Slide 1

Milestone I Presentation

FPGA for Machine Learning on a Drone

Capstone Team 109

Peter Deutsch — me@peterdeutsch.ca
Muchen He — i@muchen.ca
Arthur Hsueh — ah11962@outlook.com
Meng Wang — wzfftxwd@gmail.com
Ardell Wilson — ardellw96@gmail.com

https://capstone-skynet.github.io

1

Slide 2

Presentation Overview

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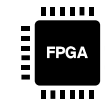Viability of the Project
Solution Path

2019-10-17

2

2

Slide 3

Why?

3

Slide 4

Context & Purpose

Increasing *machine learning* and *drone* applications

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

FPGA

2019-10-17

4

4

Slide 5

Context & Purpose

Want to combine all of them → *computing platform*
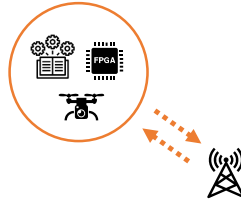
Accelerate ML using FPGA
FPGA on deployed on the drone

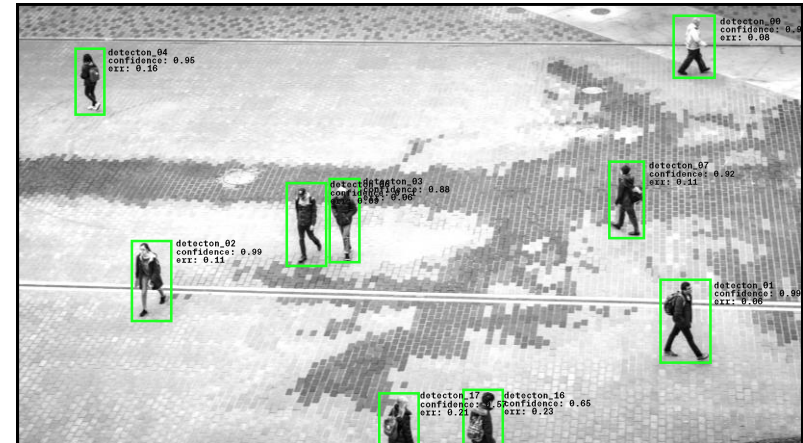Communicate with ground station

Detect pedestrians from above

For client's research in ML

5

Slide 6

6

Slide 7

Requirements
&
Constraints

7

Slide 8

Requirements

Integrated Drone Requirements

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

8

Slide 9

Requirements

Drone Legal Requirements

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

Government   Gouvernement
of Canada   du Canada

2019-10-17

Slide 10

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

2019-10-17   10

Slide 11

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

2019-10-17

Slide 12

Constraints

Time & Budget	Future-Proofing	Power & Weight	Data Transmission
Limited to C$1,000	FPGA big enough for future ML models	Battery power is limited	Limited bandwidth for data
Limited time to perform 2 sub-projects		Weight and power draw affects flight duration	Limited power emission
Coordination and leadership is challenging		Portability	Limited range

2019-10-17   12

3

Slide 13

Risks?

Slide 14

Risks
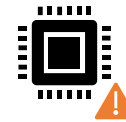
Hardware	Management	Legacy	Software
Flight crashes	Insufficient commitment	Low repairability / maintainability	Tech. debt
Loss of FPGA	Poor task management	Client doesn't know how to operate	Inadequate documentation
Loss of drone	Poor decision making		

Slide 15

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
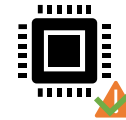
Active monitoring on risks with index < 0.4

Slide 16

Risk Management

Hardware	Management	Legacy	Software
• Follow safety protocol	• Weekly updates and status report on assigned tasks	• Actively updating all documents alongside changes	• Version tracking
	• Timeline closely tracked		• Code review

4

Slide 17

Viable?

17

Slide 18

Viability

Assess system feasibility on 3 objectives:

1 **2** **3**

Integration of FPGA with a Drone | Air-to-Ground Data Transmission | ML Implementation on FPGA

18

18

Slide 19

Viability

All three objectives individually has existing solutions

1 **2** **3**

Integration of FPGA with a Drone | Air-to-Ground Data Transmission | ML Implementation on FPGA

Aerotenna FPGA flight controller | DJI DATALINK | SymbioticEDA MARLANN

19

19

Slide 21

Viability

Combination of the three will further this field of research

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

21

21

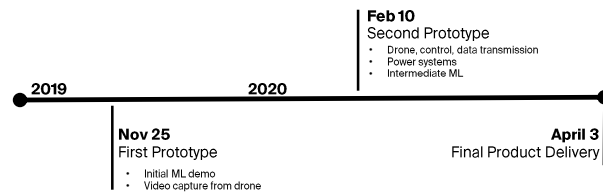## Solution?

22

Deliverables

1x   1x   1x   5x

2019-10-17   23

23

Deliverable Dates

Feb 10
Second Prototype
- Drone, control, data transmission
- Power systems
- Intermediate ML

2019   **2020**

Nov 25
First Prototype
- Initial ML demo
- Video capture from drone

April 3
Final Product Delivery

2019-10-17   24

24

Immediate Steps

Start **Small**   Start **Quickly**   Start **Legally**

- Function over scale
- Integrate existing model

- Create purchasing plans
- Tool setup takes time

- Drone registration
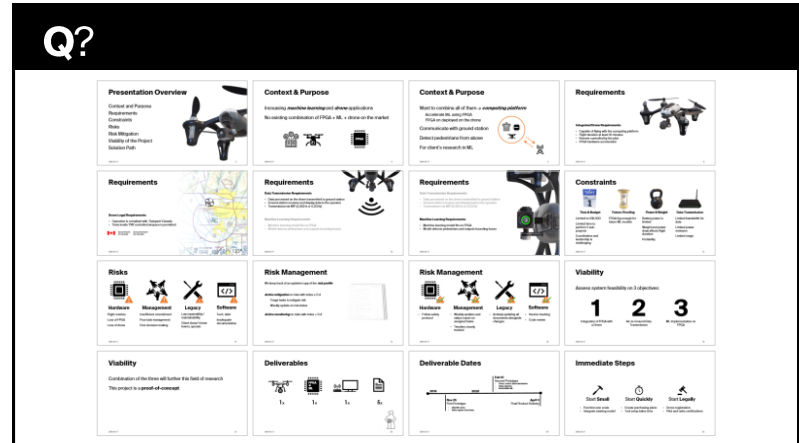- Pilot and radio certifications

2019-10-17   25

25

Q?

26

Q?

27

Thanks For Listening: Milestone I Presentation

FPGA for Machine Learning on a Drone

Capstone Team 109

Peter Deutsch — me@peterdeutsch.ca
Muchen He — i@muchen.ca
Arthur Hsueh — ah11962@outlook.com
Meng Wang — wzfftxwd@gmail.com
Ardell Wilson — ardellw96@gmail.com

https://capstone-skynet.github.io

28