

3D SCANNER PROJECT

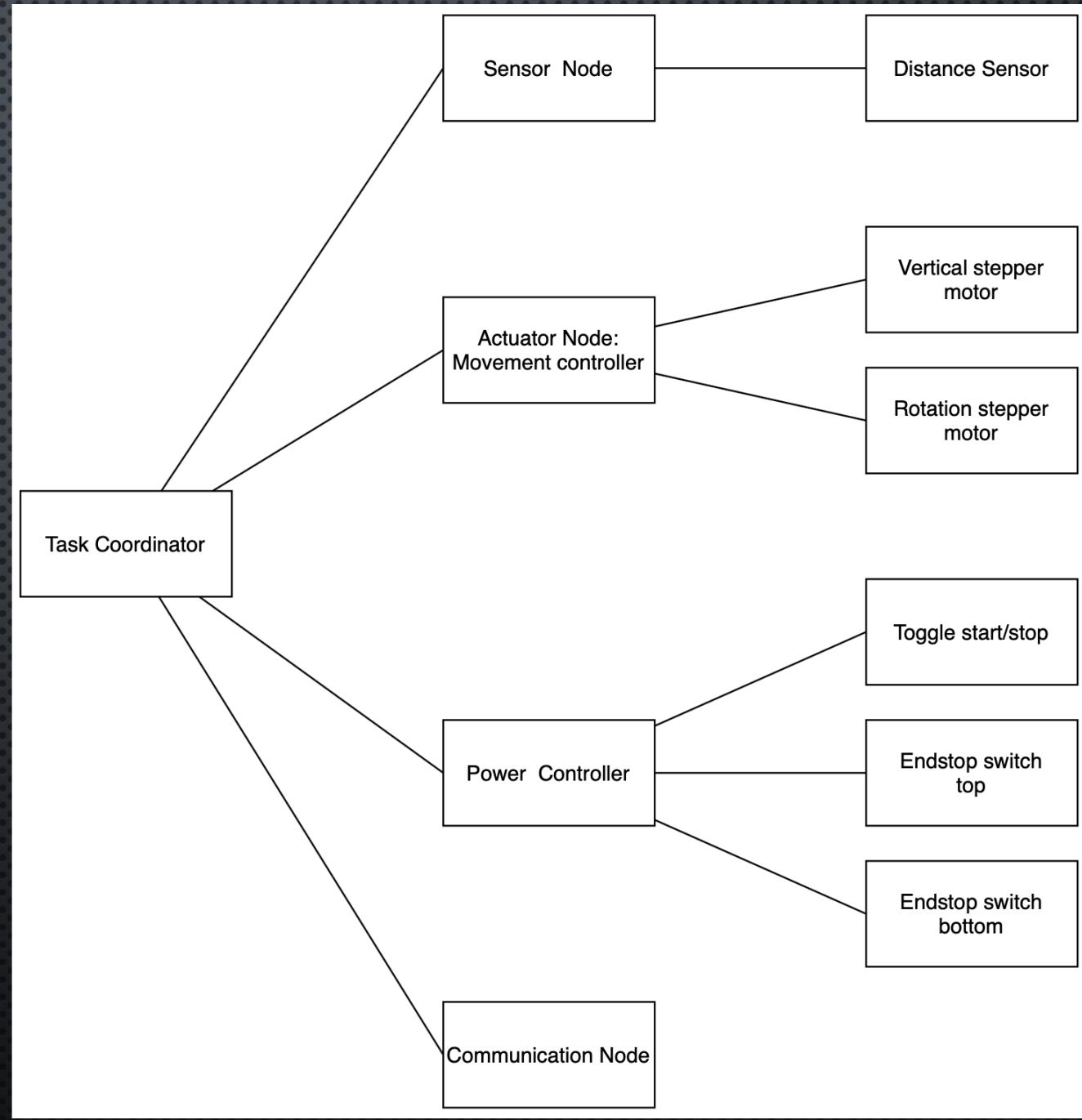
GENERAL IDEA

CREATE A DEVICE TO SCAN SMALL OBJECTS WITH A DISTANCE SENSOR, TO CREATE AND UPLOAD A 3D REPRESENTATION.

