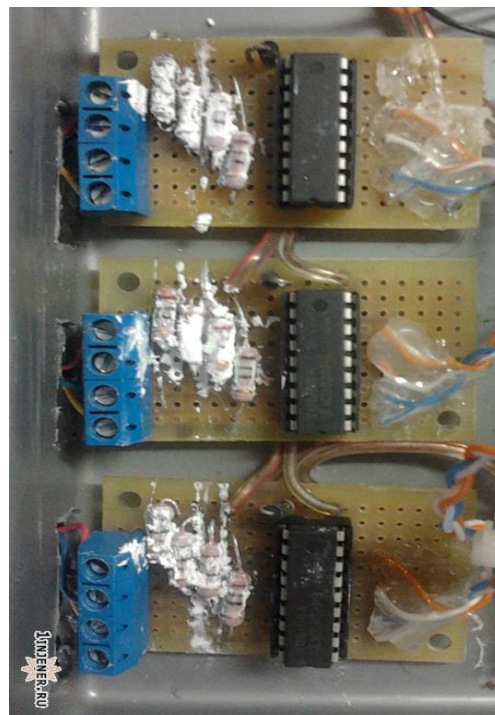
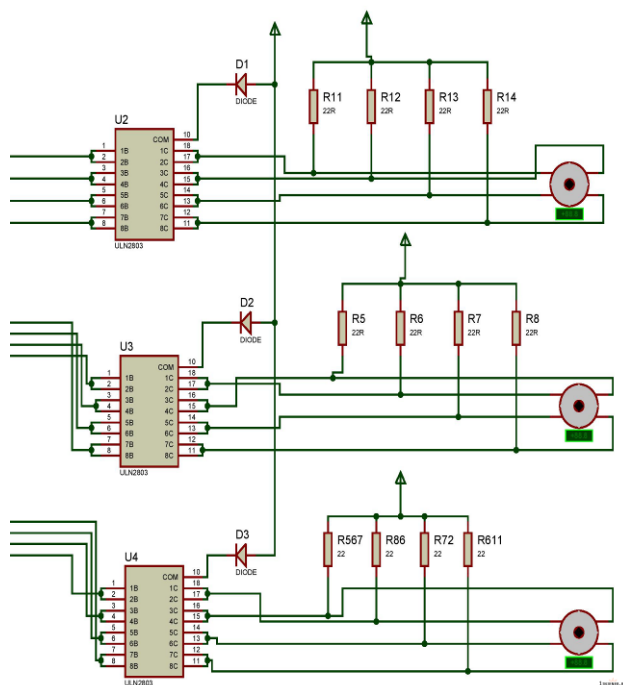


1. Power supply module
2. Commands transformation module
3. Motor control driver
4. Sensor control module

## The main components : PIC16f877a



## CNC Machine Control Unit



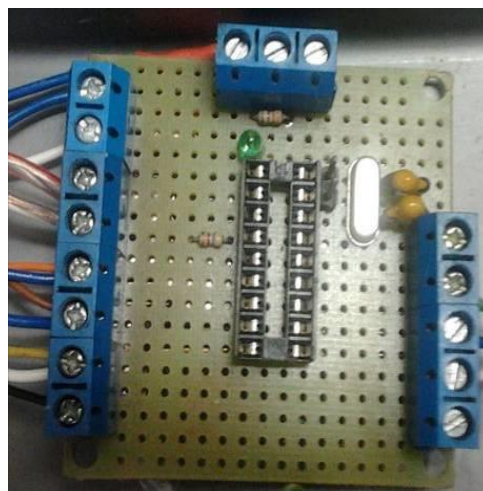
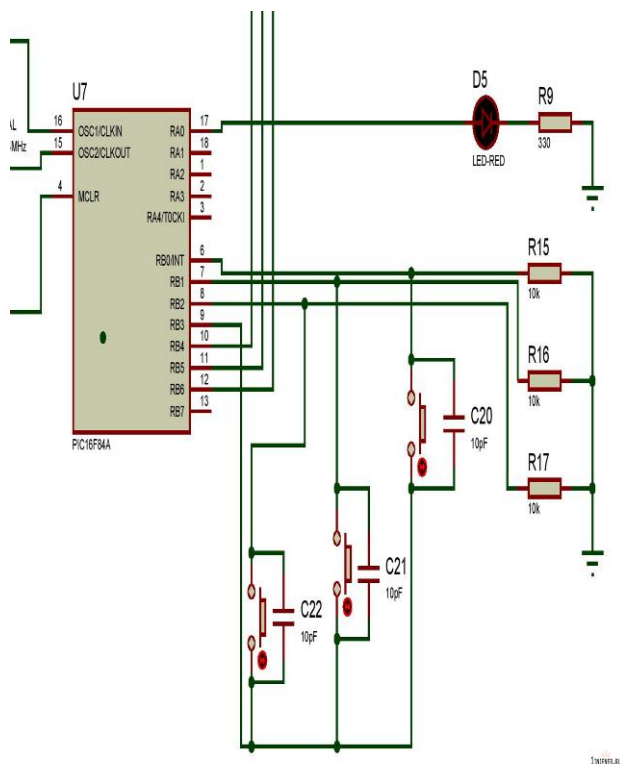
1. Power supply module
2. Commands transformation module
3. Motor control driver
4. Sensor control module

The main components : ULN2804a





## CNC Machine Control Unit

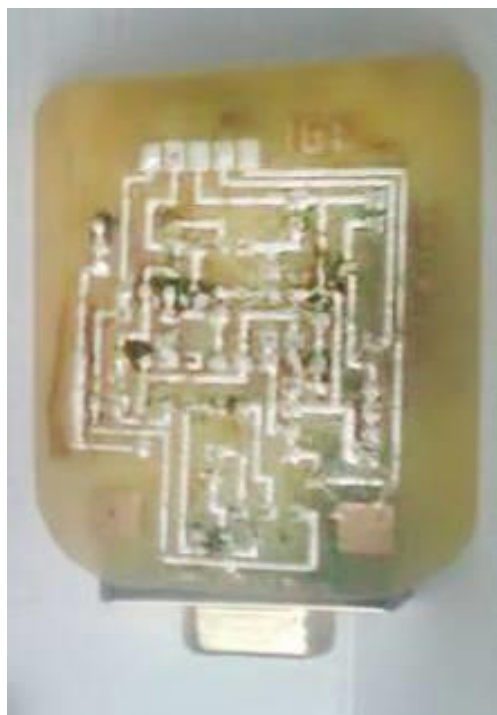
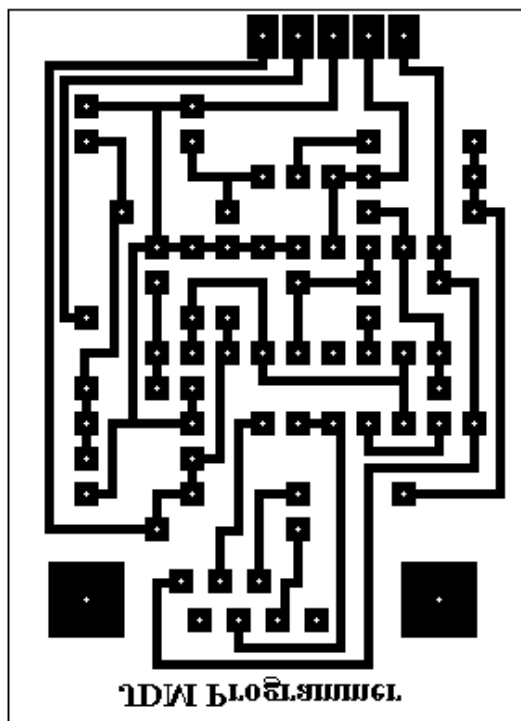


