Software Engineering Project in Helsinki University CS

Origami

11/01/2023

Basic info (1/2)

- Here's the original announcement
- Here's our proposal
- 5 students are assigned to our project, no info for their skill level yet.
- 15 hours / week / student is expected.
- 14 weeks (week 3-16) is scheduled.
  - 15 hours * 14 weeks * 5 students
  - = 1050 hours / 7.5 hour
  - = 140 man days / 22
  - = 6.4 man month.
  - Which unit for SBI workload? (e.g. 3 hours, 7.5 hours or 15 hours)

Basic info (2/2)

- Milestone 1: MWC is at the end of FEB. on **week 9**.
- Milestone 2: NEXUS Demo day is on 27th March on **week 13**.
  - week 3-16, 14 weeks, originally
  - week 3-14, 12 weeks, preferably
  - week 3-12, 10 weeks, ideally
- 15 hours * 14 weeks == 210 hours
  1. 210 hours / 14 weeks == 15 hours/week, originally
  2. 210 hours / 12 weeks == 17.5 hours/week
  3. 210 hours / 10 weeks == 21 hours/week
- UI (Dashboard & Control panel) parts should be prioritized.

Project goal (1/2)

We will reproduce Roberto's demo video, adding its ML training phase. While Roberto's demo uses relatively large hardware which may not belong to TinyML precisely (e.g. TinyML run on RTOS but not on Linux), those hardware (e.g. Jetson nano) usually come with a mature ready-made tool-stack to run ML examples immediately. There are 4 benefits of making use of Roberto's demo for this project.

1. Jetson nano is a standalone GPU, where we run the following app locally at once before starting pipeline of other nodes.
   - Computer vision app, inc. ML models
   - dashboard on a webserver
   - jupyter notebook

Project goal (2/2)

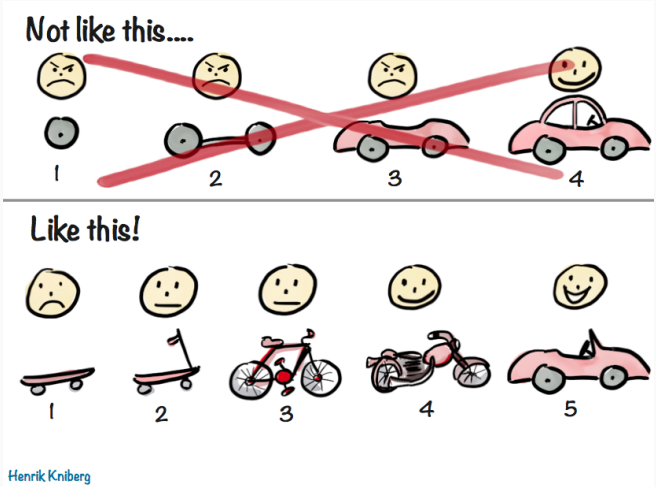
2. We could learn from Jetson nano mature tool-stack what kind of tool-stack is still missing to implement TinyMLaaS.
3. We could start with this existing demo immediately in runnable CI, and
4. We are polishing it more fancy gradually towards TinyML as-a-Service.
5. We could gradually migrating to TinyML by adding or replacing a node one by one.

- For example, we could replace the data acquistion node with:
  - camera + Arduino Nano 33 BLE Sense + RPI (for IP)
  - camera + RPI pico with WiFi

Our final goal is to run ML on a mirocontrooler node but it's better to start with the safer configuration at first.

MVP journey

We should always have a runnable MVP automatically generated by CI/CD at every Sprint.

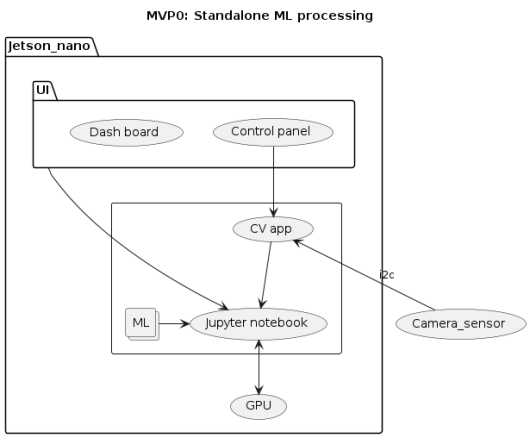


MVP0

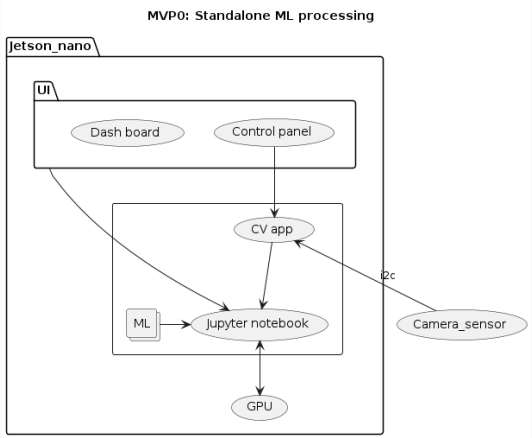
Jetson nano is almost a laptop with GPU so that everything should work standalone.

