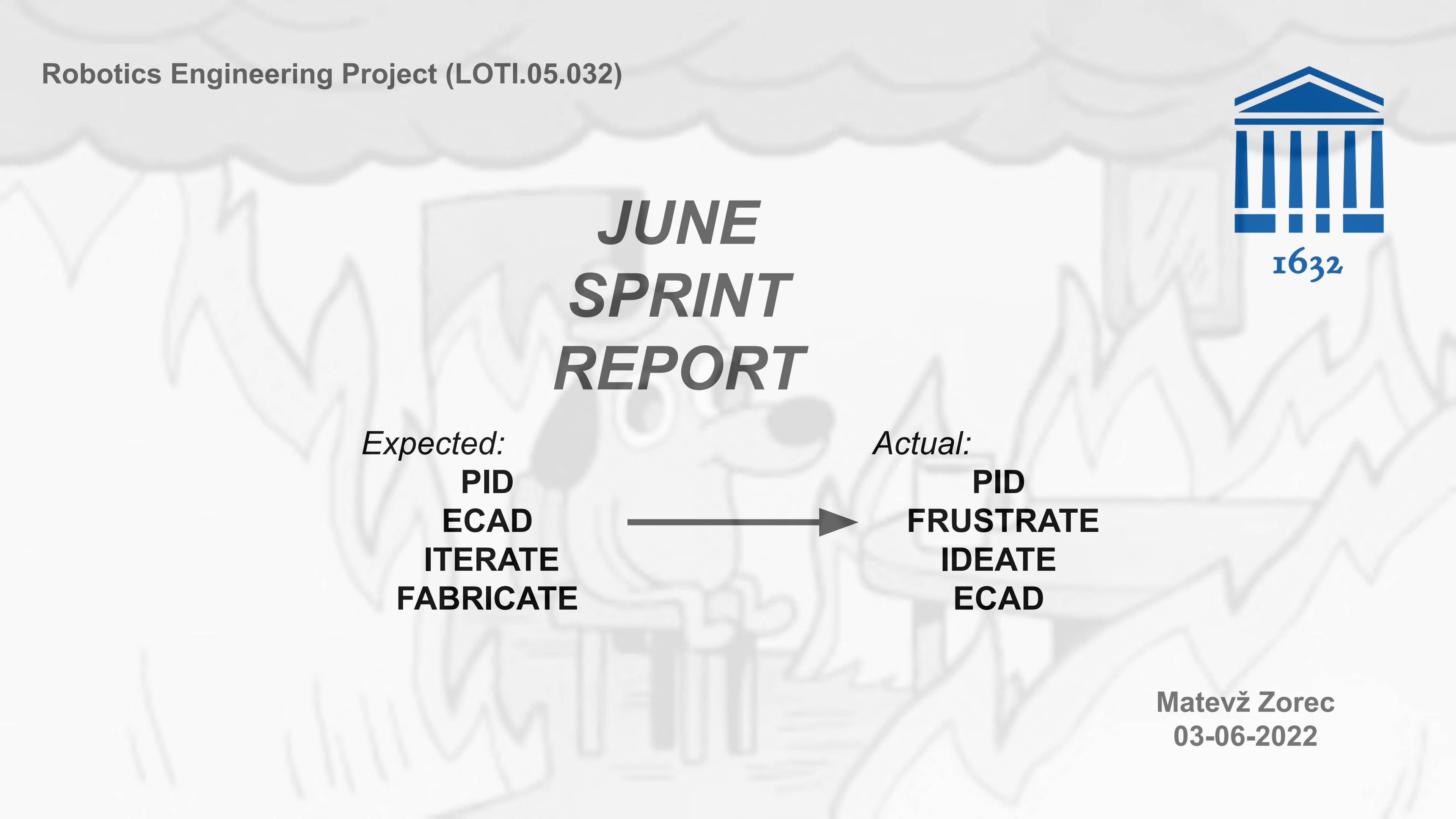
Robotics Engineering Project (LOTI.05.032)



JUNE SPRINT REPORT

Expected:

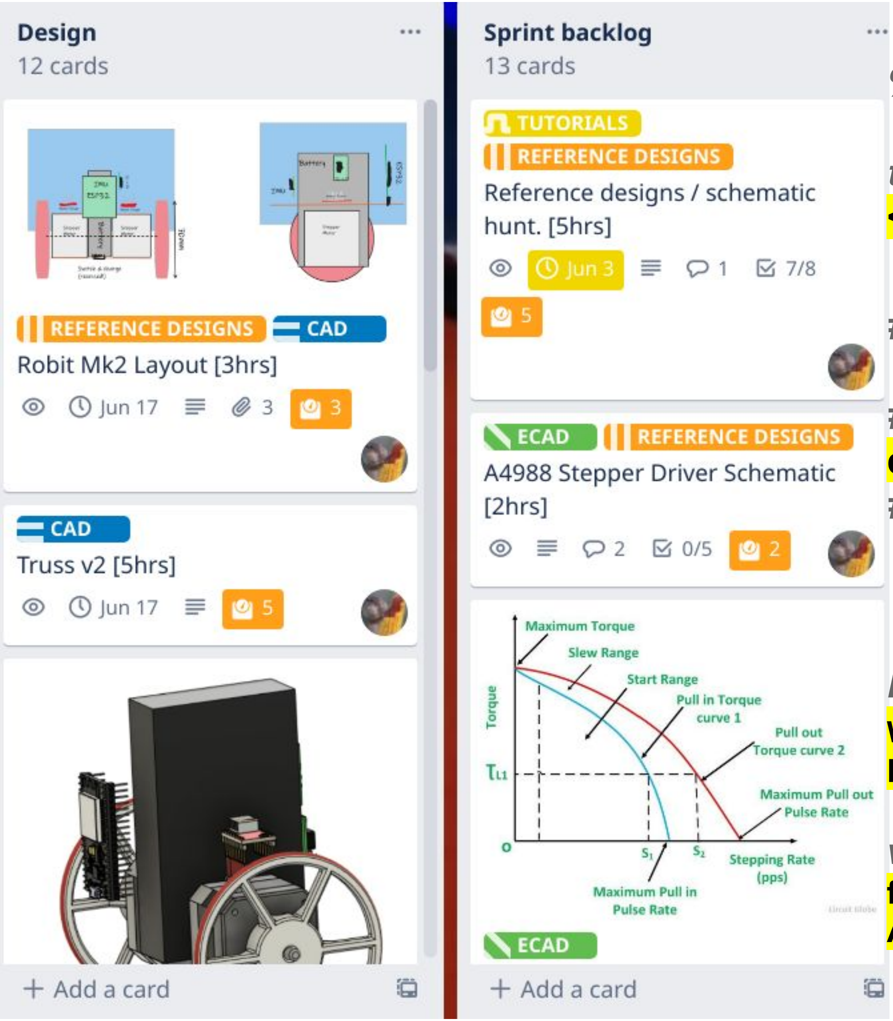
PID
ECAD
ITERATE
FABRICATE

→

Actual:

PID
FRUSTRATE
IDEATE
ECAD

Matevž Zorec
03-06-2022



Design
12 cards

REFERENCE DESIGNS | CAD
Robit Mk2 Layout [3hrs]
Jun 17 · 3 · 3

CAD
Truss v2 [5hrs]
Jun 17 · 5

+ Add a card

Sprint backlog
13 cards

TUTORIALS
REFERENCE DESIGNS
Reference designs / schematic hunt. [5hrs]
Jun 3 · 1 · 7/8
5

ECAD | REFERENCE DESIGNS
A4988 Stepper Driver Schematic [2hrs]
2 · 0/5 · 2

ECAD

+ Add a card

% progress: sprint cards

~25%

time spent

<fw, ecad, tuning, tbshooting>

TOTAL ~29hrs of 38hrs

# cards start of sprint

16

# cards each column rn

design 11 | backlog 12 | done 34

# cards at/over/under time estm.

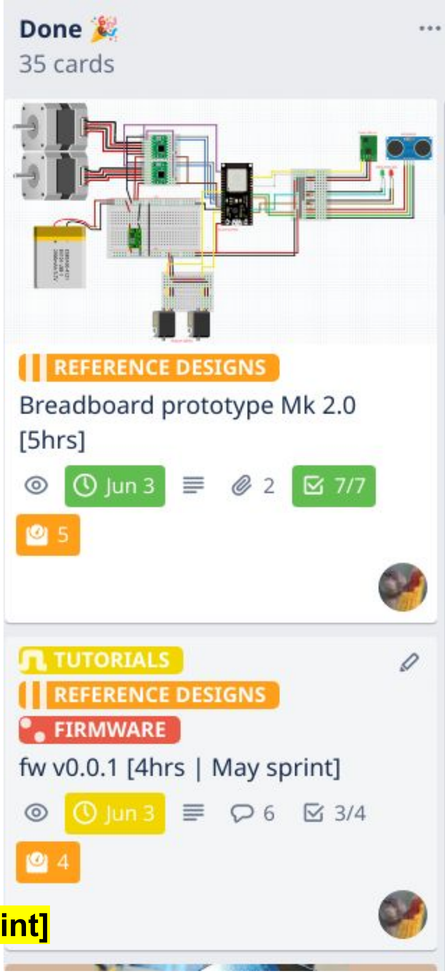
met: 1
over: 2
under: 1

best cards?

Wheel Mk2.0 [2.5 of 3hrs]
Breadboard prototype Mk 2.0 [5hrs]

worst cards:

fw v0.0.1 [10.5 of 4hrs | May sprint]
Arduino PID demo [8 of 5 hrs | May sprint]



Done 🎉
35 cards

REFERENCE DESIGNS
Breadboard prototype Mk 2.0 [5hrs]
Jun 3 · 2 · 7/7
5

TUTORIALS
REFERENCE DESIGNS
FIRMWARE
fw v0.0.1 [4hrs | May sprint]
Jun 3 · 6 · 3/4
4

Now until finish…?

