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CANDO-EPE 2020

Facultatea de Electronică, Telecomunicații și Tehnologia Informației

High Power Laser Tracking and Targeting System

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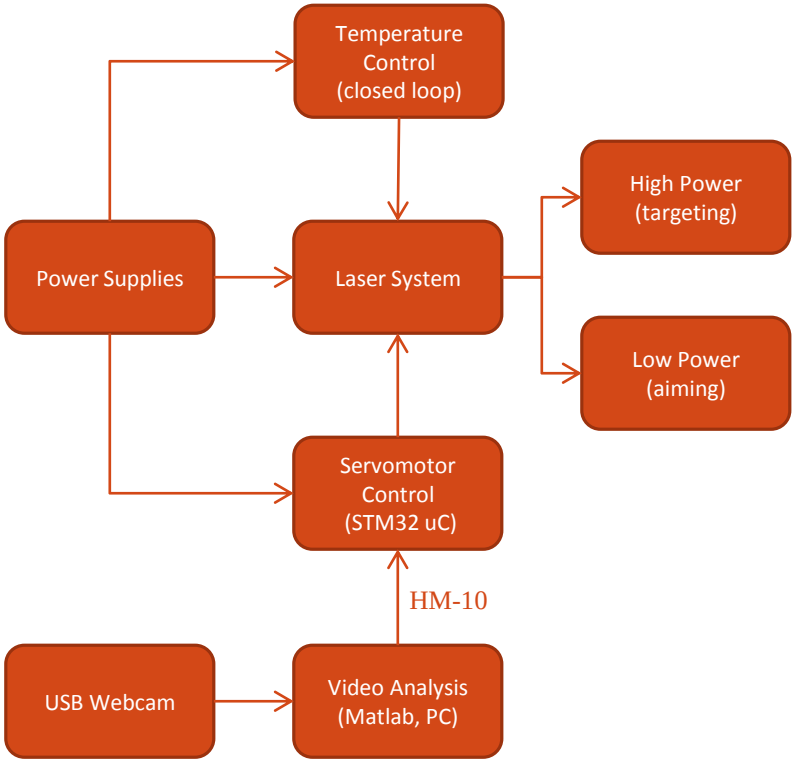
Block Diagram

- Components:
  - ✓ High and low power lasers;
  - ✓ Webcam and light filter;
  - ✓ Servomotors;
  - ✓ Personal Computer;
  - ✓ USB-UART adapter;
  - ✓ STM32F303RE Microcontroller;
  - ✓ Two HM-10 Bluetooth Modules.



Principles

- ✓After thermal equilibrium has been reached in steady state, the temperature regulator power consumption becomes constant.
- ✓The laser can be controlled from an GUI developed in Matlab R2018a.
- ✓Operating mode and targeted object shape can be chosen by user.
- ✓For multiple targets priority is assigned after calculating Euclidean distance versus image center;

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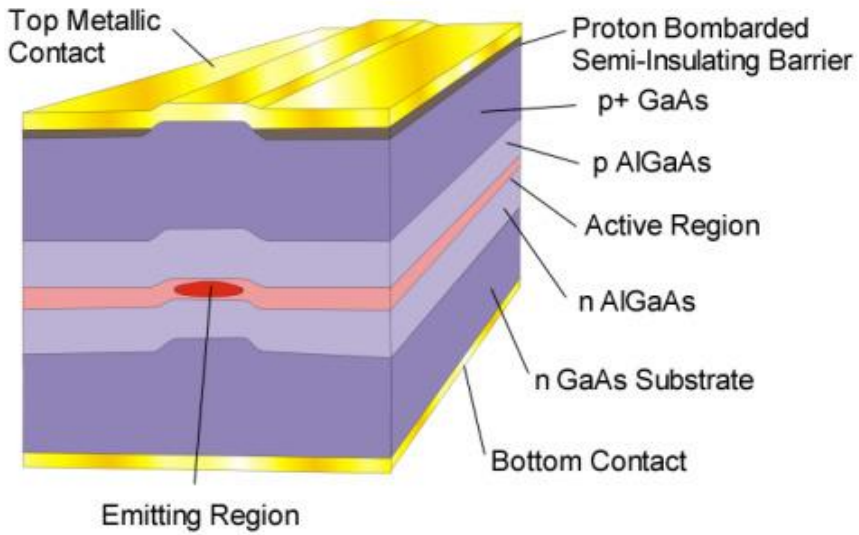
Principles

- The laser diode is a device which emits a coherent flux of radiation.