THE SCANNER SHOULD HAVE THE FOLLOWING CHARACTERISTICS

- MOVING ROTATING PLATFORM TO SCAN 360 DEGREES
- VERTICAL MOVING SUPPORT TO SCAN ALONG AN OBJECTS HEIGHT
- THE RESULTS ARE SAVED AS POINT CLOUD FILE THAT IS SENT TO AN EXTERNAL DEVICE
- IT USES AN EXTERNAL POWER SUPPLY (LAPTOP/POWER ADAPTER INTO WALL SOCKET/...)

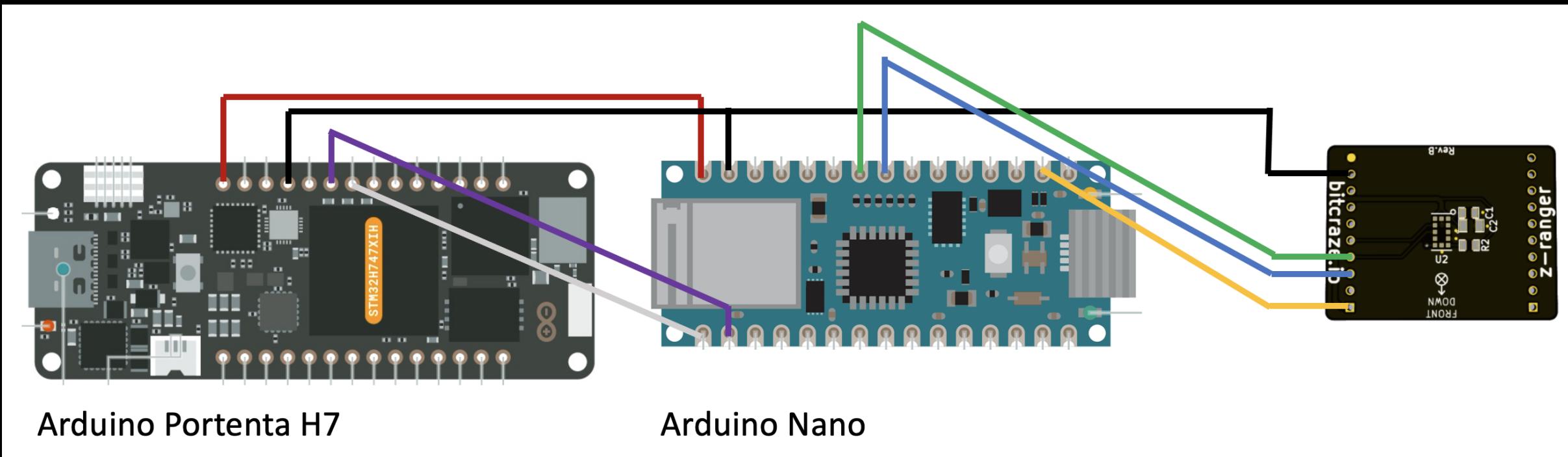
ARCHITECTURE



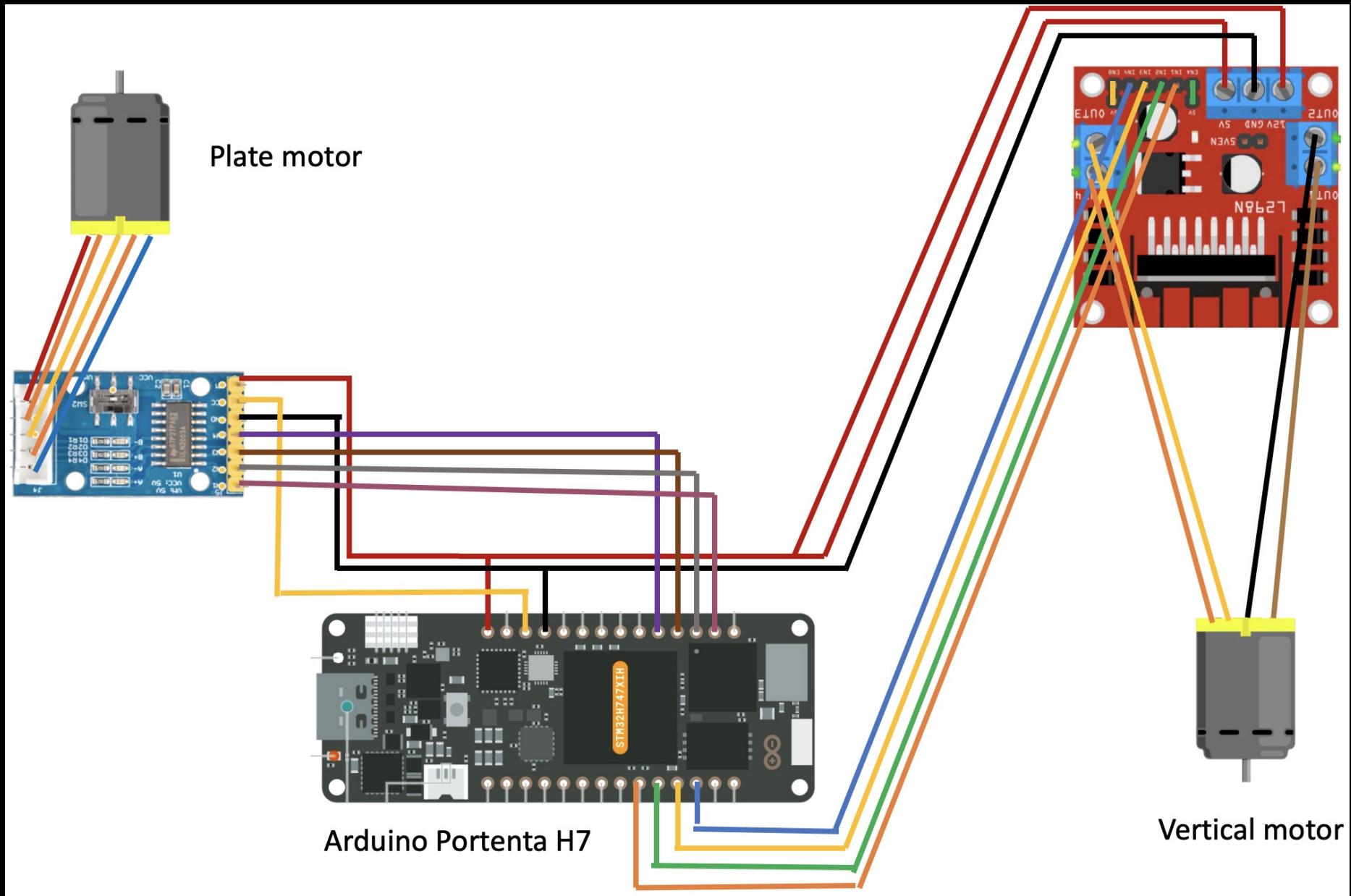
COMPONENTS

- PORTENTA H7 ARDUINO BOARD
- ARDUINO NANO 33 BLE BOARD
- Z-RANGER VL53L0x TOF SENSOR
- L298N MOTOR DRIVER
- NEMA 17 STEPPER MOTOR
- GEAR STEPPER MOTOR DRIVER BOARD FROM SEEED
- CX28BYJ48 STEPPER MOTOR
- 2X ENDSTOP MICROSWITCH
- BUTTON