1. Power supply module
2. Commands transformation module
3. Motor control driver
4. Sensor control module

The main components : PIC16F84a



## CNC Machine Control Unit



### Programing of

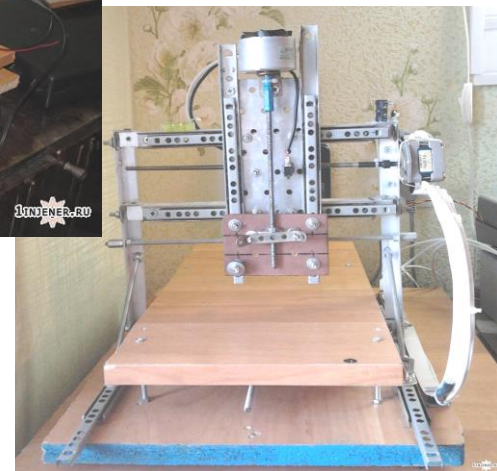
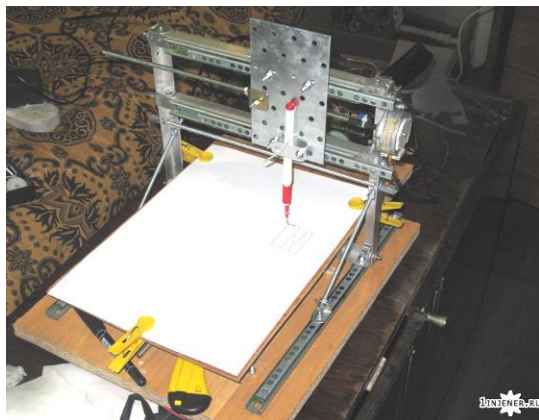
PIC12C509A,  
PIC16F84,  
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PIC16F628A  
PIC16F877A



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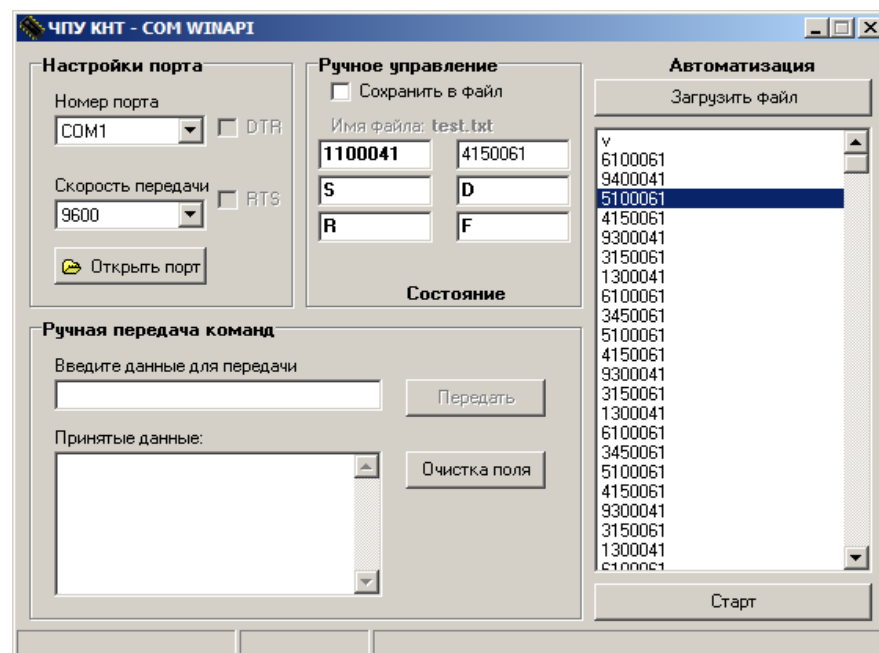
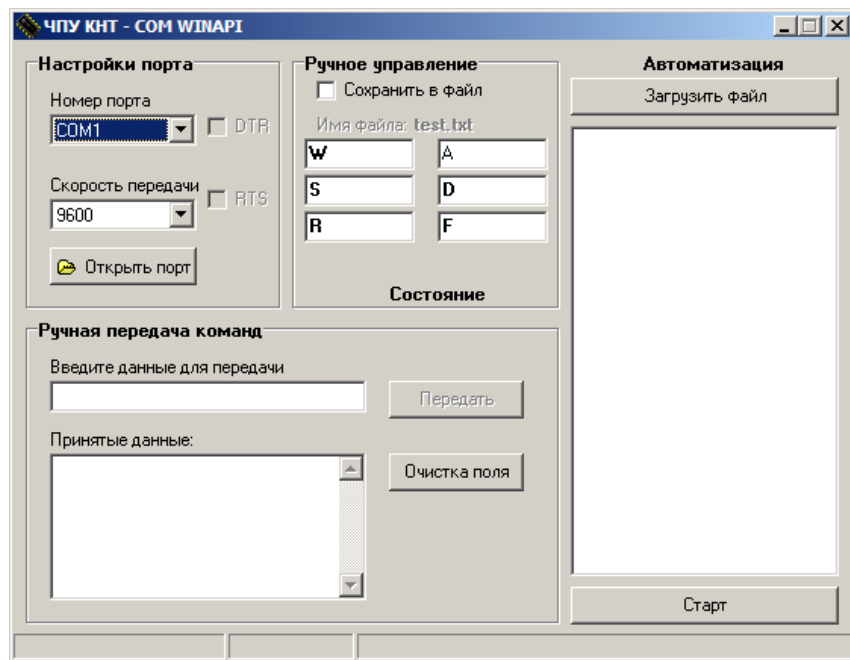
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## CNC Machine hardware design