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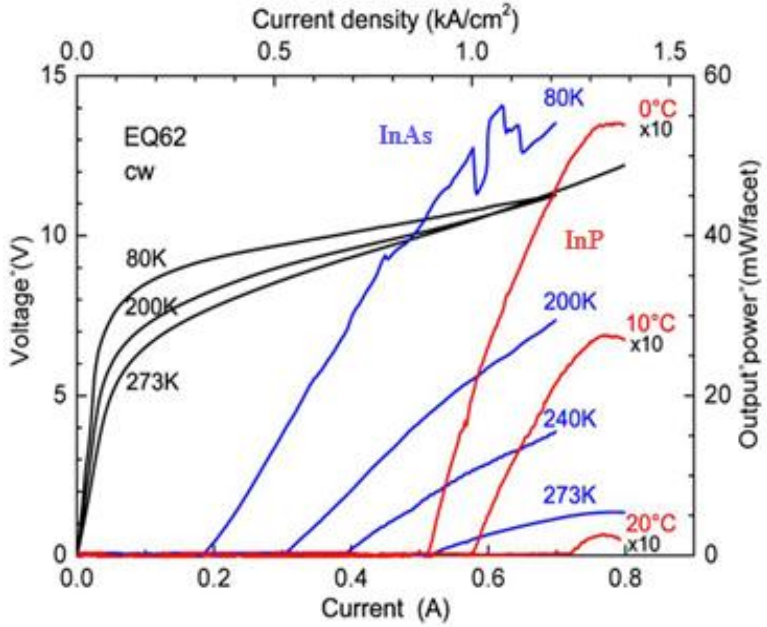
Temperature Control

- For high-power lasers, temperature control is necessary to prevent excessive temperatures.
- Moreover, as shown below, output power depends on temperature.



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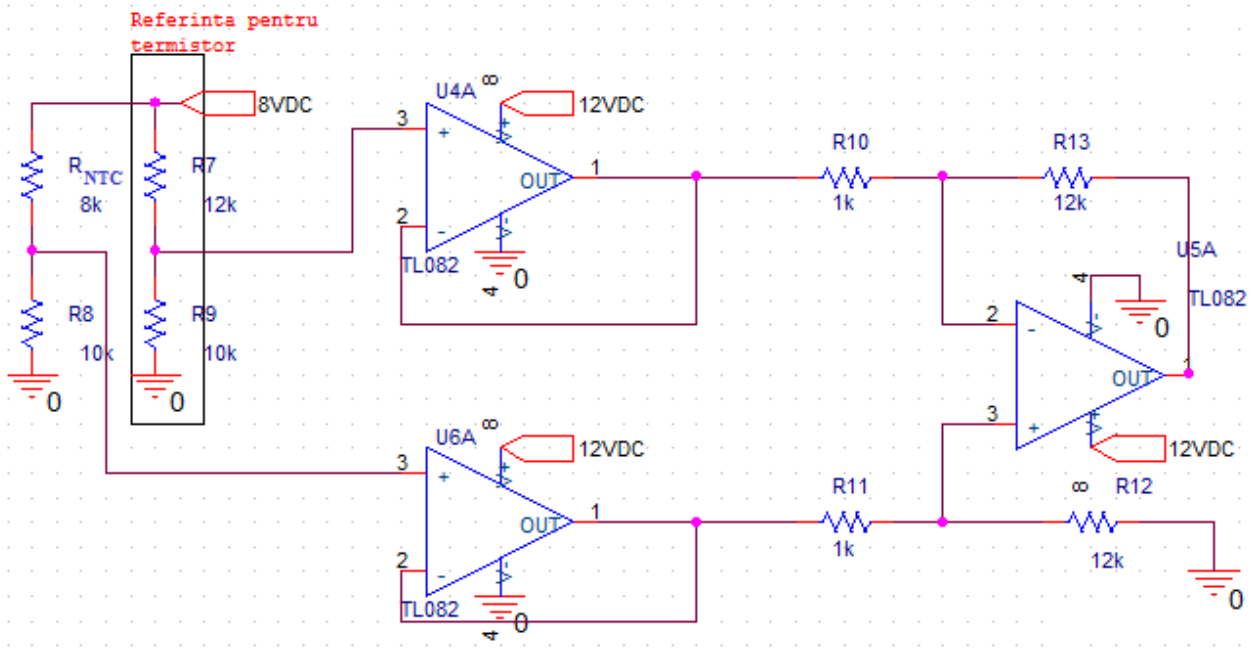
Temperature Control