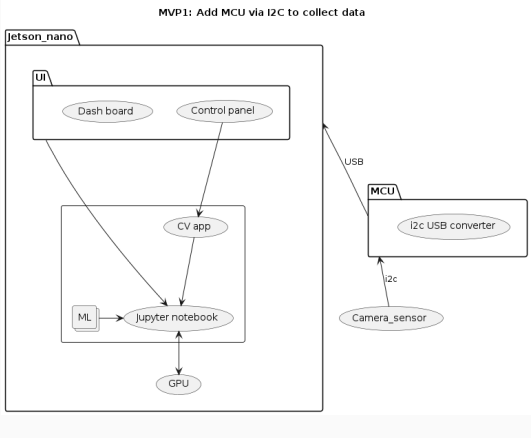
ML pipeline

1. Object detection
2. -> face detection
3. -> Person identificaion pipeline



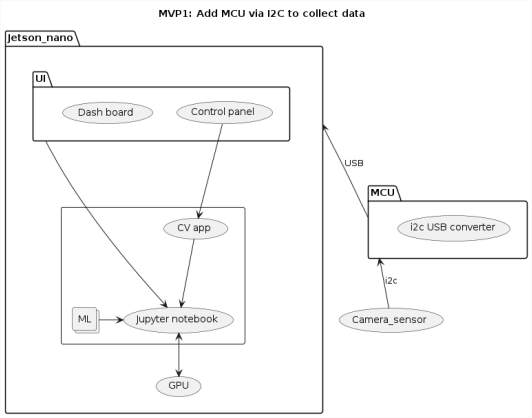
MVP0 -> MVP1

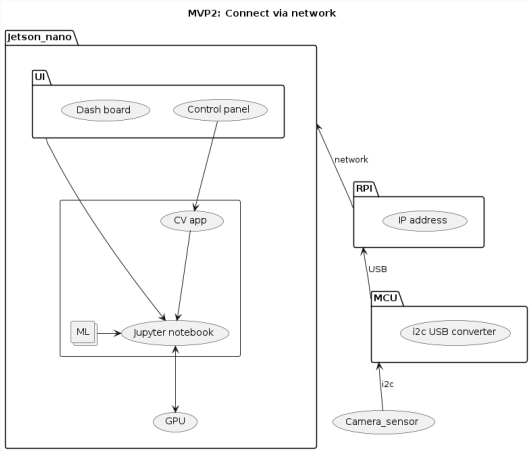




At first, we could push sensor part out via I2C.

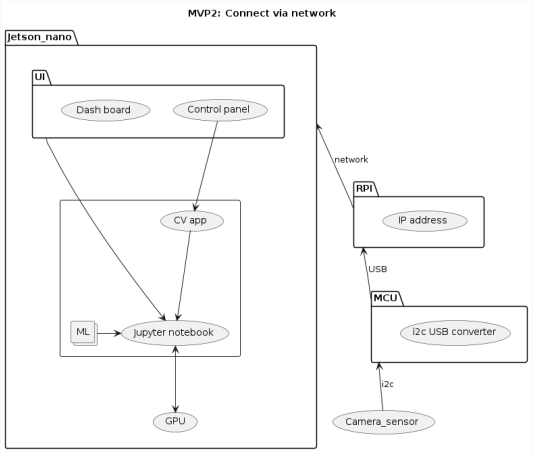
MVP1 -> MVP2

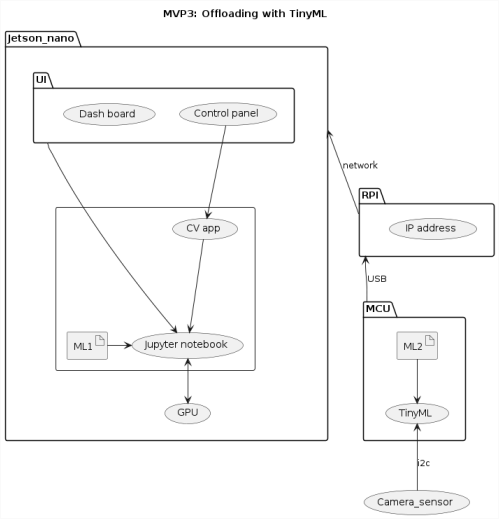




To orchestrate ML, IP connection is convenient so that we insert RPI between Jetson and MCU.