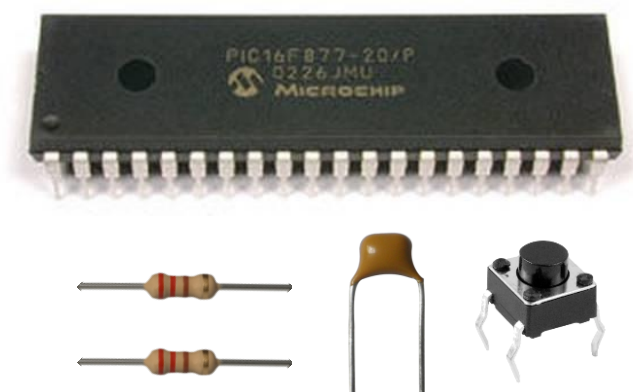


## The Test Program



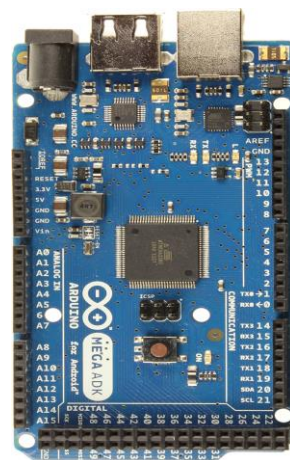


## Work in progress



PIC16FXXX

**Cheaper, but less quality and  
functionality**



Arduino



Raspberry Pi



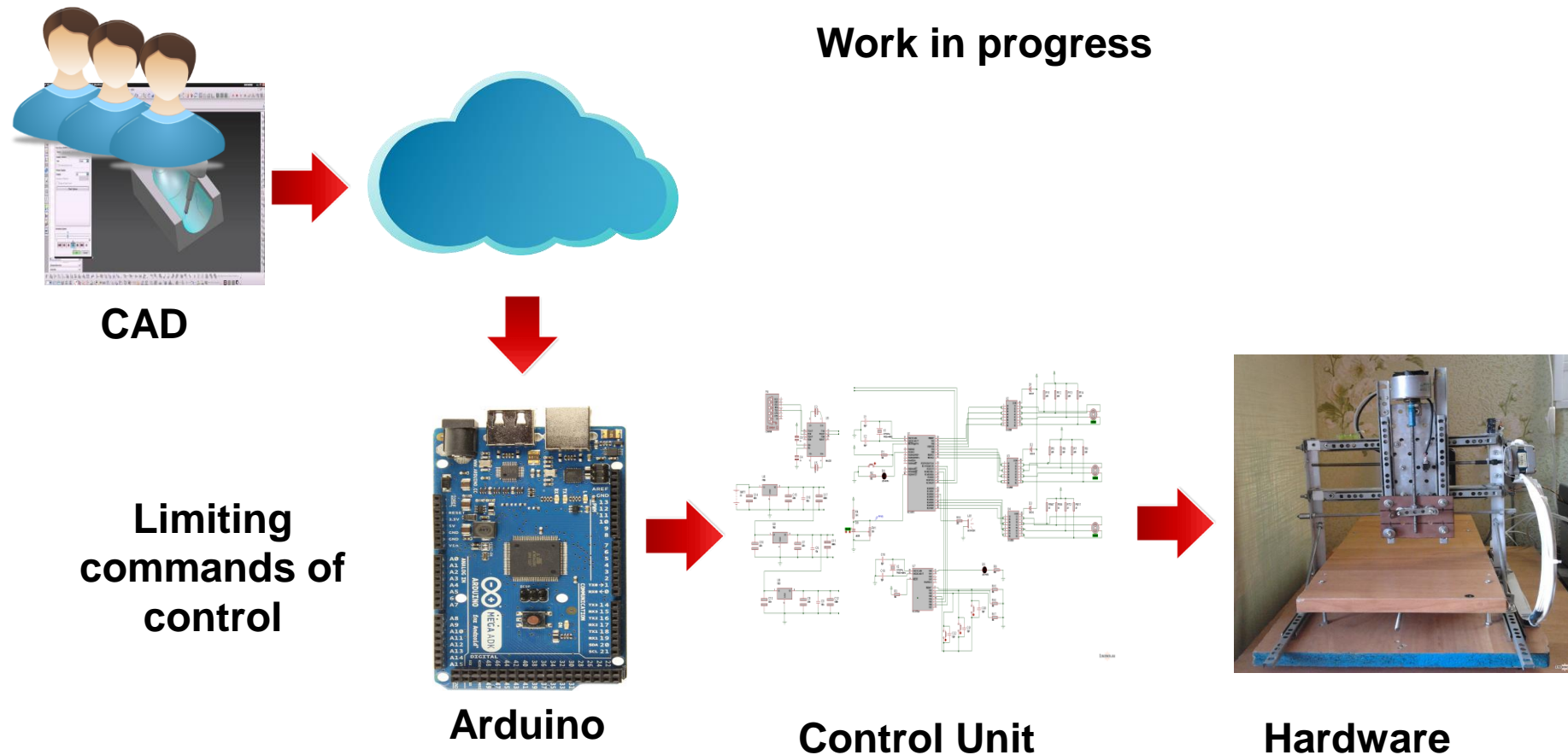
STM32

**Expensive, but high quality, more  
functionality**





## Work in progress





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# Video demonstration



[https://youtu.be/aDHGX-FLe\\_o](https://youtu.be/aDHGX-FLe_o)



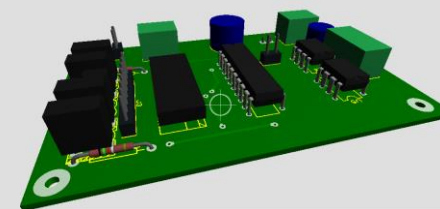
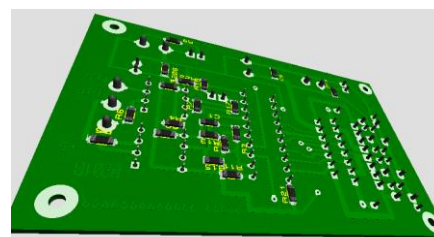
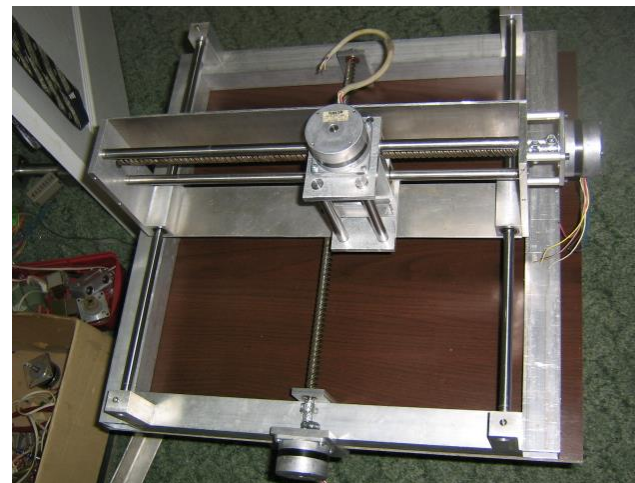
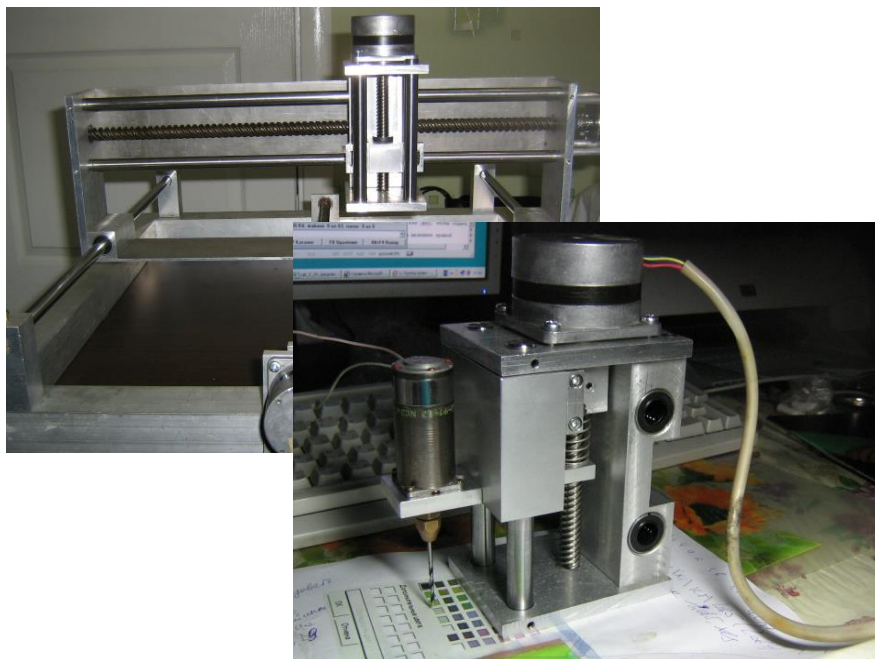
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# CNC machine