Plans:

a) **finish PID demo ⇒ self-balancing**

b) **finish fw0.0.1 ⇒ self-balancing, reliably**

c) all in one PCB:

- i) stepper driver boards
- ii) ESP32 socket OR Arduino & ESP32
- iii) Powerpath
- iv) step down
- v) IMU [I2C]
- vi) ToF [I2C]
- vii) motor connectors

schematic to gerber to Fab

d) modify truss, accommodate:

- i) PCB
- ii) charging port
- iii) reset button
- iv) power switch

e) remote control w/ ESP32 ⇒ **fw0.2.0**

Ideas:

a) Leap Motion ⇒ control

b) servo landing leg

c) auto start feature

https://blog.keithkim.com/2020/07/note-leap-motion-on-ubuntu-2004.html

Plans:

a) ~~**finish PID demo ⇒ self-balancing**~~

b) ~~**finish fw0.0.1 ⇒ self-balancing, reliably**~~

c) ~~all in one PCB:~~

  i) ~~stepper driver boards~~

  ii) ~~ESP32 socket OR Arduino & ESP32~~

  iii) ~~Powerpath~~

  iv) ~~step down~~

  v) ~~IMU [I2C]~~

  vi) ~~ToF [I2C]~~

  vii) ~~motor connectors~~

~~schematic to gerber to Fab~~

d) ~~modify truss, accommodate:~~

  i) ~~PCB~~

  ii) ~~charging port~~

  iii) ~~reset button~~

  iv) ~~power switch~~

e) ~~remote control w/ ESP32 ⇒ **fw0.2.0**~~

Ideas:

a) ~~Leap Motion ⇒ control~~

b) ~~servo landing leg~~

c) ~~auto start feature~~

WHAT HAPPENED?

- **tl;dr = STALL**
  - PID w/ motor prop. control issue
  - motor torque issue investigated
  - … basically: no way of knowing the real source of a problem until further experience gained…
  - *firmware v1*: tuning iteration counter **> 200** variations attempted (long & tedious)

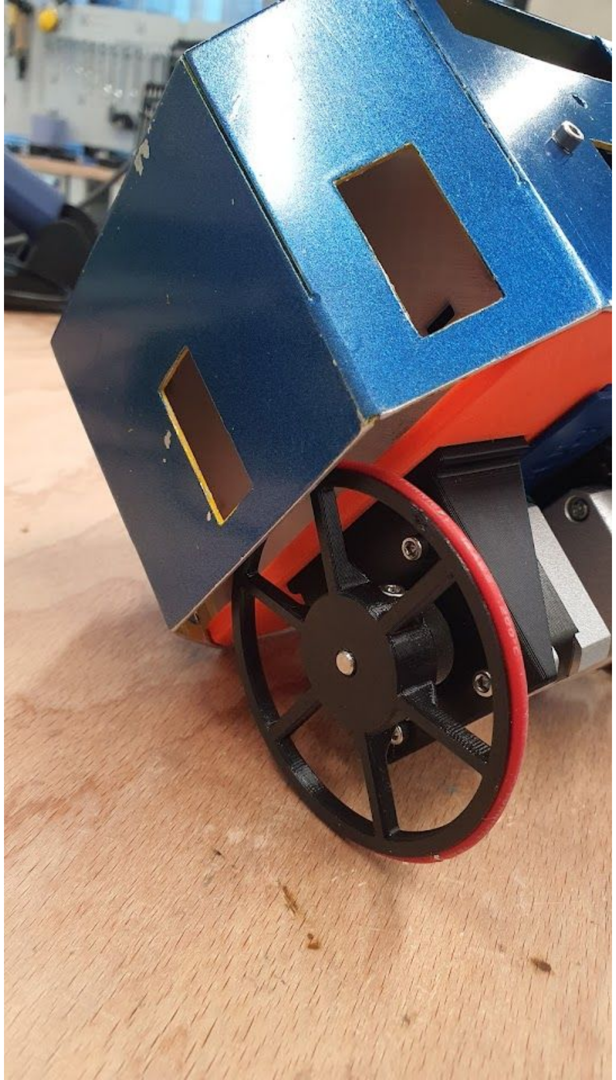
⇒ re-ideation
⇒ June sprint planning was delayed ~1 week
⇒ troubleshooting additionally delayed June sprint ~1 week

… could not find solution in timely manner, could not plan ahead… frustrating scenario lead to a re-ideation and deliberation on new robit version w/ brand new internal layout…