- Linearized temperature measurement



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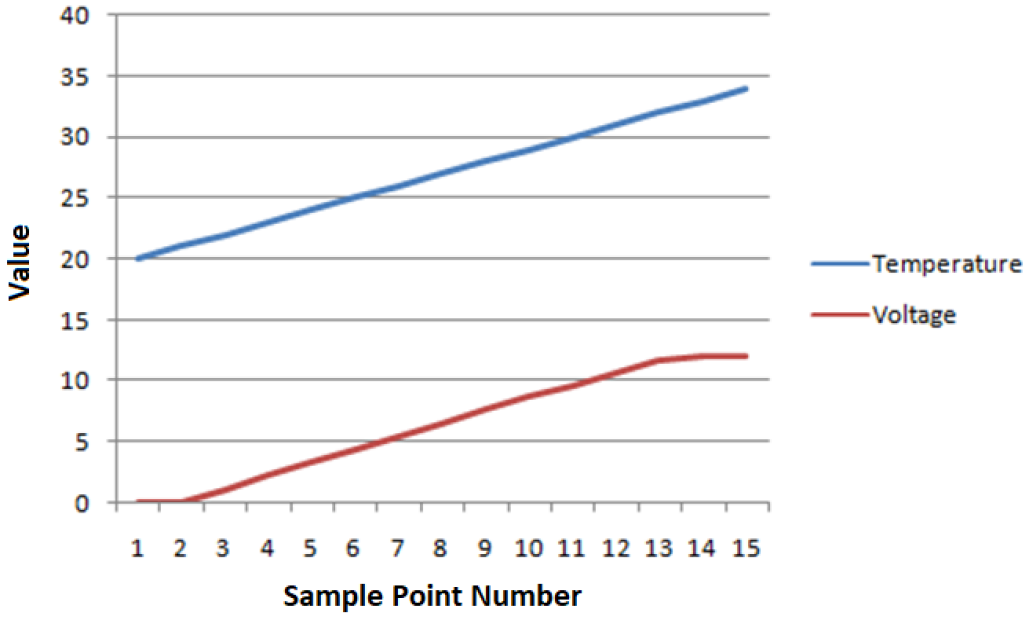
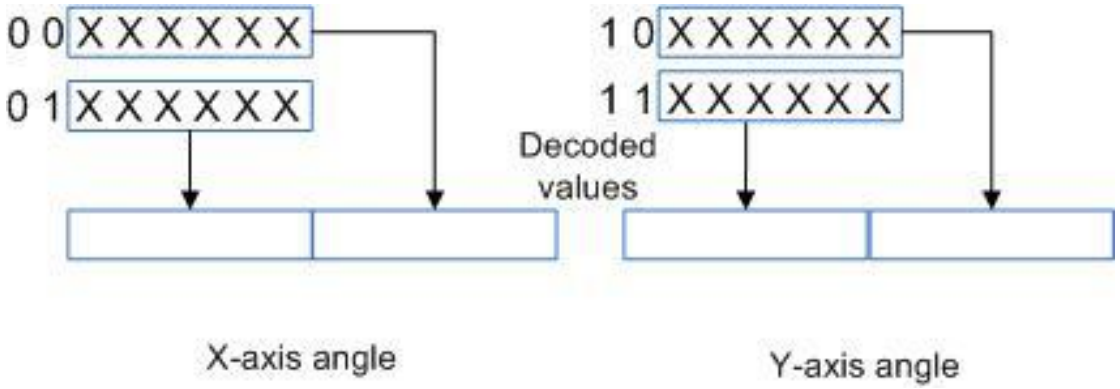
Temperature Control

- Temperature controller output voltage



Data Transmission

- Reserved Values (as function of angles):
  - ✓$\angle x=0$ – Laser power-off;
  - ✓$\angle y= 2^{12} - 1$ – Laser power-on;



Power Supplies

- Laser diode operation (continuous wave) requires constant current.
- Transient protection is necessary if switching power supplies are used, as well as overshoot or undershoot protection, for example for Ćuk, SEPIC or Zeta converters.