Donbass State Engineering Academy (DSEA)  
Kramatorsk, Ukraine



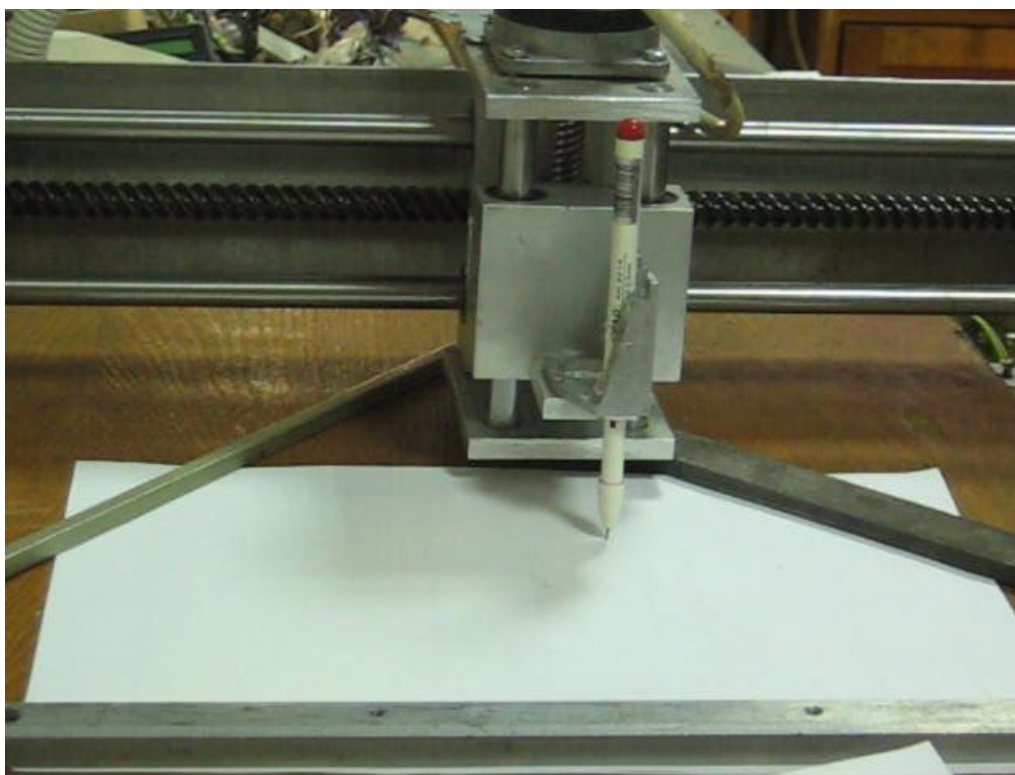


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## Video demonstration



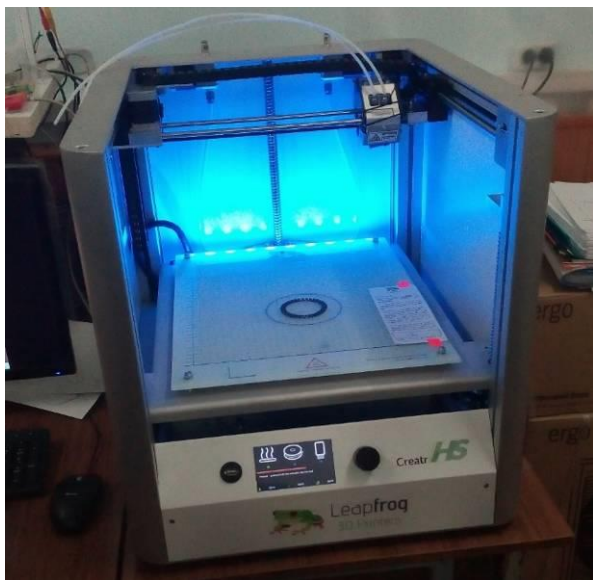




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# Modern tools for design and prototyping



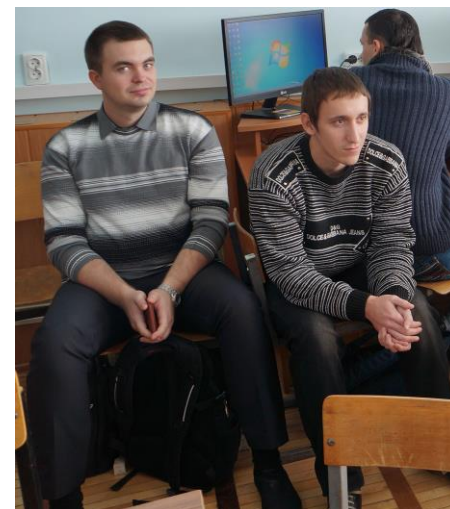
3D printer Leapfrog Creatr HS



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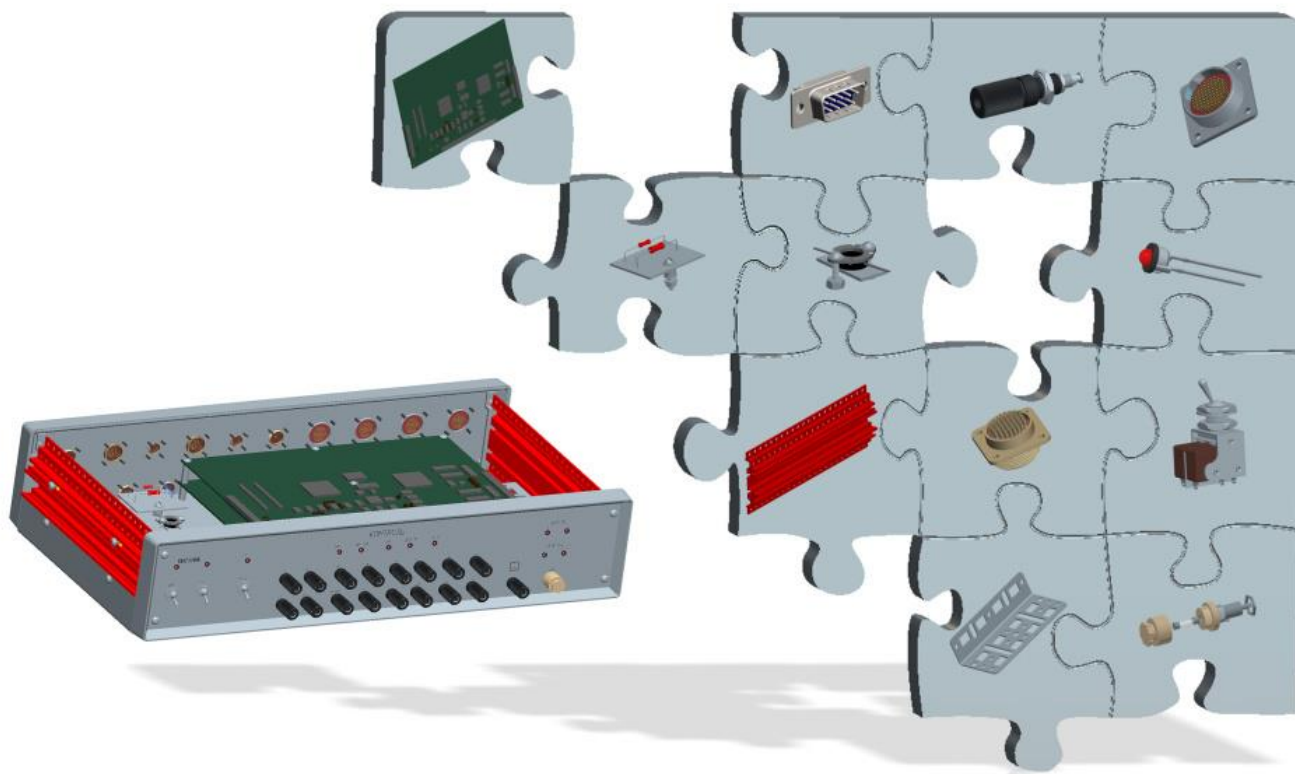
3D scanner Gotcha





