Modeling Education using xtUML and multi-copter (in Japan/Thailand)

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Agenda

- Modeling education using xtUML and multi-copter
  - For (future) professionals
  - For junior high school students

Background

- Modeling education is important

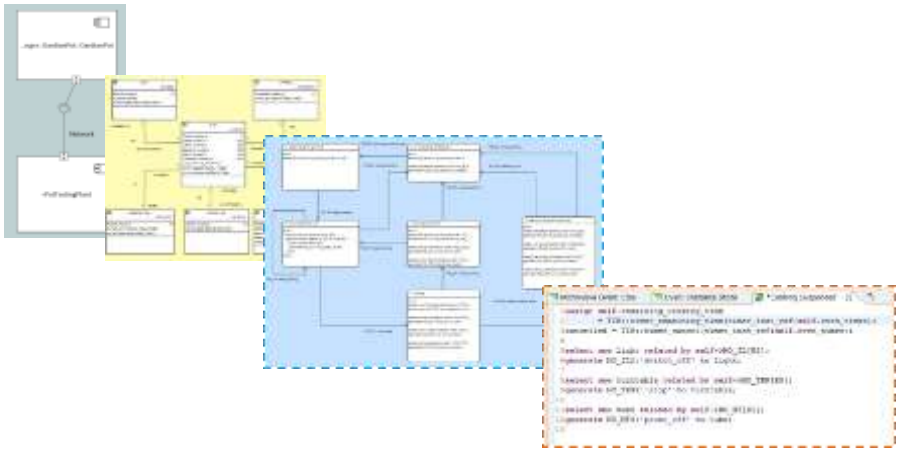
- For professionals
  - Describe huge and complex systems

- For non-professionals
  - Computational Thinking
  - Abstraction
    - Find elements and relationship between them
  - Algorithm
    - Find procedure to solve a problem

xtUML in Education

- Separation of design and implementation (codes)
  - Students concentrate to design
- Quick feedback from execution results
  - Simulation using verifier
  - Code generations using model compiler
- Easy to keep motivation
  - Students bore or afraid of writing non-executable model

BridgePoint



DJI Tello

- Fun ☺
  - Easy to use
  - Attractive for students
- Safe
  - High stability
  - Small and light
- Remote control via WiFi
  - Send control commands
  - Receive video
- SDK is provided
  - Combine other library such as OpenCV



Case 1: APRIS Robot Challenge 2018

Nov, 2018.

APRIS 2018 @ Phuket, Thailand



Overview of APRIS Robot Challenge

- Objective
  - APRIS Robot Challenge is a special event of APRIS. The event aims to provide an education to develop embedded systems which required us to learn inter-disciplinary skills such as software, electrical, and mechanical engineering. Attendees can learn these skills through Project-Based Learning in which develops an autonomous multi-copter system.

- Attendees
  - Thai 58 students
    - Most of Thai students study EE not CS
  - Japanese 23 students

- Co-located two days events of APRIS

Timetable

Nov. 1	10:00 – 10:10	Opening
	10:10 – 11:00	Installation, Basics of Tello Control
	11:00 – 12:00	Control Programming(Step by step programming for controlling quad-copter using python)
	12:00 – 13:00	Lunch
	13:00 – 15:30	Cont.
	15:30 – 18:00	**System Analysis and Design (Refinement from given requirements to design using UML behavior diagram)**
Nov. 2	9:00 – 14:00	Project-Based Learning
	14:00 – 15:00	Contest
	15:00 – 16:00	Presentation
	16:00 – 17:00	1-hour event
	17:00 – 17:10	Closing Remark

Overview of this lecture

- Goal
  - Why should we model?
  - Development process using *models*
- Process
  - Step-by-step hands-on
    - Using real programs and drawings
  - Adding functions
    - Simple sequencer (Ver. 1)
    - CSV sequencer (Ver. 2)