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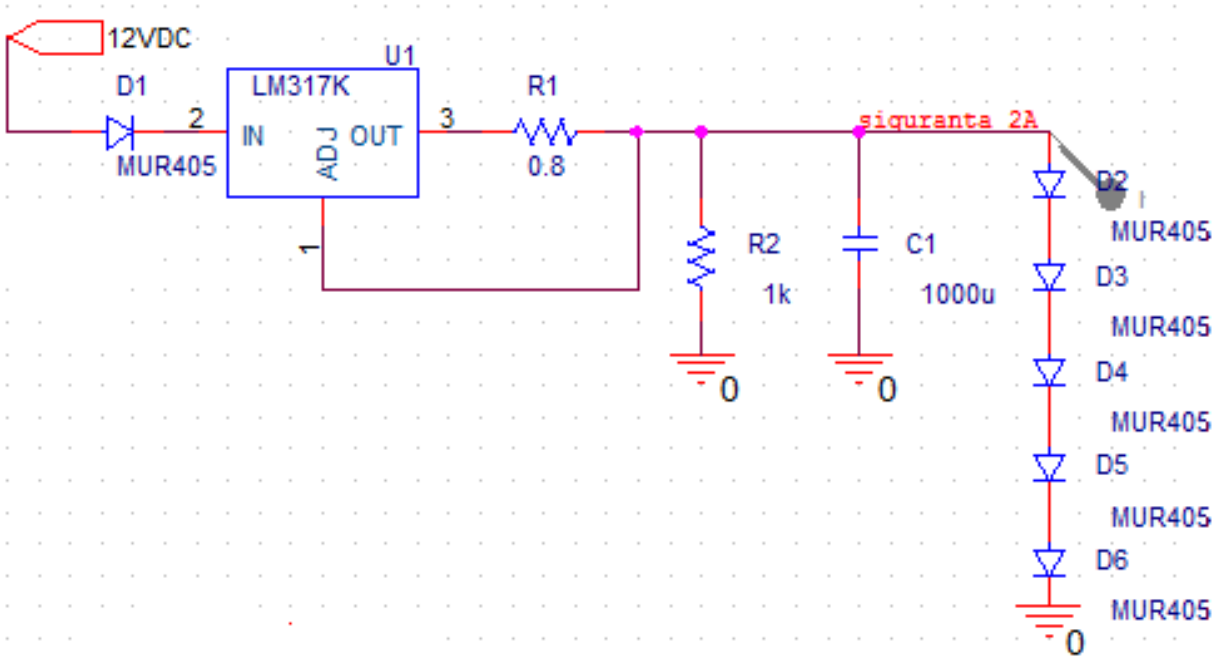
Power Supplies

- Constant current linear driver



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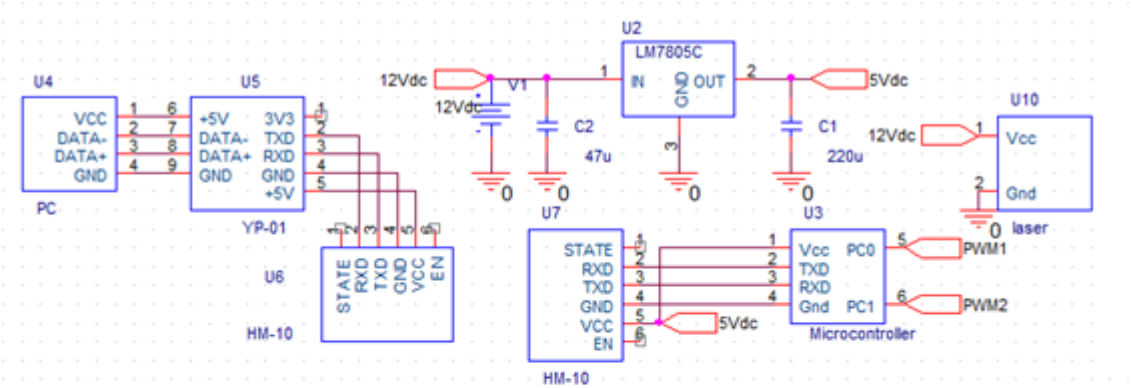
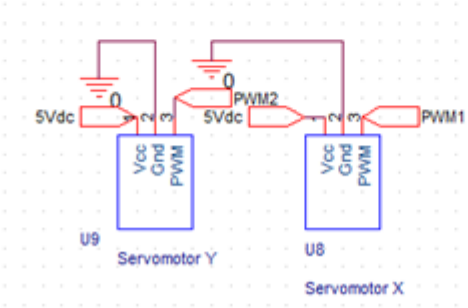
Power Supplies