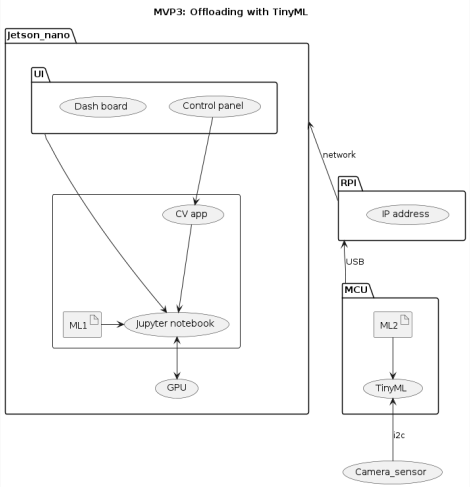
MVP2 -> MVP3

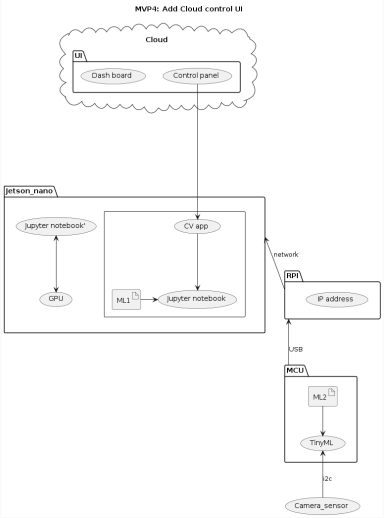




Run a small part of ML processing as TinyML on MCU.

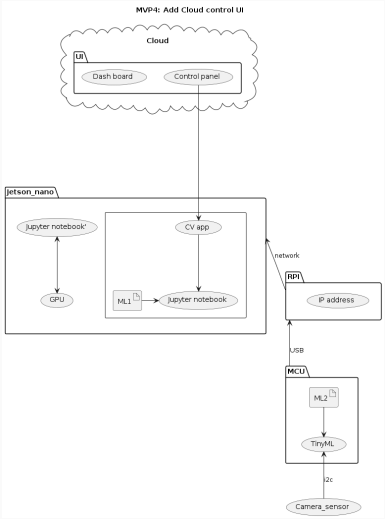
MVP3 -> MVP4

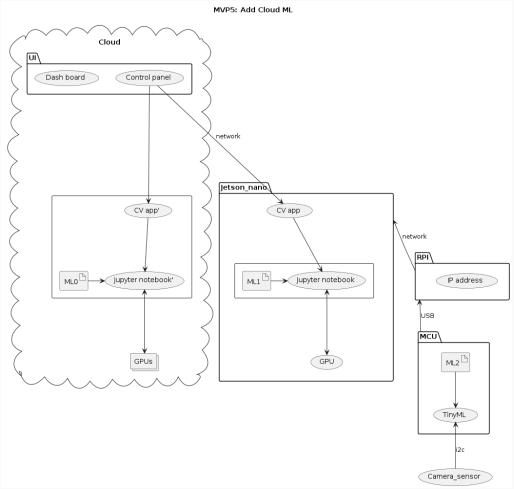




Factor out UI part on Cloud. (e.g. ELK stack?)

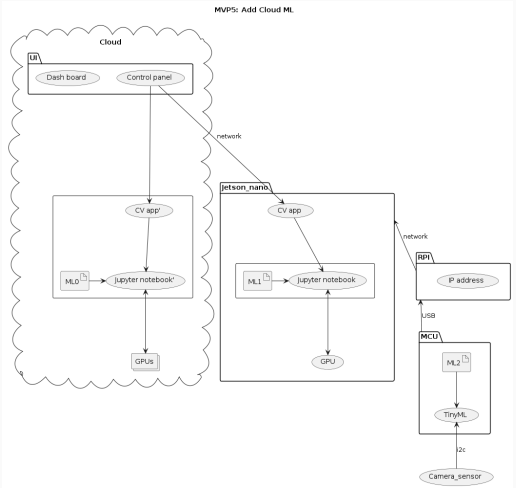
MVP4 -> MVP5

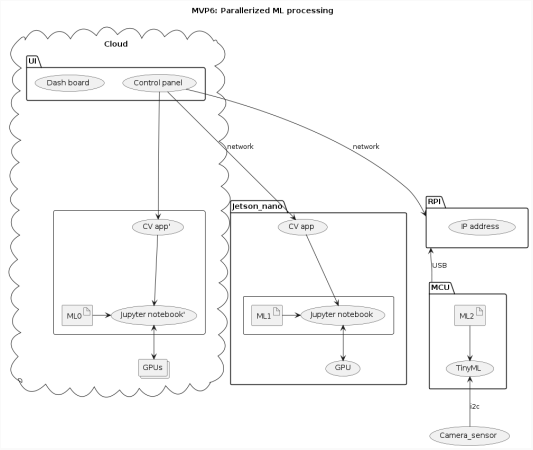




Run some part of ML processing on Cloud.