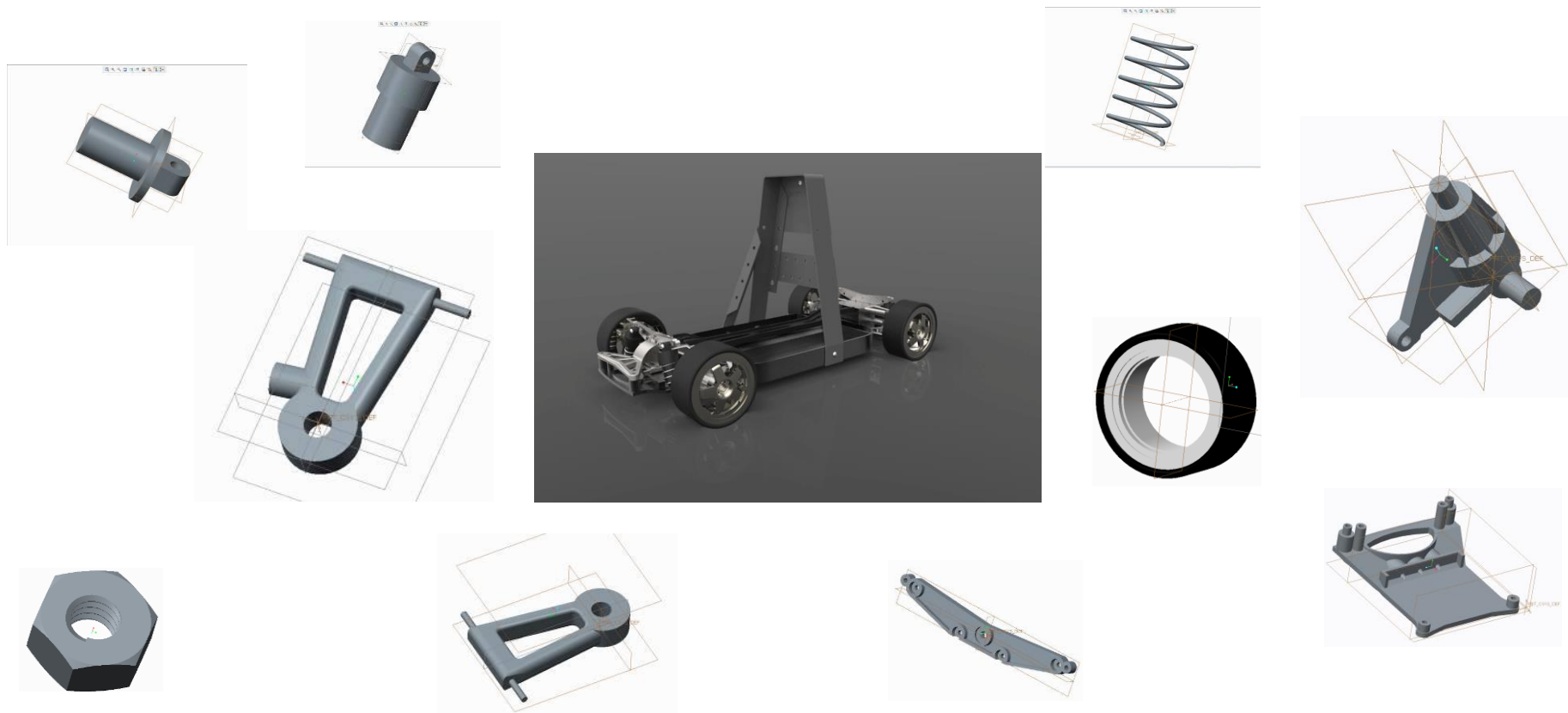


## *Student integrated project in Creo Elements/Pro 5.0*





## CREO virtual model of car body

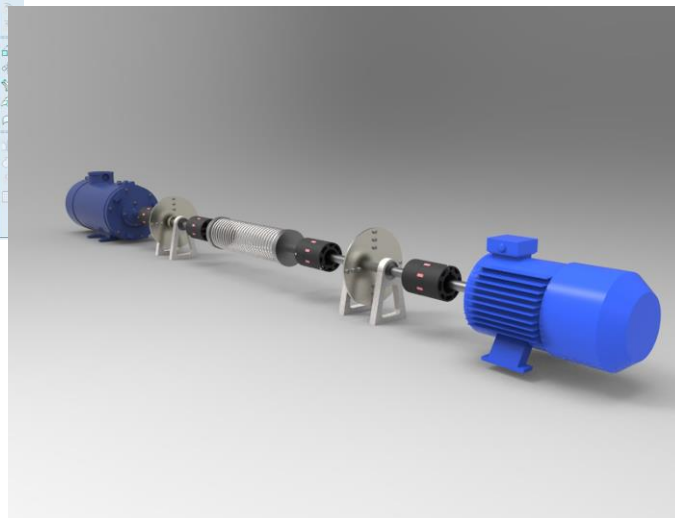
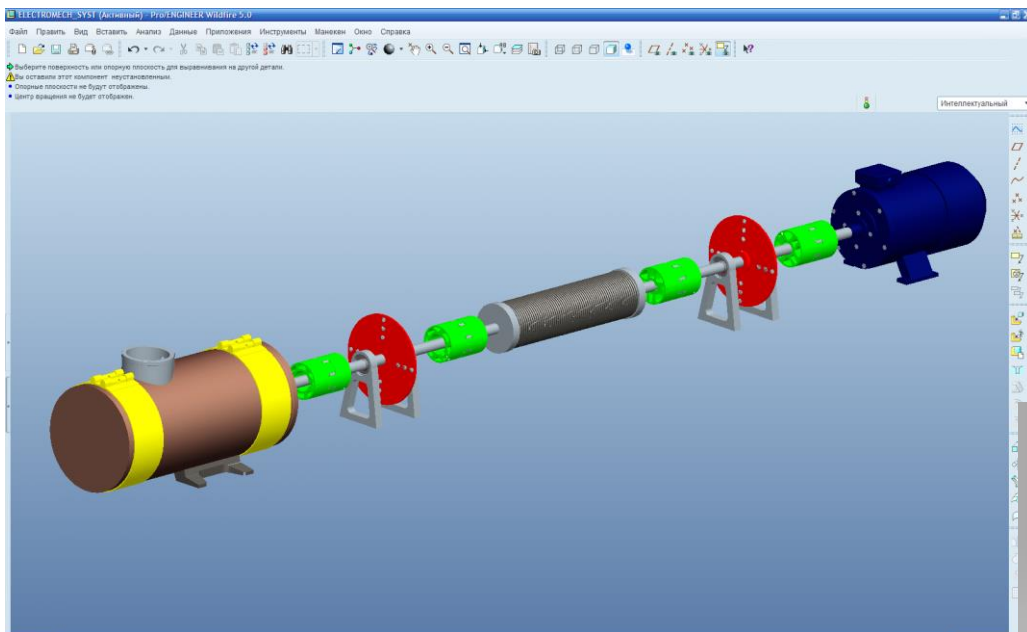