- Constant voltage linear driver





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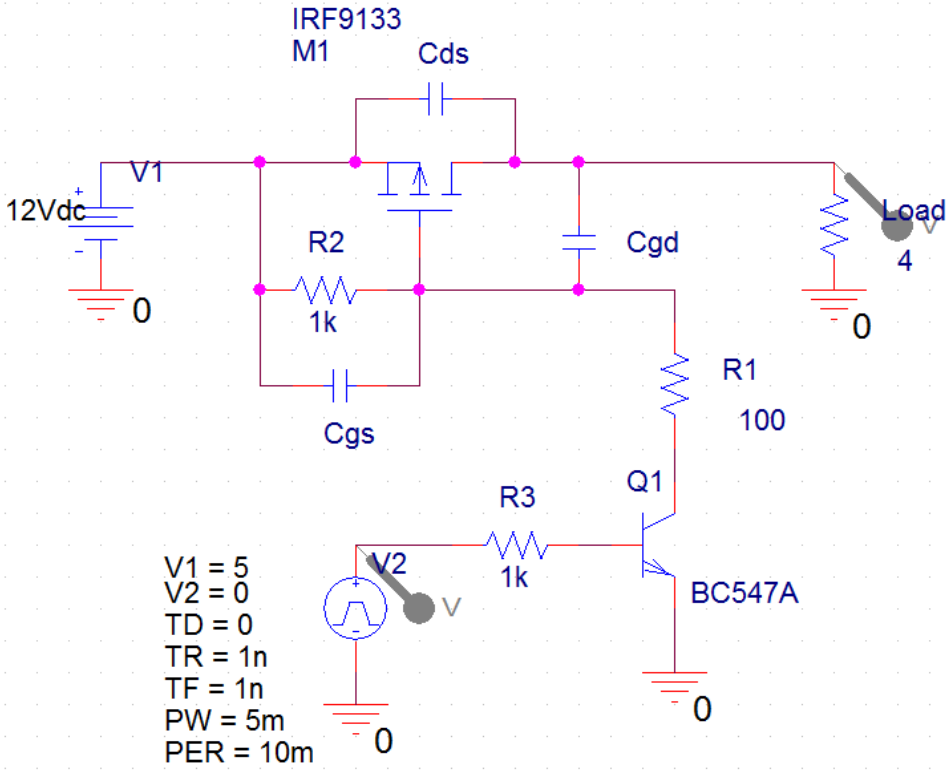
Power Supplies

