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RM-EBS 2022

**Mini Project:** AI-powered 2-DoF robotic arm manipulator for object tracking in real-time

**Intro:** autonomous robots and drone manipulations are the robotic community's new era. It enables the robot to interact with the environment and perform very complex tasks.

**Aim:** building an advanced digital circuit that controls a 2-DoF robotic arm based on object detection using AI and a camera system. The system utilizes the MPSoC board to gather data from the camera, run AI on the FPGA to identify the object/arm location, and perform control operations to move the motors to reach the same object/arm position. Imagine the robotic arm is following your arm movement 😊

https://www.youtube.com/watch?v=X61LvKh1IPs

**Project description:**

Design a digital circuit that takes a camera as input and interfaces with two motors (Dynamixel ax-12a). The circuit processes heavy computational tasks (AI) on its FPGA while interfacing seamlessly with the motors using ROS2 on its CPU.

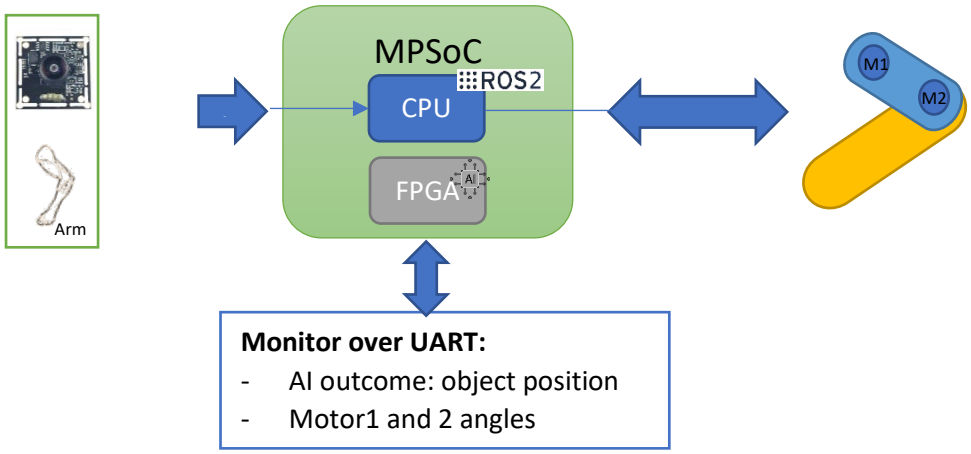
Task 1: Train an AI network to recognize your arm position in the x,y domain.

Task 2: Once the position is identified, use inverse kinematics to calculate the position of each motor. The kinematics equations can run on the CPU or the FPGA*.

Task 3: interface with the motors using ROS2 and send the calculated position to them.

*Rationalize between the CPU and the FPGA to reach real-time performance.

The concept of the project:




* For inspiration: https://automaticaddison.com/how-to-build-a-2-dof-robotic-arm/

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**Document the outcome:**

- Explain in detail the developed components/interfaces in your project.
- Explain how the digital design is working. You may use a flow chart to show how the data are transferred between the developed units.
- Explain how the project is tested (simulation and real world).

Use parts of the code and screenshots from the simulation to answer these questions. Make 5 minutes video to explain how the project works. Upload the video to YouTube or other media channels and add the link to the report.

The page limit is 15 pages (maximum). The submission should include the report in pdf format and a link to the developed code.
Submission is in DigitalExam. Submission deadline: 23:59 15/01/2023.