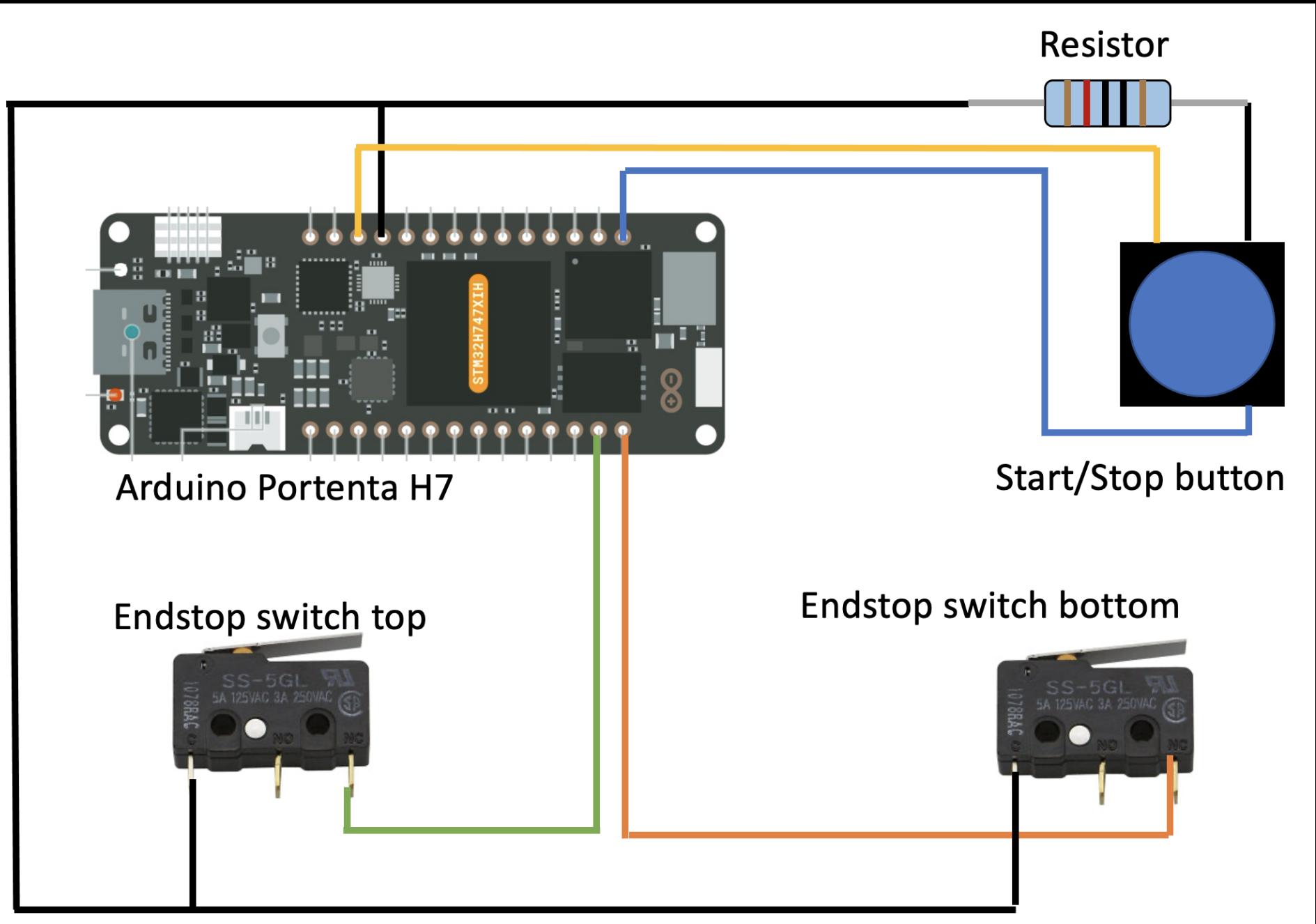
Z-RANGER VL53L0X TOF SENSOR

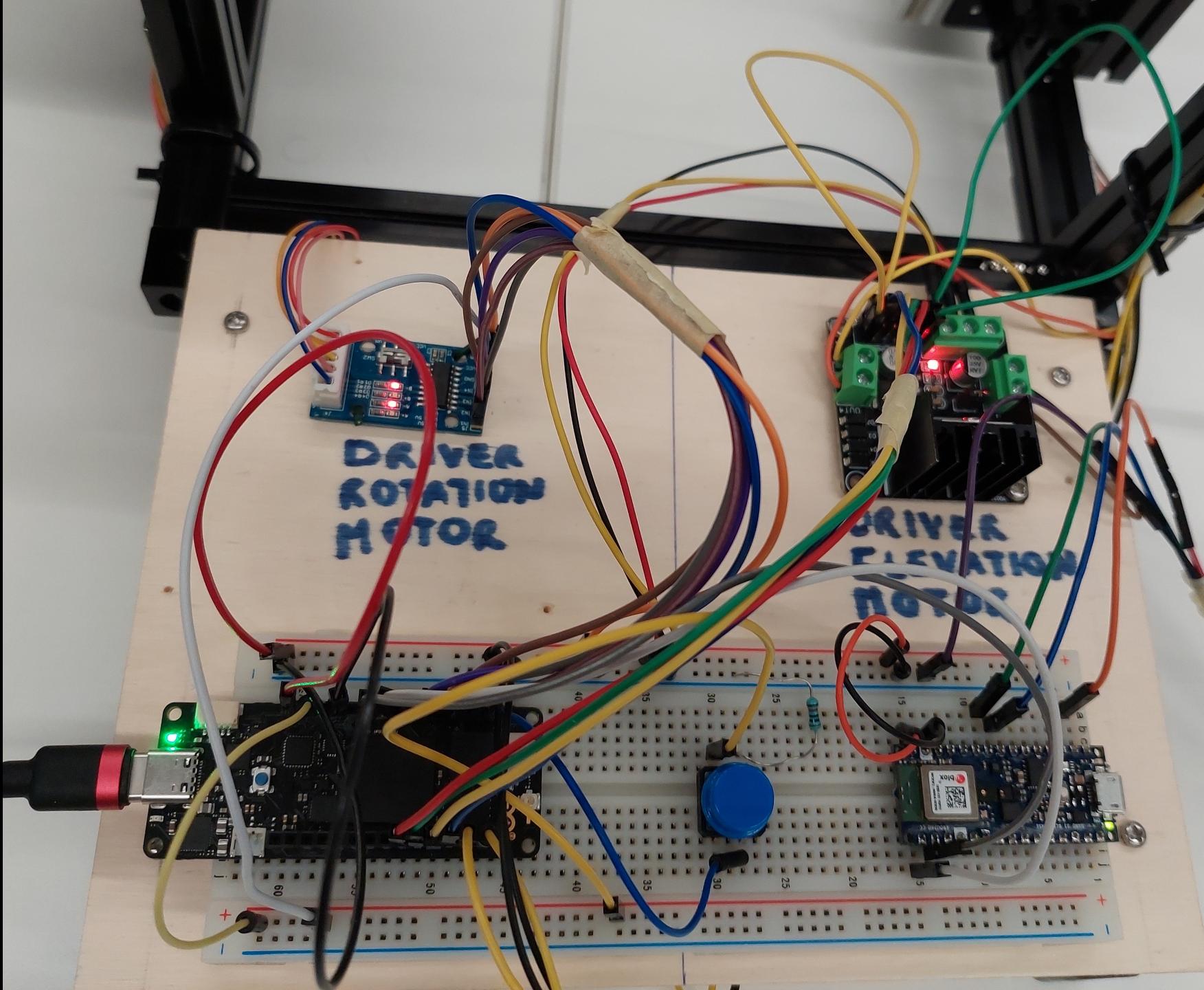


ACTUATORS



