

Milestone I Presentation

FPGA for Machine Learning on a Drone

Capstone Team 109

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<https://capstone-skynet.github.io>



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Presentation Overview

Context and Purpose
 Requirements
 Constraints
 Risks
 Risk Mitigation
 Viability of the Project
 Solution Path



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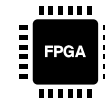
Why?

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Context & Purpose

Increasing **machine learning** and **drone** applications

No existing combination of FPGA + ML + drone on the market



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Context & Purpose

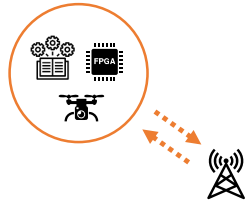
Want to combine all of them → **computing platform**

- Accelerate ML using FPGA
- FPGA on deployed on the drone

For client's **ML research**

Communicate with ground station

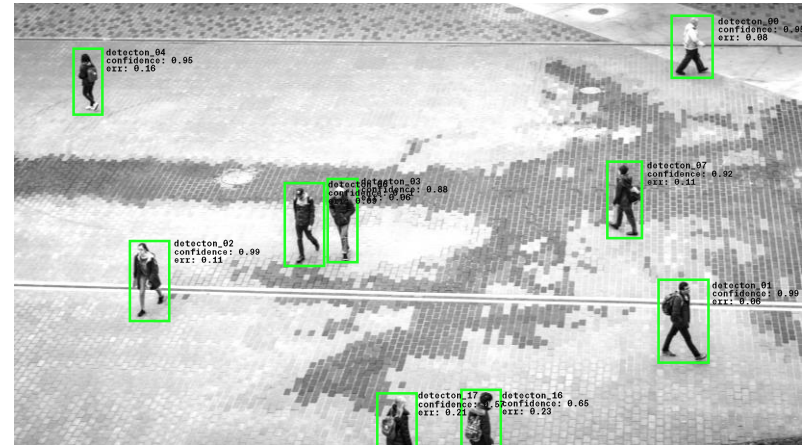
Detect pedestrians from above



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Requirements & Constraints

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Requirements



Integrated Drone Requirements

- Capable of flying with the computing platform
- Flight duration at least 10 minutes
- Remote controlled by the pilot

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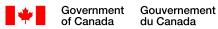
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Requirements

Drone Legal Requirements

- Operation is compliant with *Transport Canada*
- Tests inside YVR controlled airspace is permitted



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Requirements

Data Transmission Requirements

- Data processed on the drone transmitted to ground station
- Ground station receives and display data to the operator
- Transmission via WiFi (2.4GHz or 5.2GHz)

Machine Learning Requirements

- Machine learning model fits on FPGA
- Model detects pedestrians and outputs bounding boxes



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Requirements

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Constraints



Time & Budget

- Limited to C\$1,000
- Limited time to perform 2 sub-projects
- Coordination and leadership is challenging



Future-Proofing

- FPGA chip area big enough for future ML models



Power & Weight

- Battery power is limited
- Weight and power draw affects flight duration
- Portability



Data Transmission

- Limited bandwidth for data
- Limited power emission
- Limited range

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Viable?

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Viability

Assess system feasibility on 3 objectives:

1

Integration of FPGA with a Drone

2

Air-to-Ground Data Transmission

3

ML Implementation on FPGA

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Viability

All three objectives individually has existing solutions

1

Integration of FPGA with a Drone



Aerotenna FPGA flight controller

2

Air-to-Ground Data Transmission



DJI DATALINK

3

ML Implementation on FPGA



SymbioticEDA MARLANN

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Viability

Combination of the three will further this field of research

This project is a **proof-of-concept**

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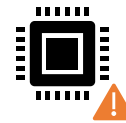
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Risks?

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Risks



Hardware

- Flight crashes
- Loss of FPGA
- Loss of drone



Management

- Insufficient commitment
- Poor task management
- Poor decision making



Legacy

- Low reparability / maintainability
- Client doesn't know how to operate



Software

- Tech. debt
- Inadequate documentation

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Risk Management

We keep track of an updated copy of the **risk profile**

Active mitigation on risks with index ≥ 0.4

- Triage tasks to mitigate risk
- Weekly update on risk status

Passively monitoring on risks with index < 0.4

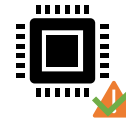


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Risk Management



Hardware

- Follow safety protocol
- Only power on when absolute ready



Management

- Weekly updates and status report on assigned tasks
- Timeline closely tracked



Legacy

- Actively updating all documents alongside changes



Software

- Version tracking
- Code review

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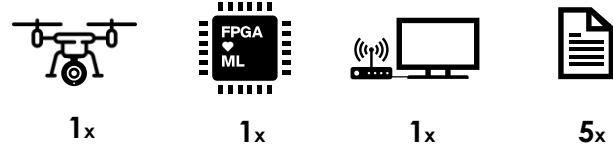
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Solution?

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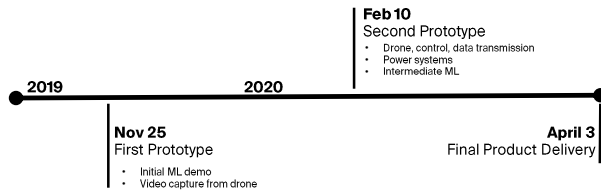
Deliverables



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Deliverable Dates



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Immediate Steps



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<p>Context & Purpose</p> <p>Identify the overall objectives of the project and the specific goals to be achieved. This includes the scope, the stakeholders, and the resources available.</p>	<p>Context & Purpose</p> <p>Identify the overall objectives of the project and the specific goals to be achieved. This includes the scope, the stakeholders, and the resources available.</p>	<p>Requirements</p> <p>Identify the specific requirements of the project, including the functional and non-functional requirements. This includes the user requirements, the system requirements, and the performance requirements.</p>	<p>Requirements</p> <p>Identify the specific requirements of the project, including the functional and non-functional requirements. This includes the user requirements, the system requirements, and the performance requirements.</p>
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