Photo of Heritage

A0 poster paper



AR-Marker

How to compete

- You can try as much as pos
  - Best time and performance a
- Committees decide a winn results.
  - How many requirements do
  - Speed
    - From taking off at the start poin the investigation area.
  - Accuracy
    - Turn to the correct direction at
    - Landing position.
    - The number of defects.
      - Type of defects (even or odd nu

APRIS2018

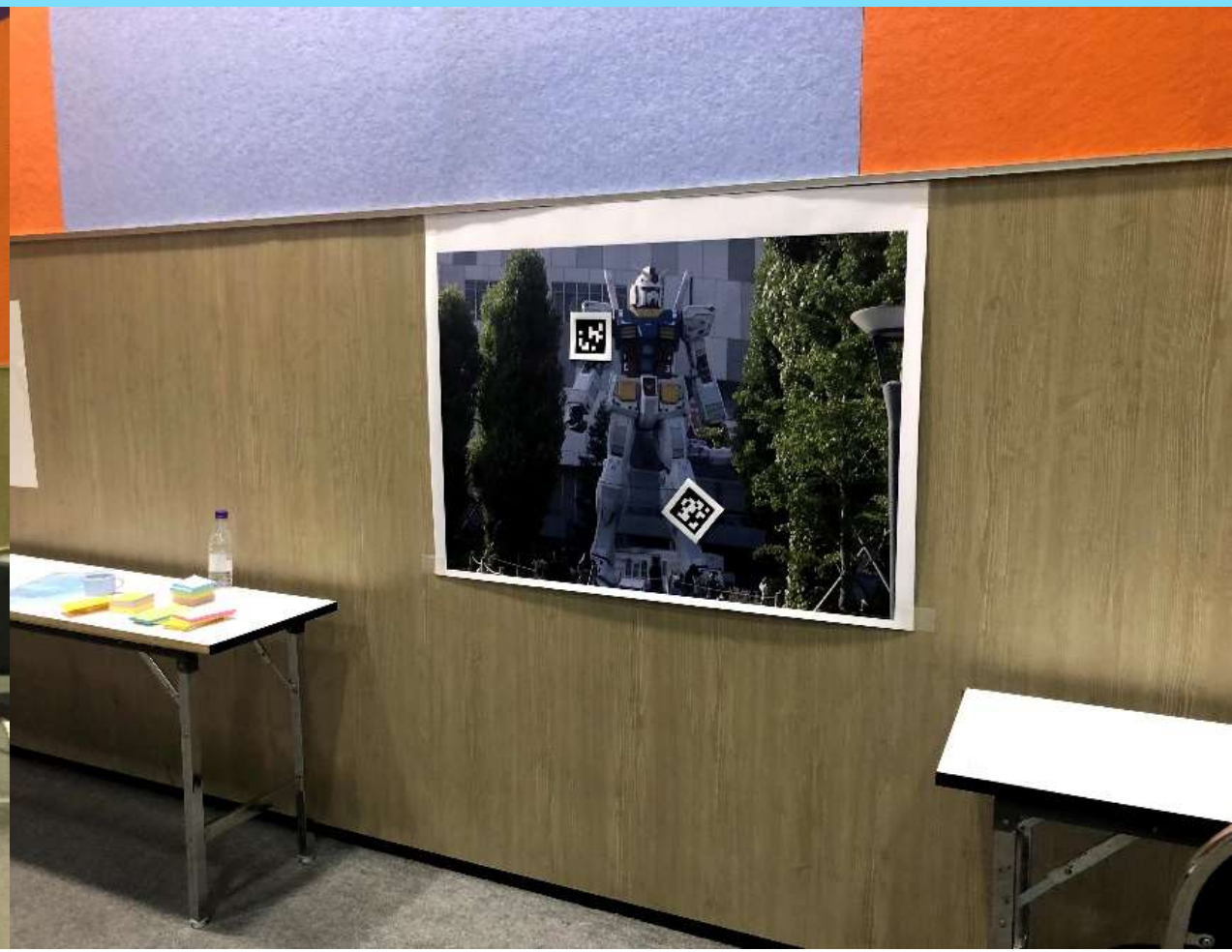
Final Presentation

- 5minuites including Q and A
- Spoken in English

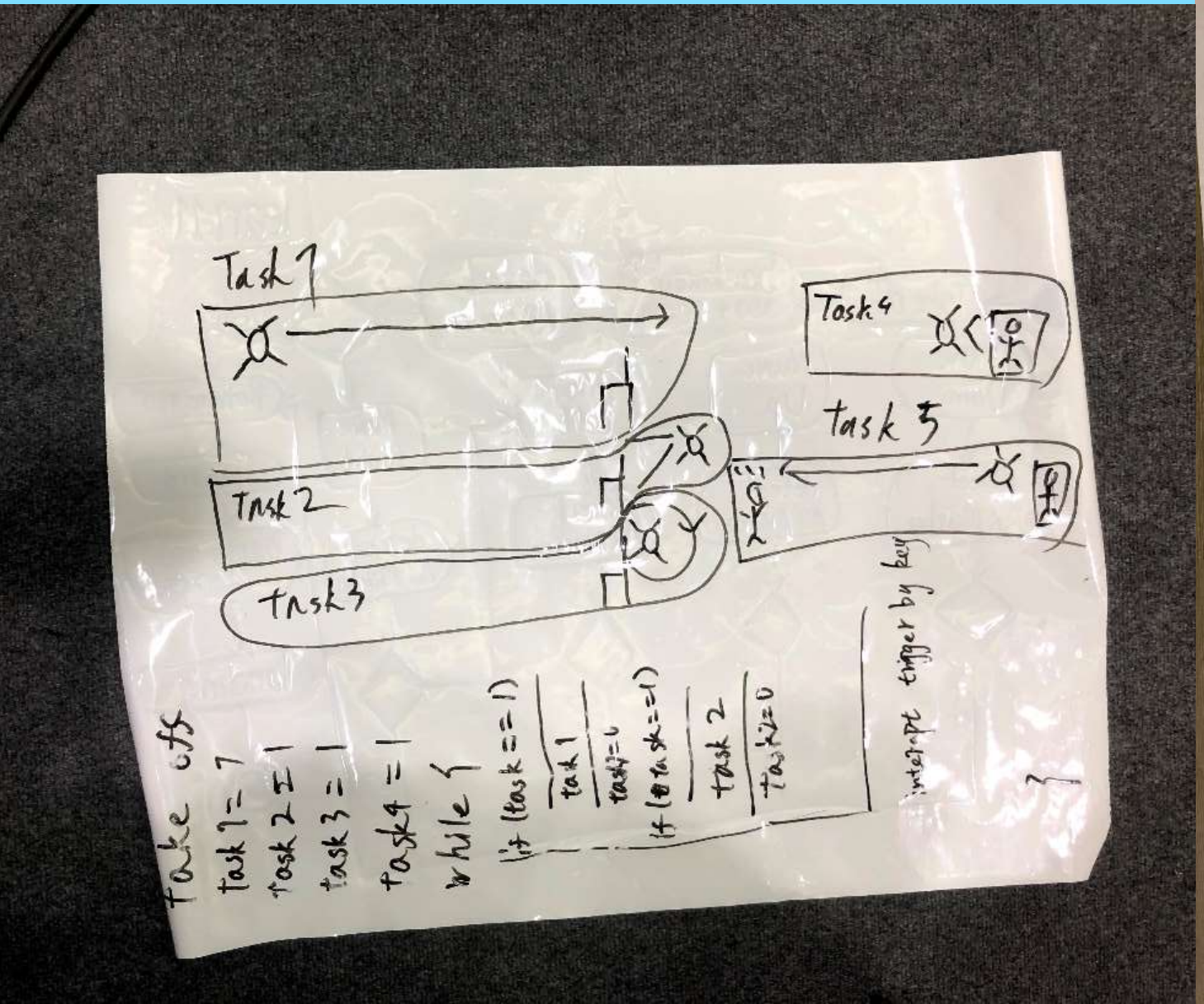
1. Goal with keywords
   - What is a characteristic problem?
2. Method including models
   - How to solve this problem
3. Plan with Scrum keywords
4. Reflection
   - What is the most impressive thing?
   - What do you feel happy and unhappy?
   - What do you want to challenge in the next time?