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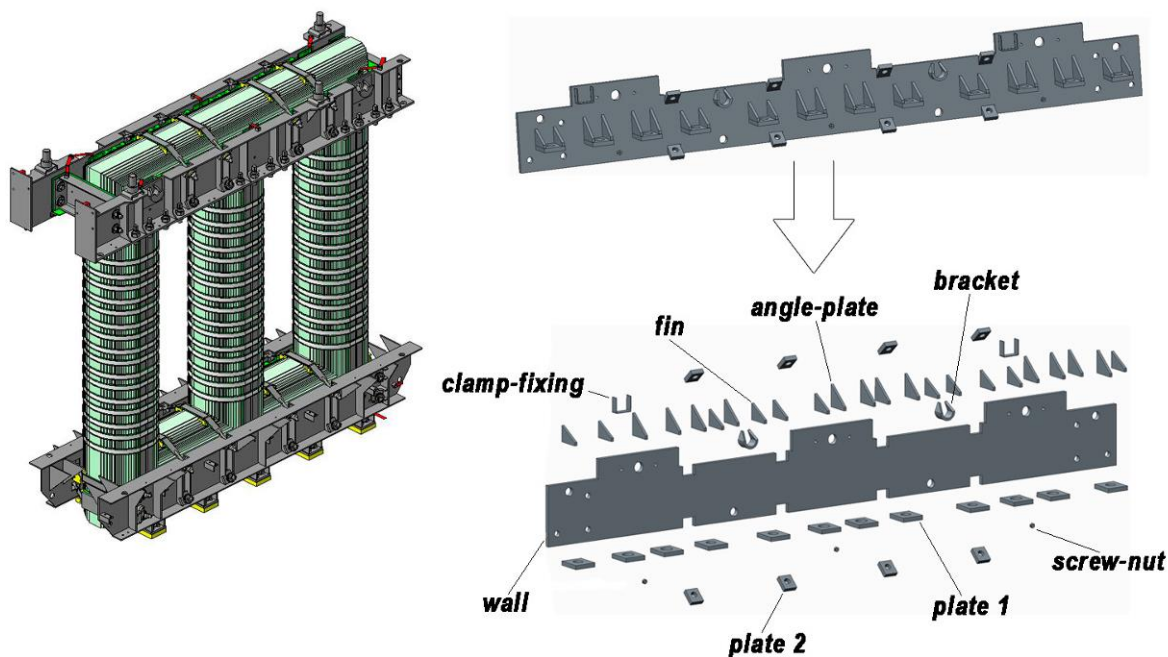
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### CREO virtual model of electromechanical system



