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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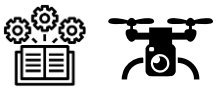
Context & Purpose

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

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



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Context & Purpose

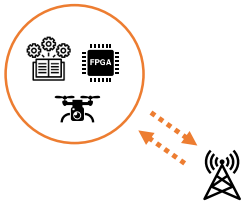
Want to combine all of them → ***computing platform***

- 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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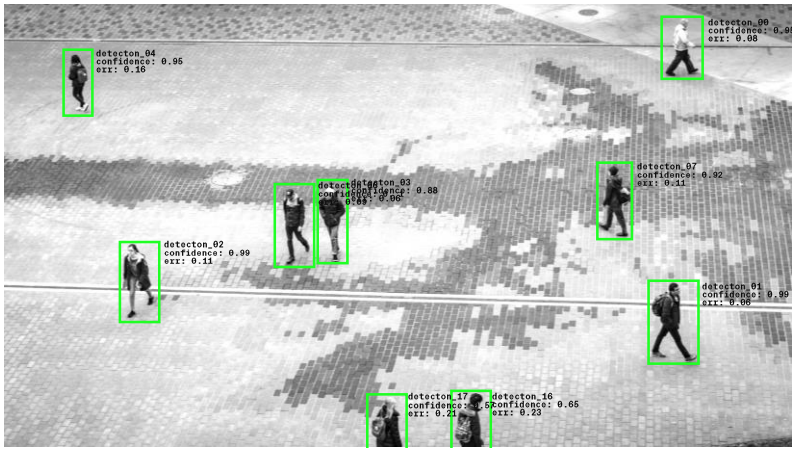

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Requirements & Constraints

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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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Requirements

Drone Legal Requirements

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

Government of Canada / Gouvernement du Canada

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

Requirements

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Machine Learning 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

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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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 repairability / 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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Solution?

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Deliverables

1x

1x

1x

5x

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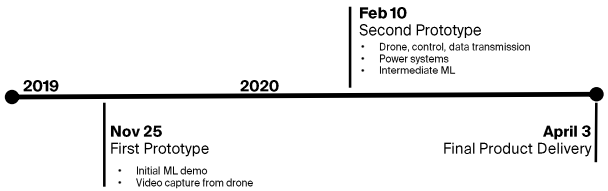
Deliverable Dates



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Immediate Steps

Start **Small**

- Function over scale
- Integrate existing model

Start **Quickly**

- Create purchasing plans
- Tool setup takes time

Start **Legally**

- Drone registration
- Pilot and radio certifications

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Q?

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Q?

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