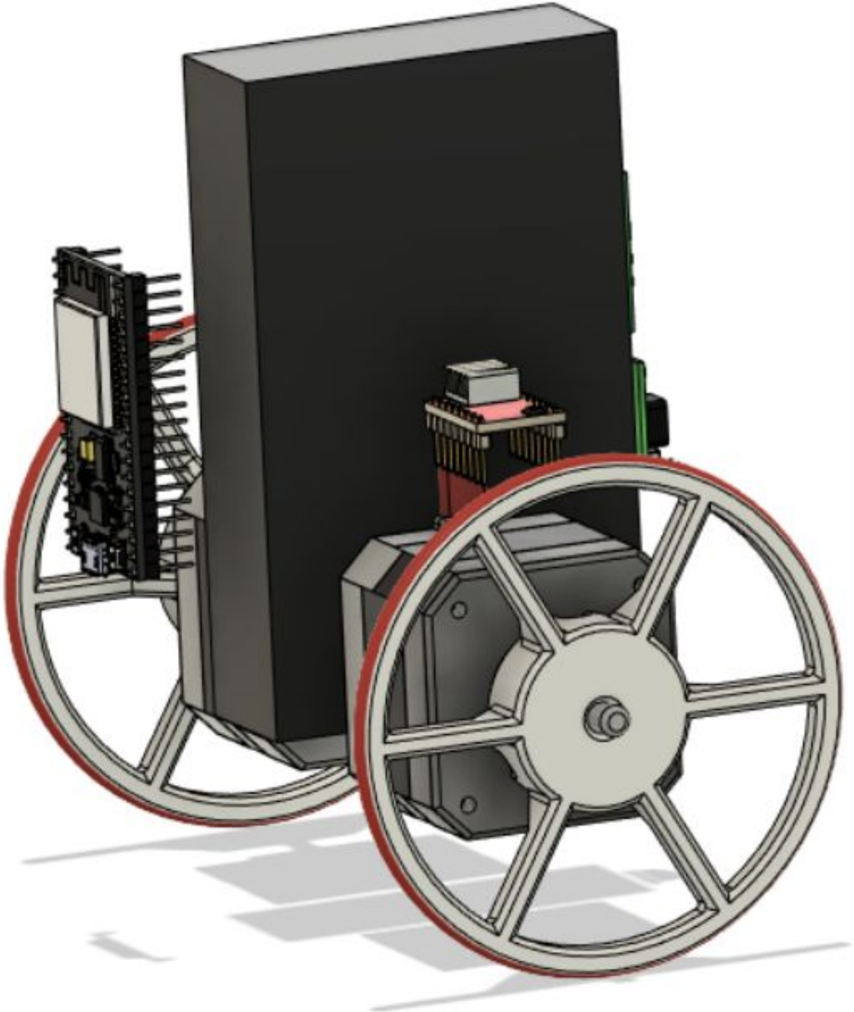
…Took a new approach:

1st consultation:

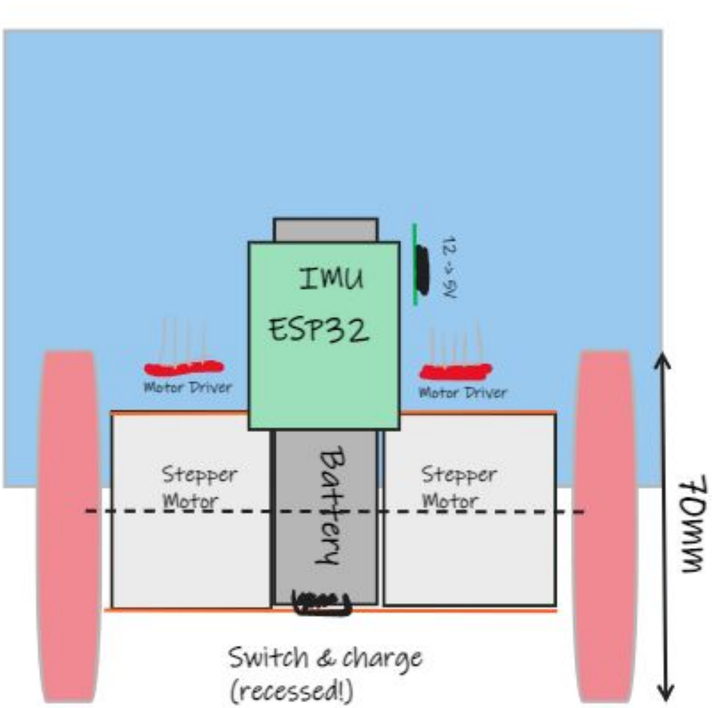
⇒ redesign motor controller,
⇒ new PID understanding, new tuning approaches (already > 100 variations)
… still no luck but better results…