- On-off laser state control from GUI



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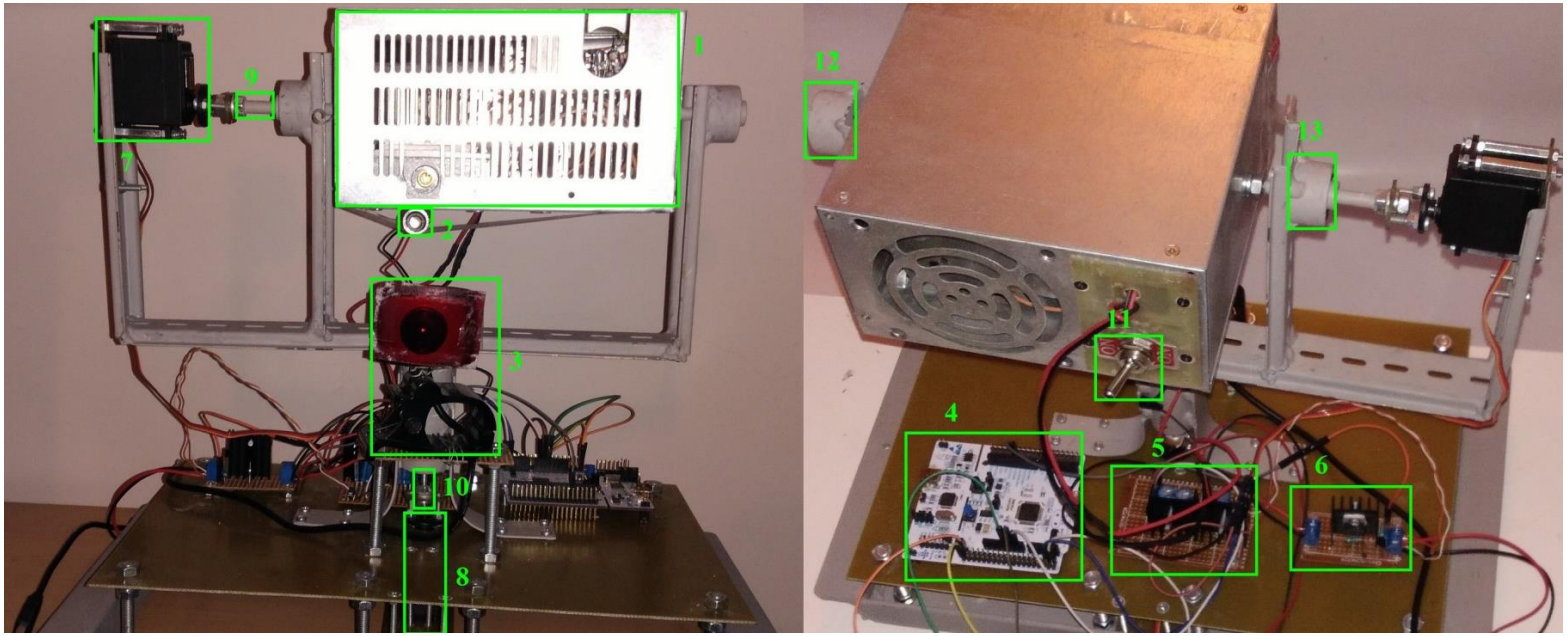
Implementation

- Prototype description



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Implementation

Components:

1. High-power laser;
2. Low-power laser;
3. Webcam and filter;
4. STM32F303RE Microcontroller;
5. Servomotor power supply;
6. On-off state control circuit;
7. Vertical axis servomotor;
8. Horizontal axis servomotor;
9. Servomotor axle;
10. Servomotor axle;
11. Switch;
12. 627RS bearing;
13. 627RS bearing.

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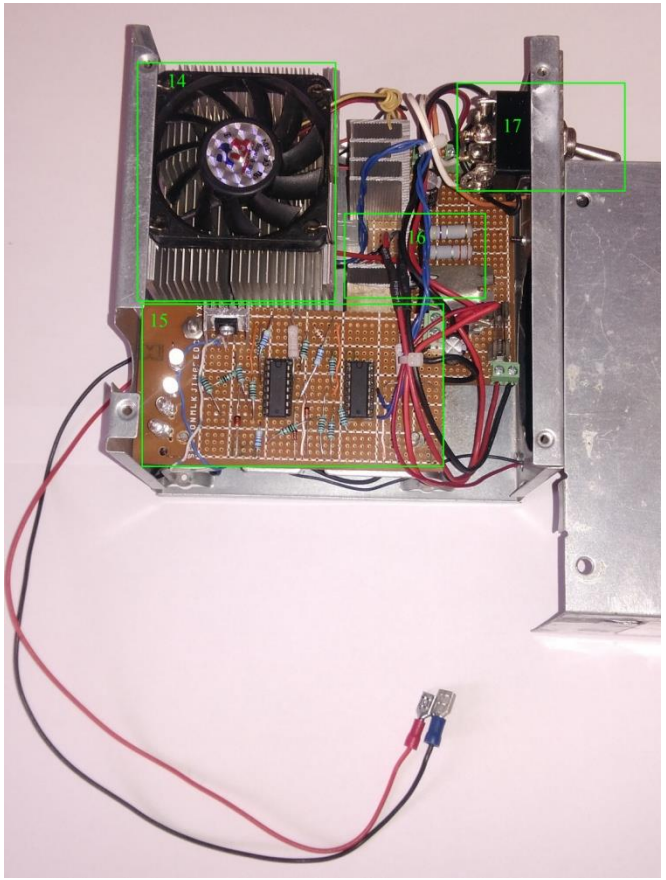
Implementation