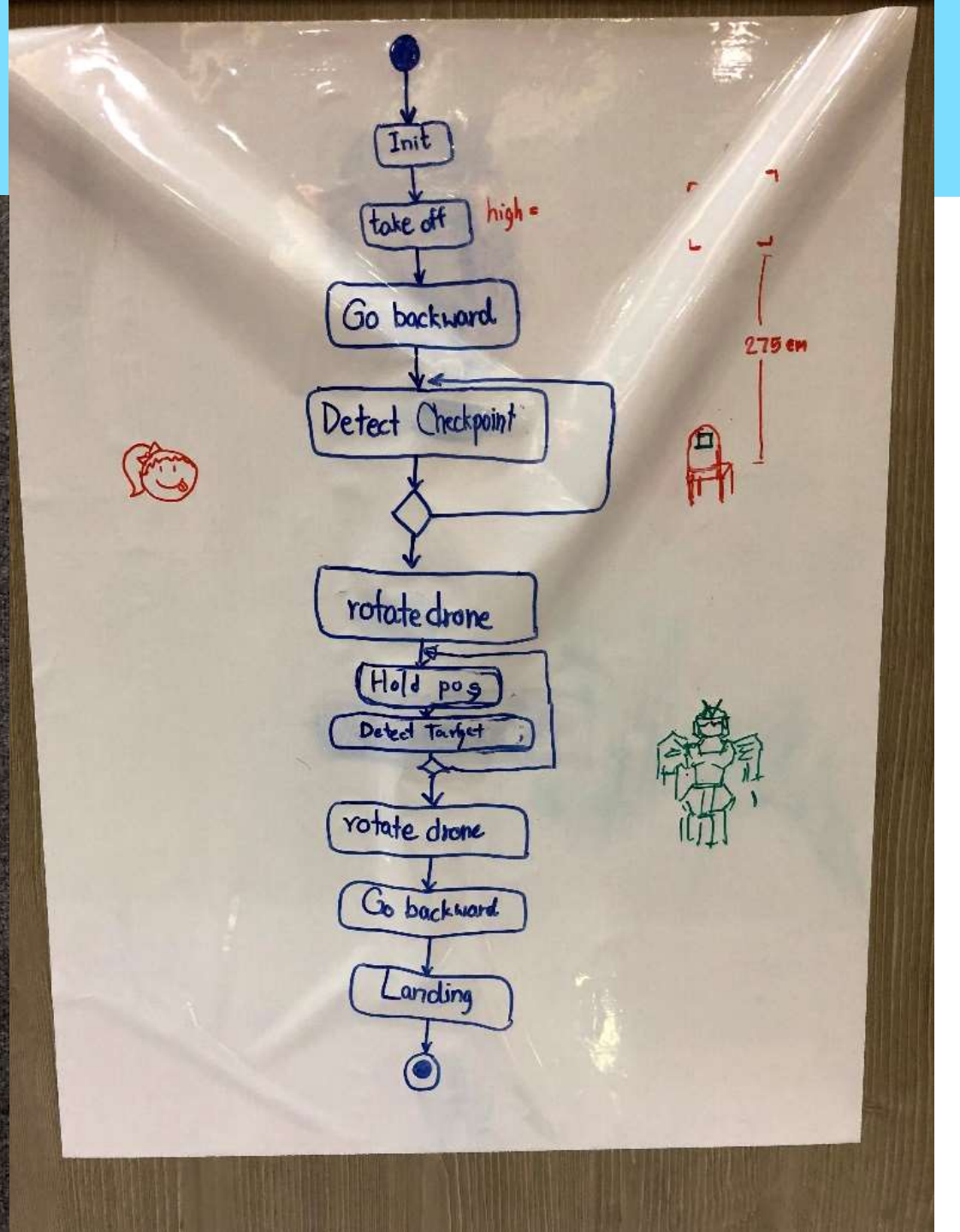
Fields





Drawing Models(?)



