**Mission Statement**

High-speed rotating shafts are used as power for various applications such as agricultural semiconductors and robotics. The encoder is a sensor that converts the angular position of rotation into digital signals. As the speed and control accuracy of high-speed axes become more and more required. Ordinary digital circuits become unable to handle these digital signals accurately. This project aims to design a high-speed digital circuit to process the digital signals from encoders (20,000rpm). This circuit is capable of handling signals generated by high-speed encoders with synchronous or asynchronous frames. Also, the maximum reliable speed and robustness to noise of this circuit will be tested.

The project is broadly divided into two major milestones. The first milestone is the simulation of the circuit. Requires switching between different rate digital input positions to read out the rate and pulses per revolution of encoder. The second milestone is the building of a real-world FPGA-based circuit. Synchronize and antiphase pendulums are used to drive real-world encoders. The first milestone simulation circuit is expected to be completed by July 17th, and the second milestone real-world circuit is expected to be completed by August 7th.

The required resources are rotary encoder, Arduino Nano 33 IoT board, AX2 TinyFGPA, Arduino IDE, circuit building kit, electric pendulum, electric welding kit, TinyFPGA programmer and Lattice Diamond.

The prerequisites and preparatory tasks are:

1. reading and learning the user guide of Arduino and AX2 TinyFGPA.
2. Learning how encoder works.
3. Learning about the programming language of Arduino.
4. Learning the building of an electric pendulum circuit.

**References**

[1] R. Mardiyanto, J. Anggoro and F. Budiman, "2D map creator for robot navigation by utilizing Kinect and rotary encoder," 2015 International Seminar on Intelligent Technology and Its Applications (ISITIA), 2015, pp. 81-84, doi: 10.1109/ISITIA.2015.7219957.

[2] J. Wang and X. Cui, "Rotary Encoder Based Self-Positioning Method for Mobile Robot," 2018 5th International Conference on Information Science and Control Engineering (ICISCE), 2018, pp. 500-504, doi: 10.1109/ICISCE.2018.00111.

[3] TinyFPGA A-Series User Guide https://tinyfpga.com/a-series-guide.html

[4] Getting Started with Arduino products https://www.arduino.cc/en/Guide  
[5] Pendulum experiment https://github.com/practable/penduino

[6] RE36 rotary magnetic shaft encoders Data sheet https://www.rls.si/eng/fileuploader/download/download/?d=1&file=custom%2Fupload%2FRE36D01\_07.pdf