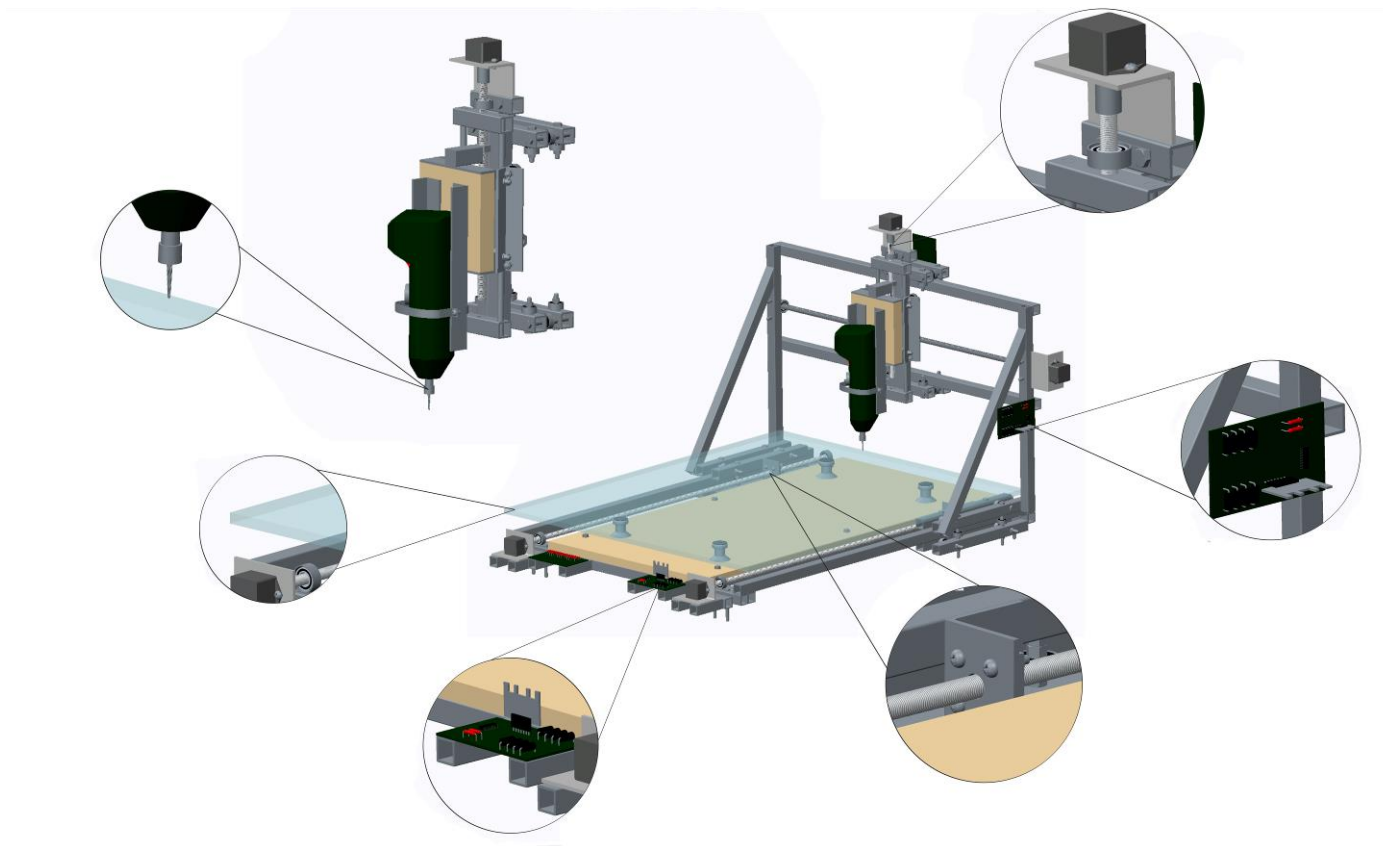


## Design of 3D model of transformer beam in Creo 2.0





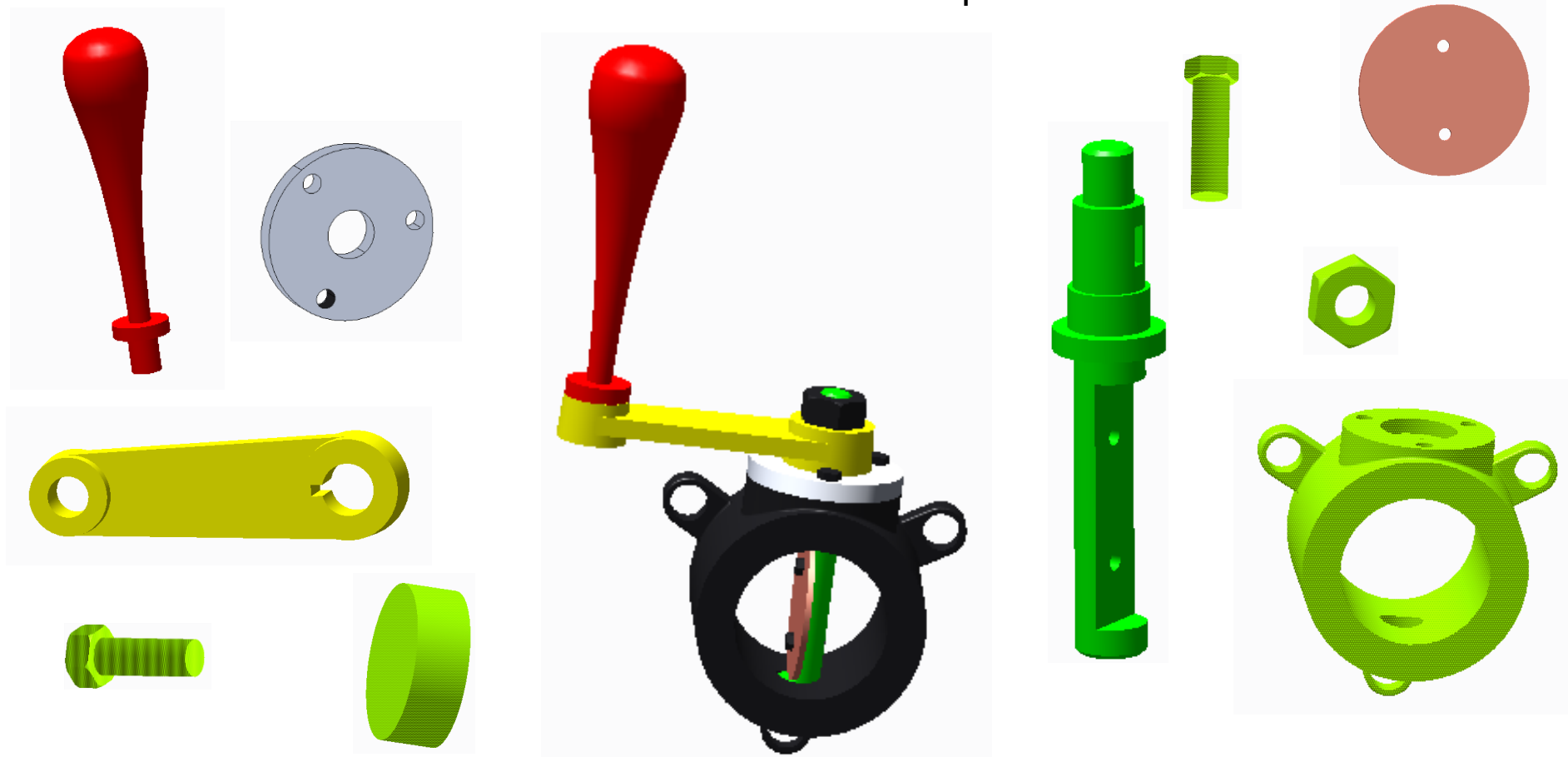
## CREO virtual model of CNC machine





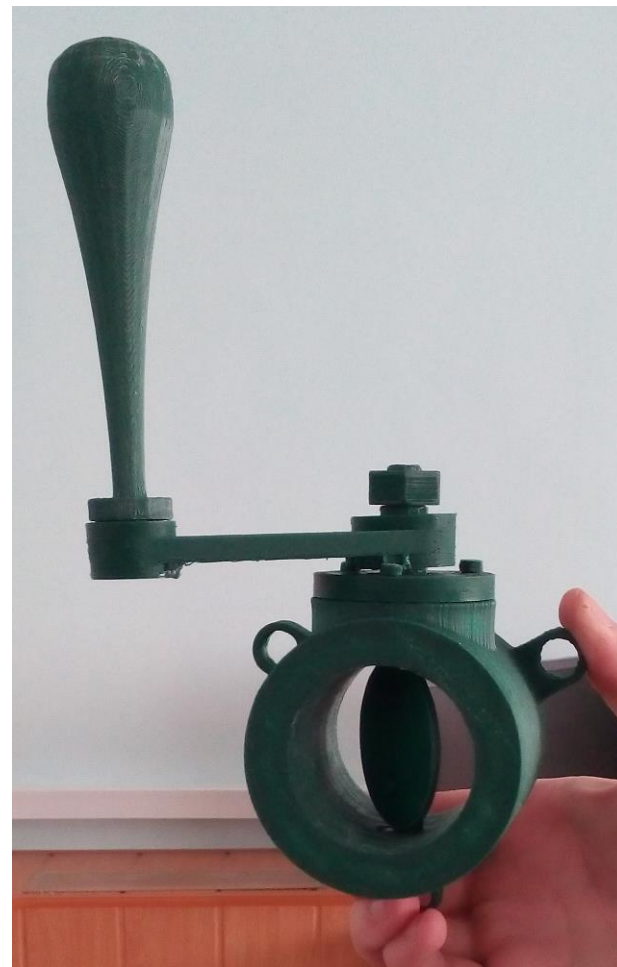
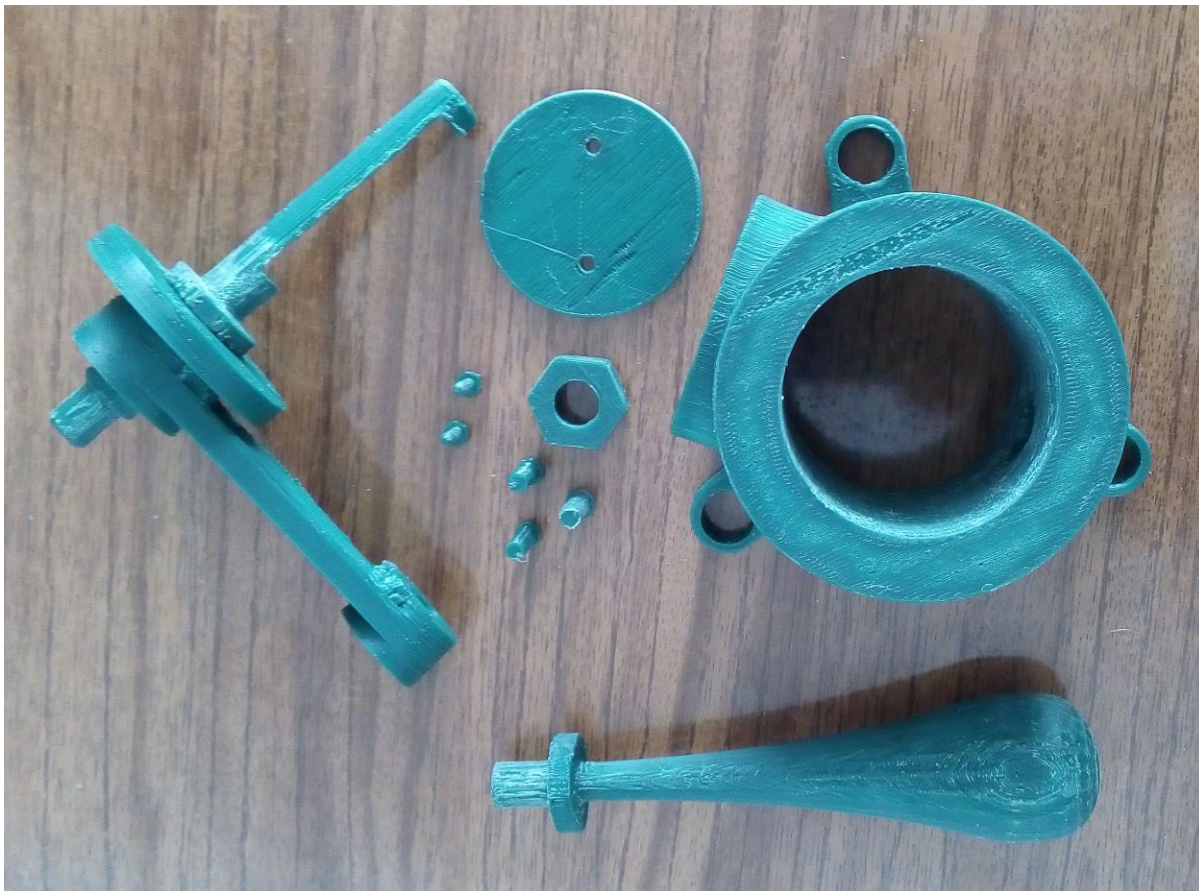