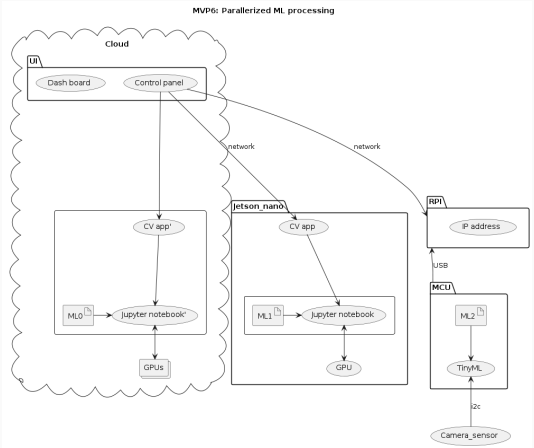
MVP5 -> MVP6

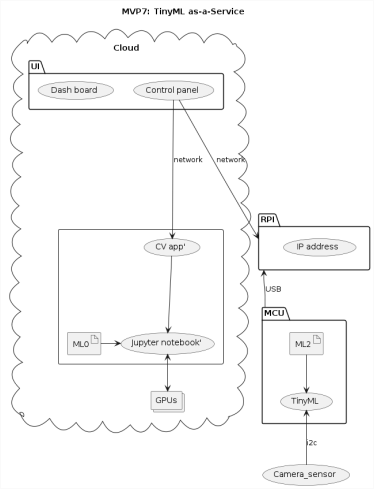




No need to cascade MLs so that Cloud control panel commands each node independently.

MVP7





We could get rid of Jetson nano if feasbile.

Kick-off meeting Agenda (1/3)

Scheduled on 16th JAN (MON)

Get familiar with all participants.

- Everyone introduces oneself
  - what he can do
  - what he wants to do
  - how he understand this project

Explain the Project goal

- We should present demo video.

Set up a SCRUM team (e.g. specify each role in the project)

- SM: Michi + a HU instructor
- PO: Roberto
- Developer: 5 students
- ML: Hiroshi

Kick-off meeting Agenda (2/3)

User story mapping

- Specify PBIs always as GitHub issues, which need to be a PR and it automatically runs CI/CD as acceptance tests.
- Estimate PBI effort
- Specify acceptance tests
- 1 increment == 2 sprint
- 1st sprint planning should be done on 16th.

Kick-off meeting Agenda (3/3)

Agree on WoW in SCRUM

- Use Github project KANBAN
- Use Discord channel to communicate or Slack?
- Agree on scheduling a Daily meeting day & time
- 1 increment == 2 sprint
- 1st sprint should have some Architecture investigation to find out which components are reusable.
- 1st sprint should have a ZFR (Zero Feature Release) to make sure that CI/CD works on Github workflow (action) without any features (or just with existing components)
- We should run CI/CD to reproduce the current Roberto's demo story at first, without a training part. If HW is not available, it could be simulated.

Architecture investigation

- How should we understand Roberto's demo architecture?
  - Any architecture document?
  - Any architecture block diagram?
  - Any flow diagram?
  - Any list of components used? which could be reused and which not, since the outcome of this project would be opensource'ed.
  - Any list of software frameworks each components uses?
- Should we map each Seamless TinyML lifecycle management's phase on this demo scenario?
- Should we make sure which phases are still missing? (e.g. "2. Model training")

Mapping

Phase #	Name	Early phase	Demo
1	Data collection	Simulated	RPI pico + Cam
2	Model training	Missing	On Cloud VM?
3	Model squeezing	ML compiler	ML compiler
4	Model splitting	Standalone	Pipelining
5	Model deployment	Standalone	TBI
6	Model update	Dashboard	Control panel

Questions

- What's the main purpose of this project from students' perspective? (e.g. experience Agile development)
- How long can the 16th meeting be allocated? (e.g. 3-4 hours with lunch break)
- What kind of competency are students generally expected? (e.g. Python, JS, Java, Frontend, Embedded)
- Can student's weekly working hours be negotiable? (e.g. 15 hours with 14 weeks -> 17.5 hours with 12 weeks)