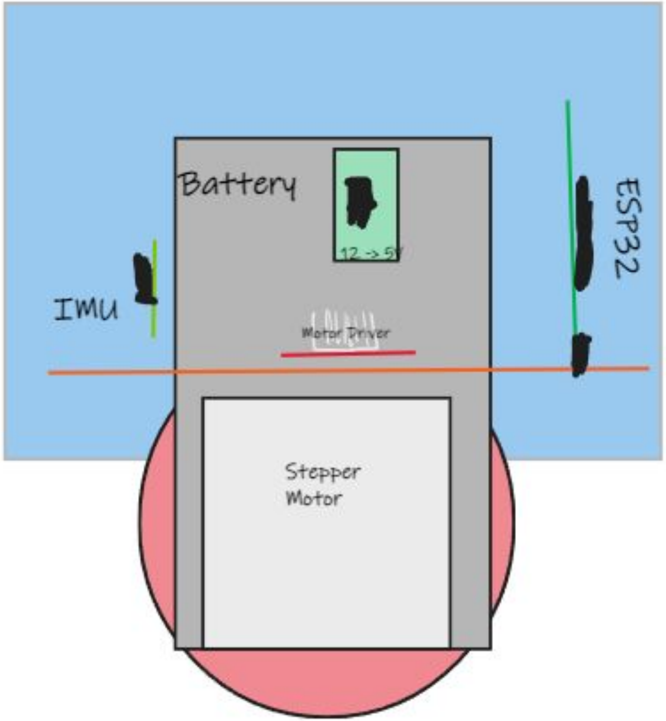


Mk1 ⇒ Mk2

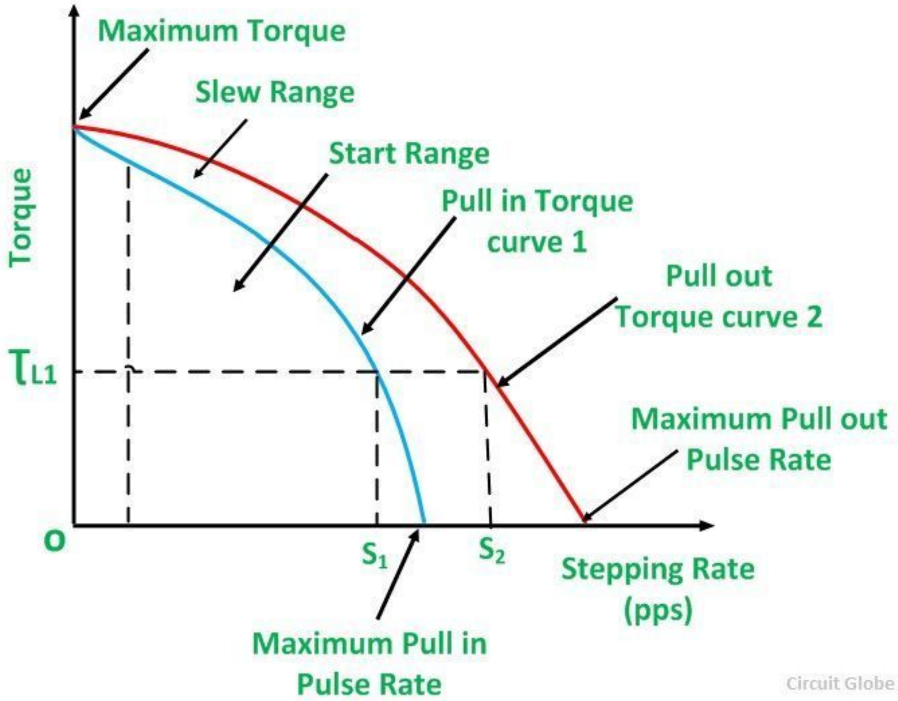


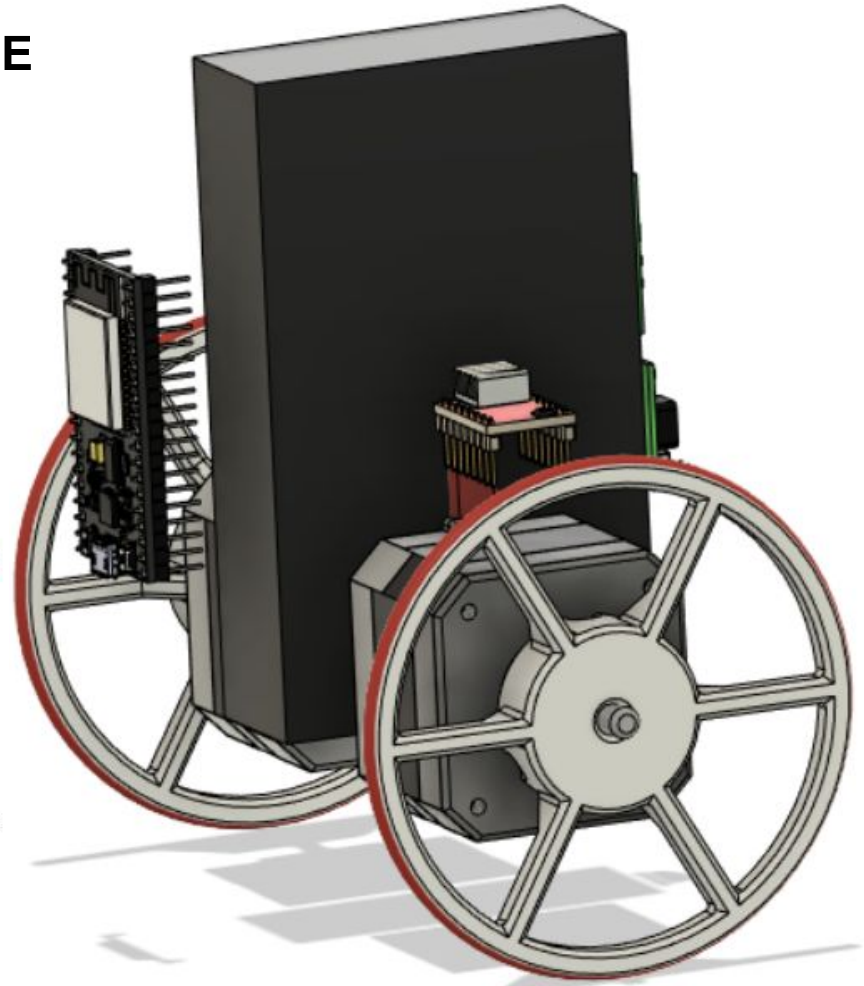
LAYOUT Mk2 [ideation]