## CREO virtual model of simple valve





Printed real valve prototype

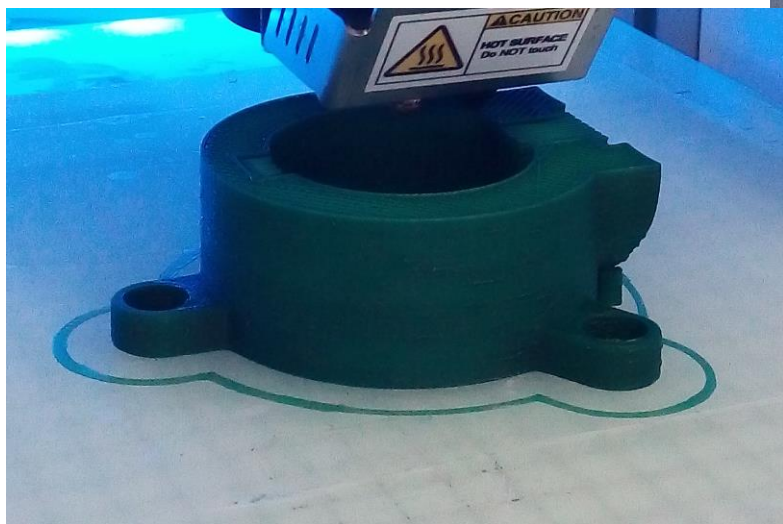




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## 3D printing



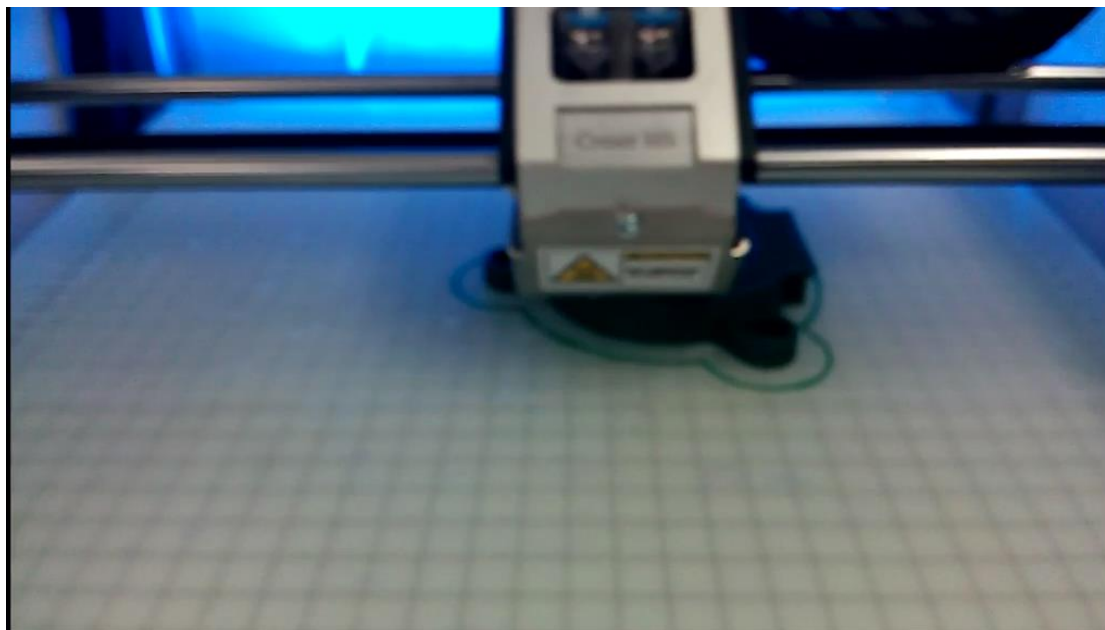




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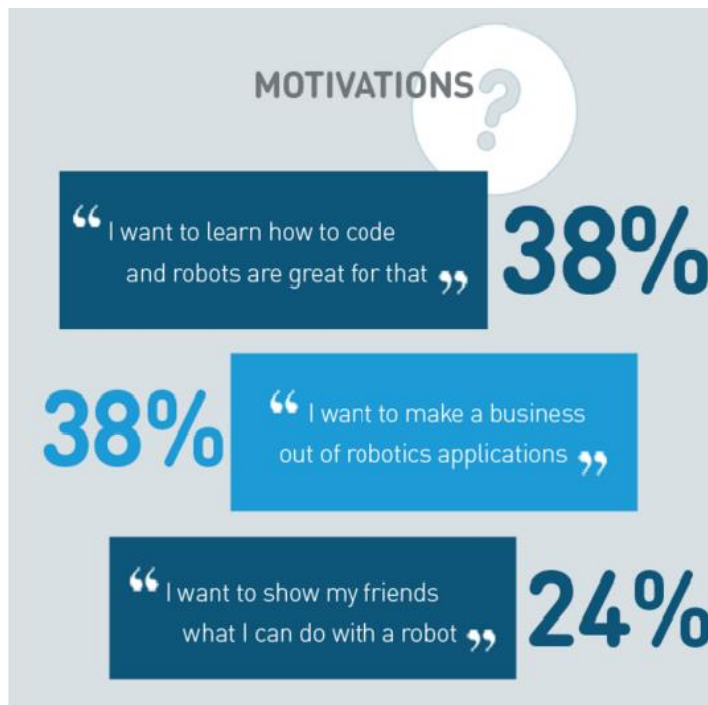
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## Video demonstration





We are open for new projects



<https://community.aldebaran.com/en/developerprogram>





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# THANK YOU FOR YOUR ATTENTION!



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