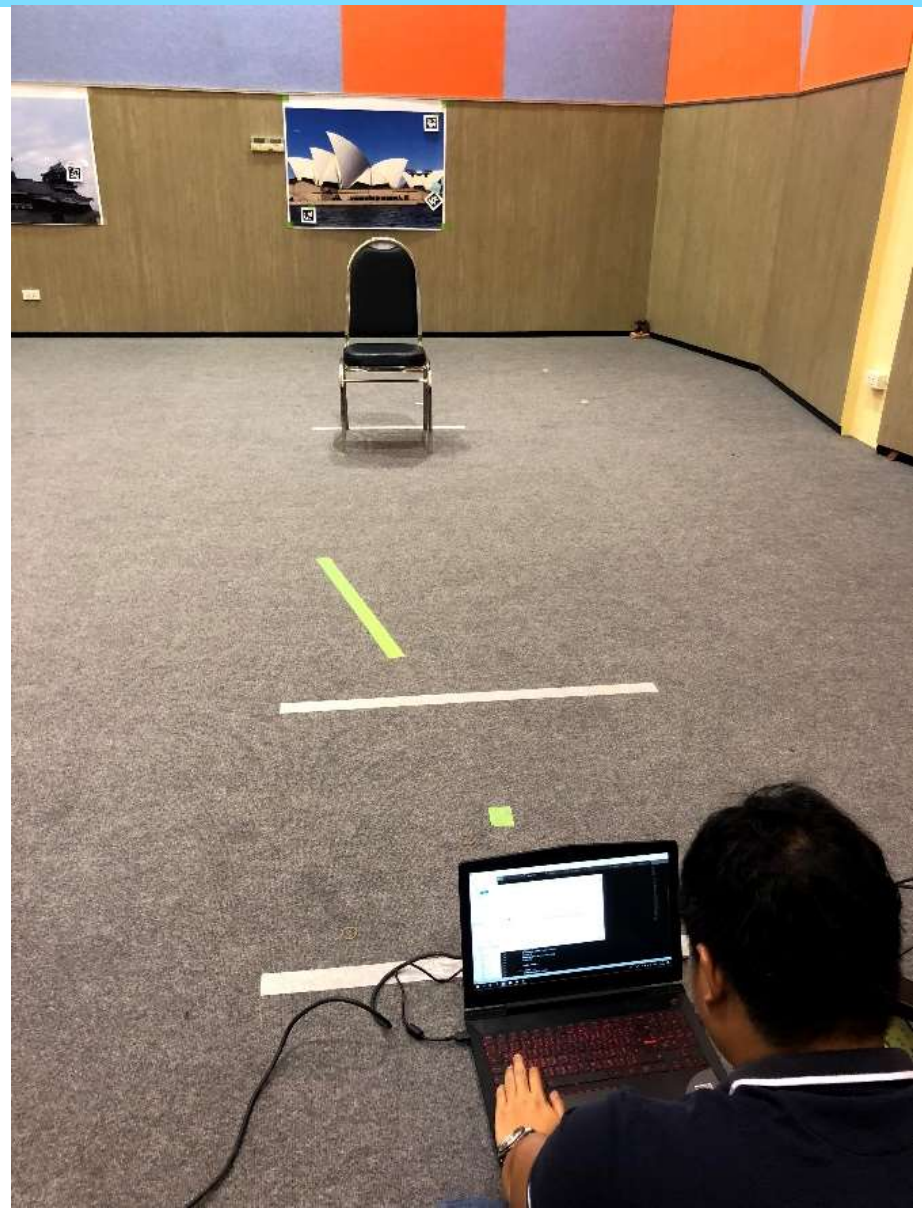


Implementing





Testing





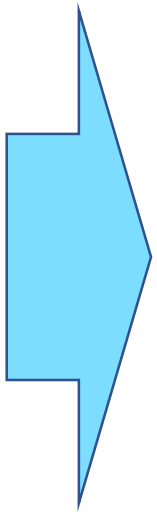
Questionnaire

- I'm enjoying designing the robot challenge program
  - 1 – 4(best): 3.4
- I could understand the System Analysis and Design more
  - 1 – 4(best): 3.0