Components:

14. Fan and heatsink (Peltier);
15. Thermistor resistive bridge;
16. Constant current driver;
17. Switch.



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Experimental Results

- Static (left side) and dynamic (right side) target detection

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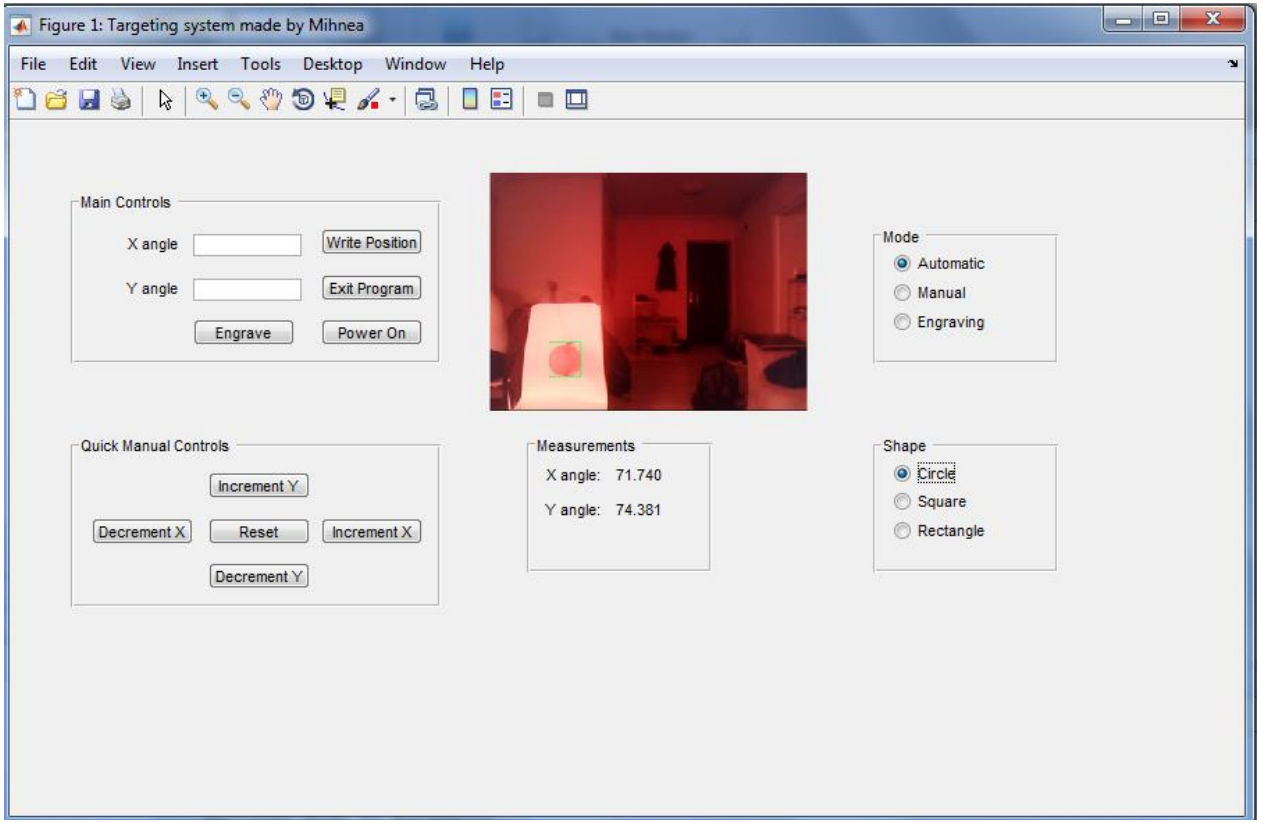
Experimental Results

- Matlab GUI



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Experimental Results

- Overview
  - https://youtu.be/bZ_fjSy511Q

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Conclusions

1. Laser prototype implementation
2. Closed-loop temperature controller design
3. Microcontroller and Matlab algorithms validation
4. GUI development and testing
5. Successful detection of static and dynamic targets

Thank you for your attention!