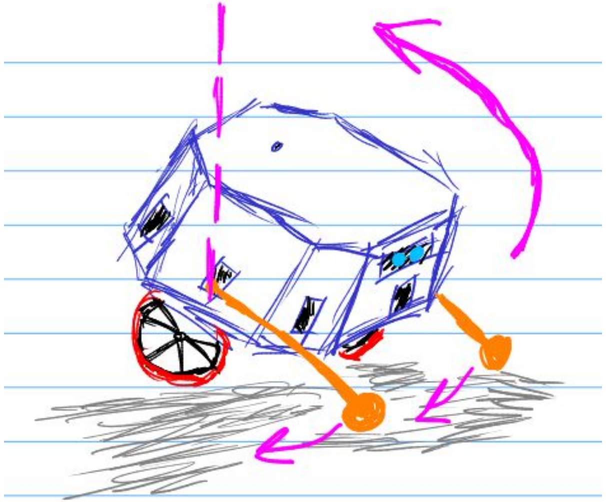


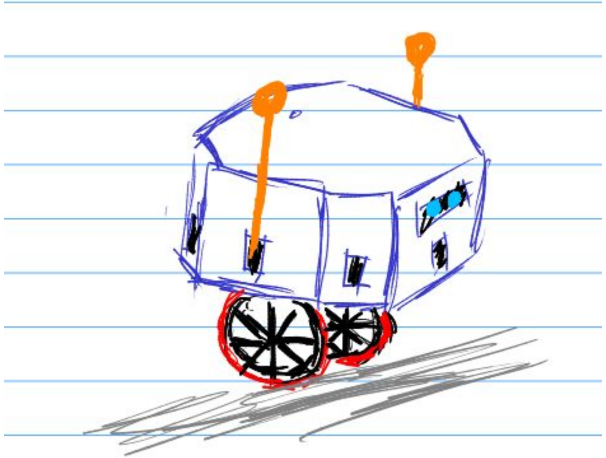


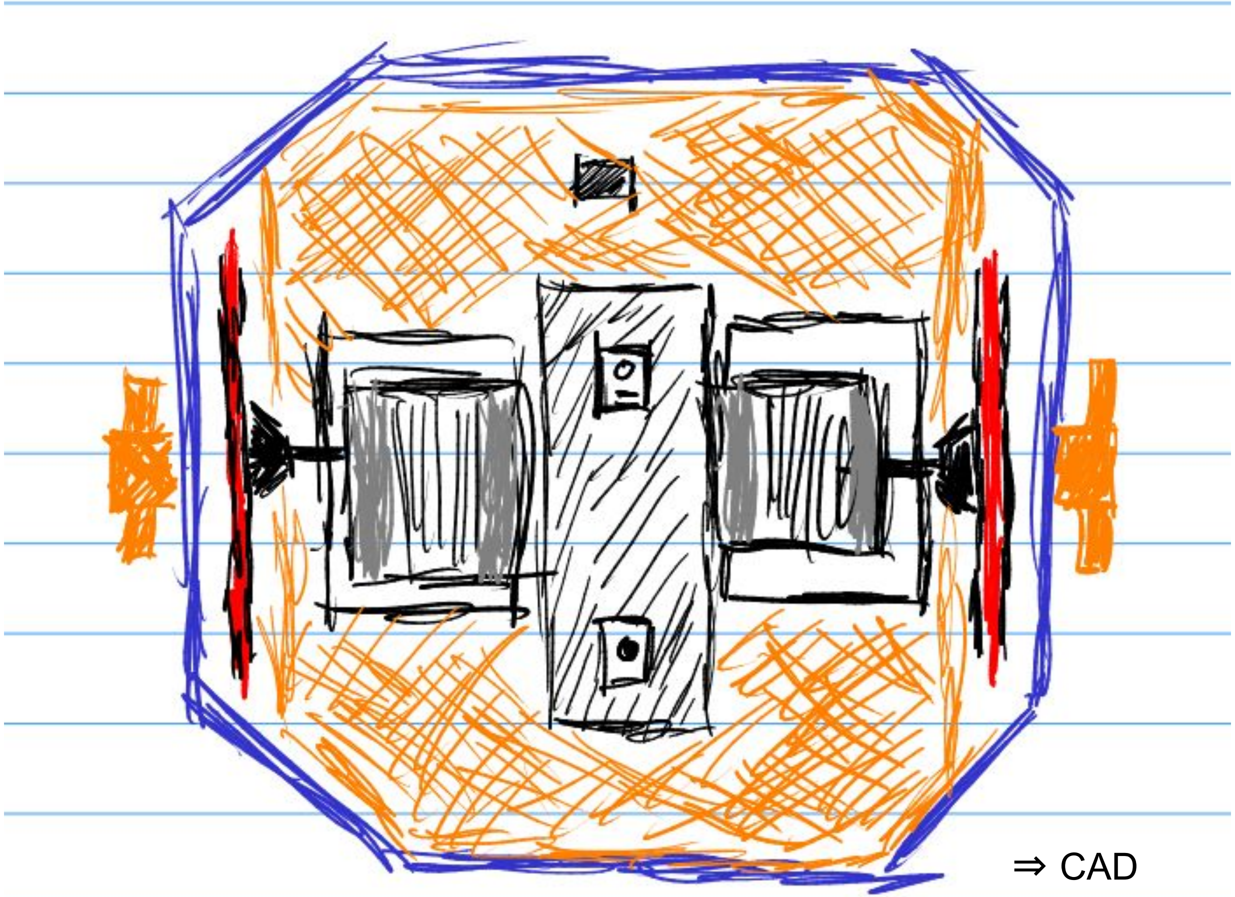
STEPPER TORQUE \ STEP RATE





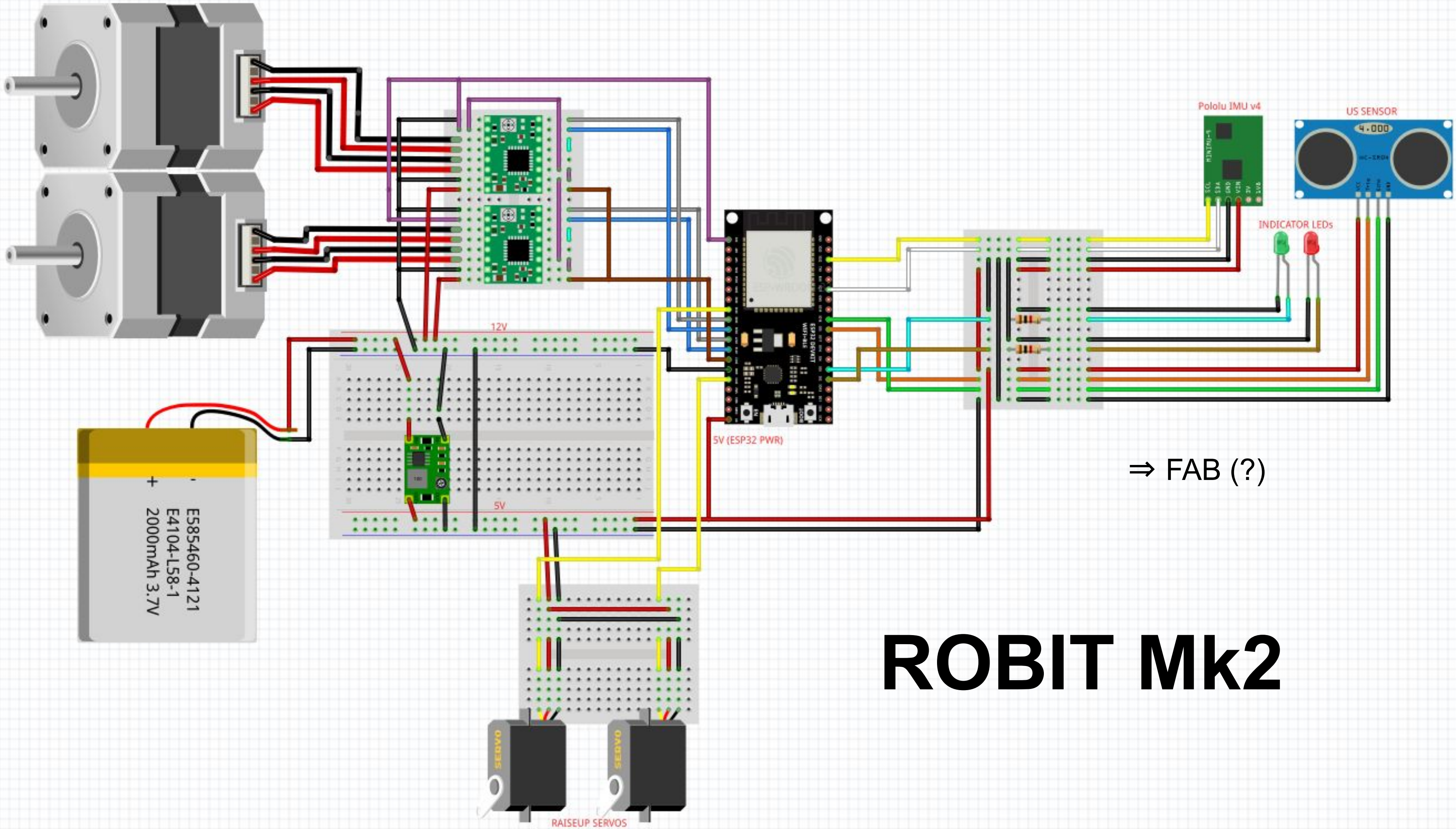






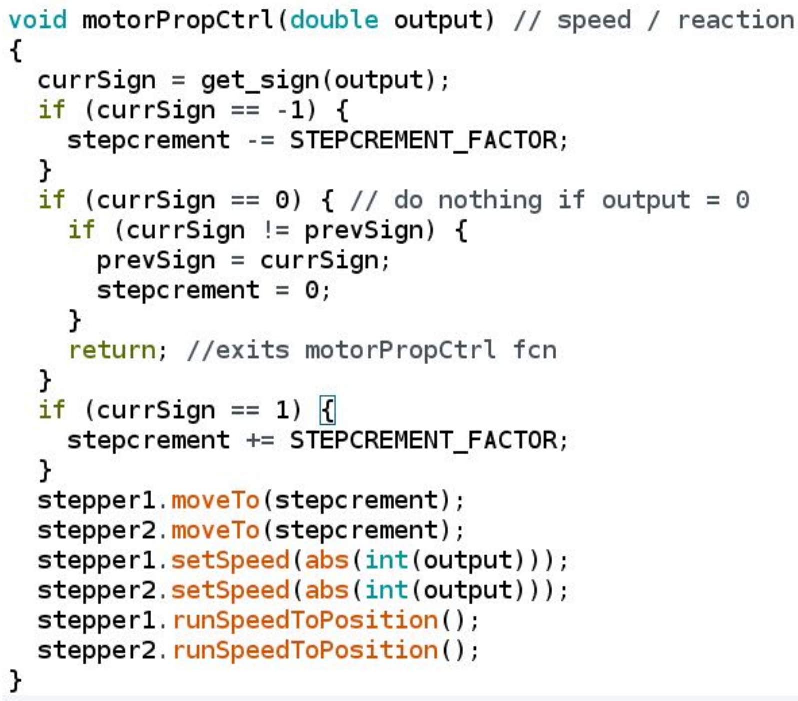
⇒ CAD

ROBIT Mk2

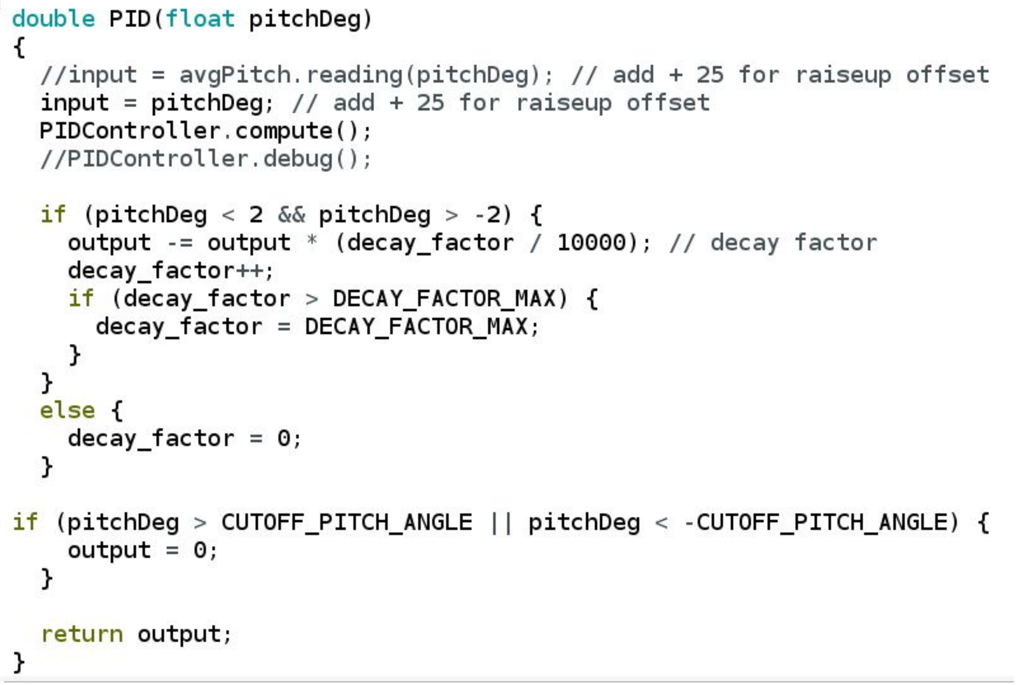


⇒ FAB (?)

ROBIT Mk2



```
void motorPropCtrl(double output) // speed / reaction
{
  currSign = get_sign(output);
  if (currSign == -1) {
    stepcrement -= STEPCREMENT_FACTOR;
  }