- Comments
  - International collaborations
  - Controlling a multi-copter is fun!
  - We need more time

Challenges

- Using non-executable UML
  - UML as a communication tools
  - Write python codes
- Because…
  - Non-CS students
  - Non-CS professors
  - (Not enough time to teach)
- But…
  - Most of students draw activities only
  - They don’t update class diagram
  - Writing python code is fan ;-)



This year

- Conducted pre-training
  - Class/state machine diagrams
    - Based on Leon Starr’s xtUML book
- Preparing BridgePoint project
  - To enforce to draw class/state machine diagrams

APRIS Robot Challenge 2019 @ Pattaya, Thailand



Case 2:
for junior high school students

August 2019

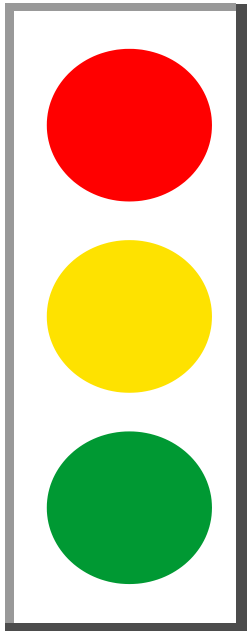
Course overview

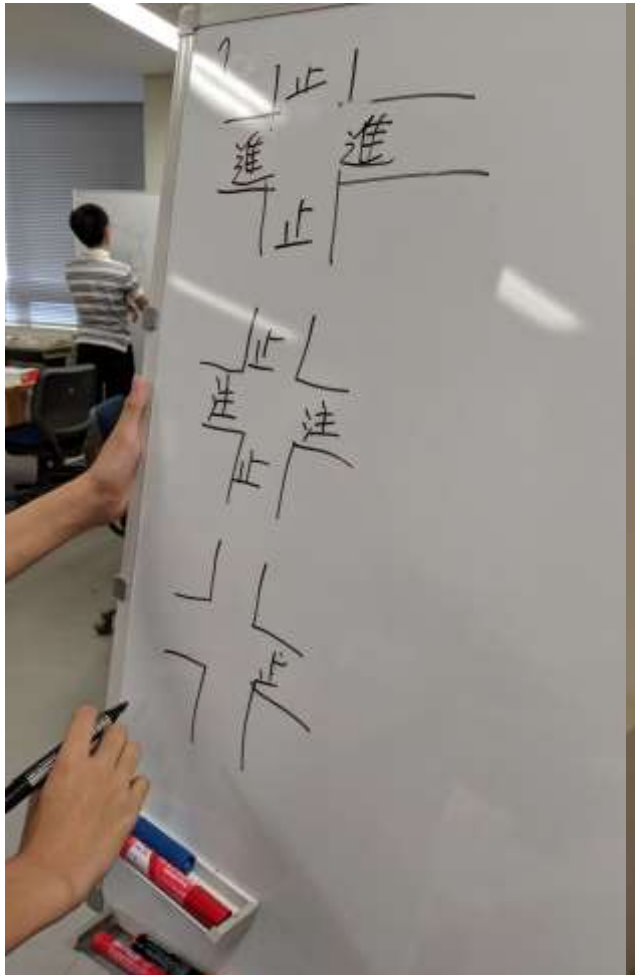
- Objectives
  - Give an overview of how to develop software
    - Stepwise refinement from requirements to design
  - Understand state-machine diagram under some limitations
    - Predefined triggers and actions

- 4 Hours lecture
  - 1-hour Software Development Process, Modeling
  - 1-hour State machine modeling
  - 2-hours Hans-on

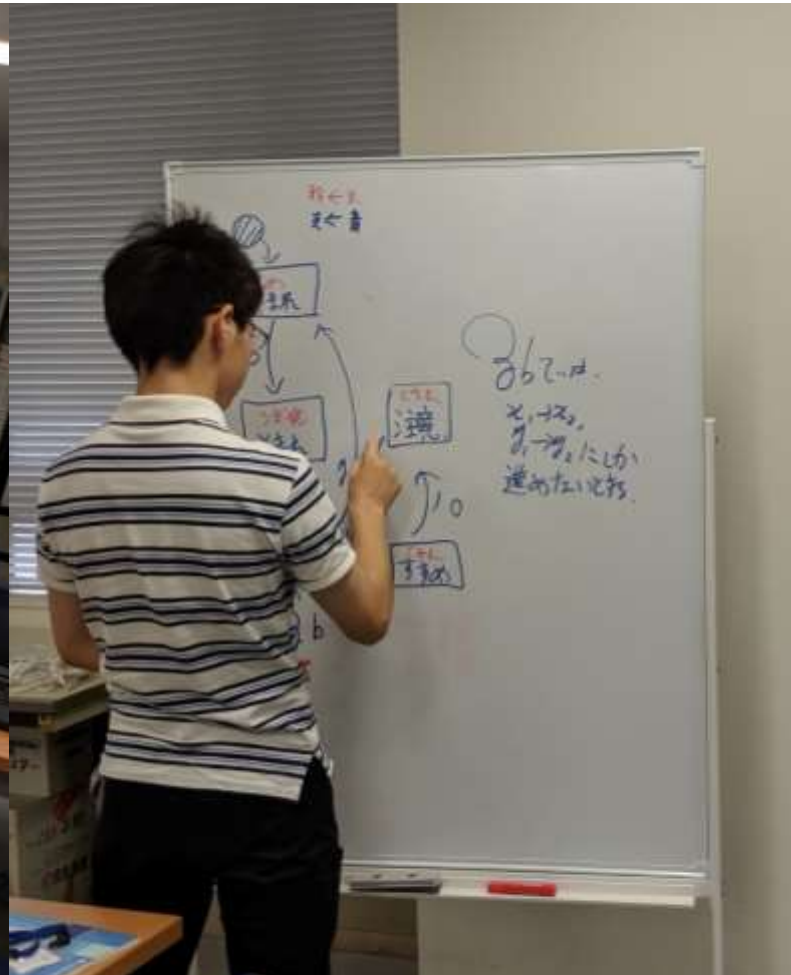
Lab 1

- Draw state-machine diagram
  - Behaviors of traffic lights









Lab 2, 3

- Lab 2
  - Control Tello using smart phone
  - Students already excited ☺
- Lab 3
  - Draw a state-machine diagram to take off and land
  - Scenario
    - Take-off
    - Wait 5 sec
    - Land



Lab 4 (Final)

- Let’s fly Tello cool!
  - Write sequence of control
    - Using natural language
  - Draw state machine diagram
  - Run!

- Show off at the final presentation ☺
  - Intended sequence of control
    - Achieved and challenges
  - Demo flight

From Questionnaires

- Satisfaction (1..5): 4.25

- Comments
  - Fun
    - More fun than expected
    - It is very fun to control drone
  - Think
    - It is excellent to think control sequence myself
    - It is good that everyone made a different thing and had a personality
  - Difficulty
    - I have never done programming, but I was able to do it. It was fun.
    - I thought it was difficult, but it was fun.

Challenges

- No feedback loops
  - Currently feed forward (sequence) control only

- Implementing camera feature
  - Receive movie
  - Read AR marker id
  - Read AR marker and get x, y, z or normal vector
  - …



Modeling Education using xtUML and multi-copter

- xtUML and multi-copters attracts students' interests
  - Increase teaching effectiveness