  if (currSign == 0) { // do nothing if output = 0
    if (currSign != prevSign) {
      prevSign = currSign;
      stepcrement = 0;
    }
    return; //exits motorPropCtrl fcn
  }
  if (currSign == 1) {
    stepcrement += STEPCREMENT_FACTOR;
  }
  stepper1.moveTo(stepcrement);
  stepper2.moveTo(stepcrement);
  stepper1.setSpeed(abs(int(output)));
  stepper2.setSpeed(abs(int(output)));
  stepper1.runSpeedToPosition();
  stepper2.runSpeedToPosition();
}
```



```
double PID(float pitchDeg)
{
  //input = avgPitch.reading(pitchDeg); // add + 25 for raiseup offset
  input = pitchDeg; // add + 25 for raiseup offset
  PIDController.compute();
  //PIDController.debug();

  if (pitchDeg < 2 && pitchDeg > -2) {
    output -= output * (decay_factor / 10000); // decay factor
    decay_factor++;
    if (decay_factor > DECAY_FACTOR_MAX) {
      decay_factor = DECAY_FACTOR_MAX;
    }
  }
  else {
    decay_factor = 0;
  }

if (pitchDeg > CUTOFF_PITCH_ANGLE || pitchDeg < -CUTOFF_PITCH_ANGLE) {
    output = 0;
  }

  return output;
}
```