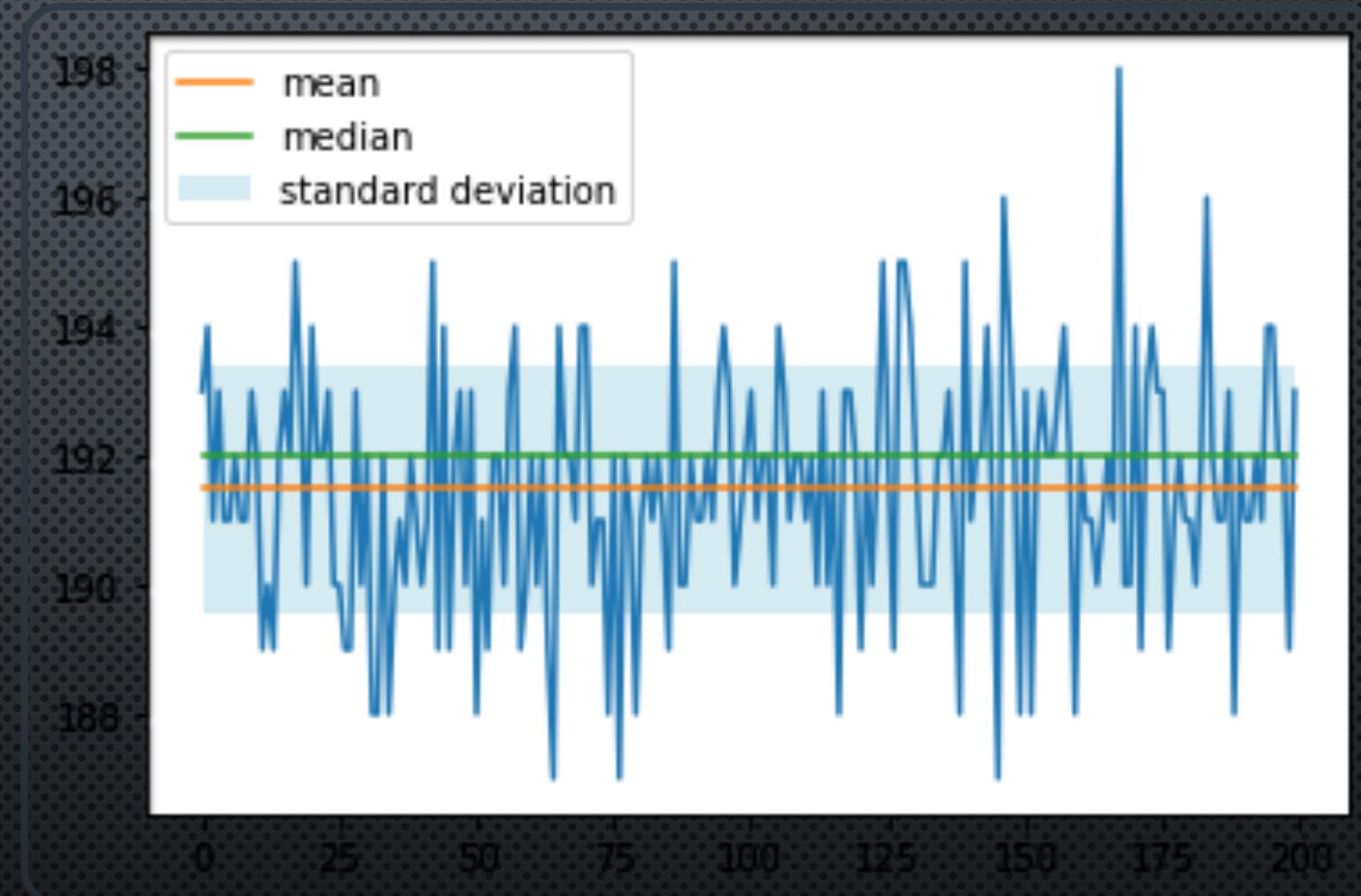
SWITCHES





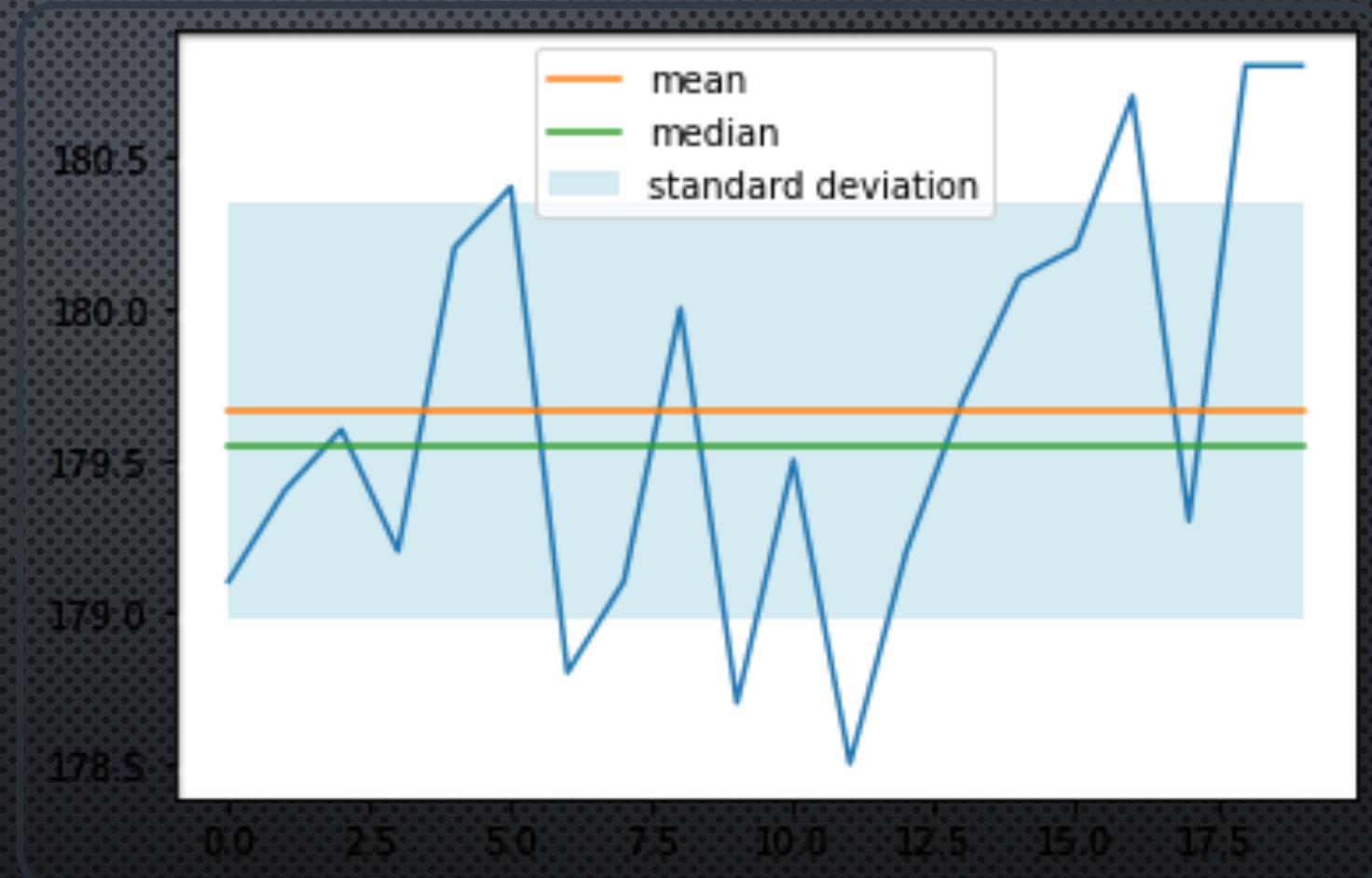
SENSOR CALIBRATION

- TEST ON 200 SAMPLES AT A FIXED DISTANCE = 196 MM
- STANDARD DEVIATION OF 2.122
- MEAN VALUE = 191.475
- MEDIAN VALUE = 192.0



SENSOR CALIBRATION

- USING SAMPLING = 10:
- WE OBTAINED A STANDARD DEVIATION = 1.966



SOFTWARE DETAILS

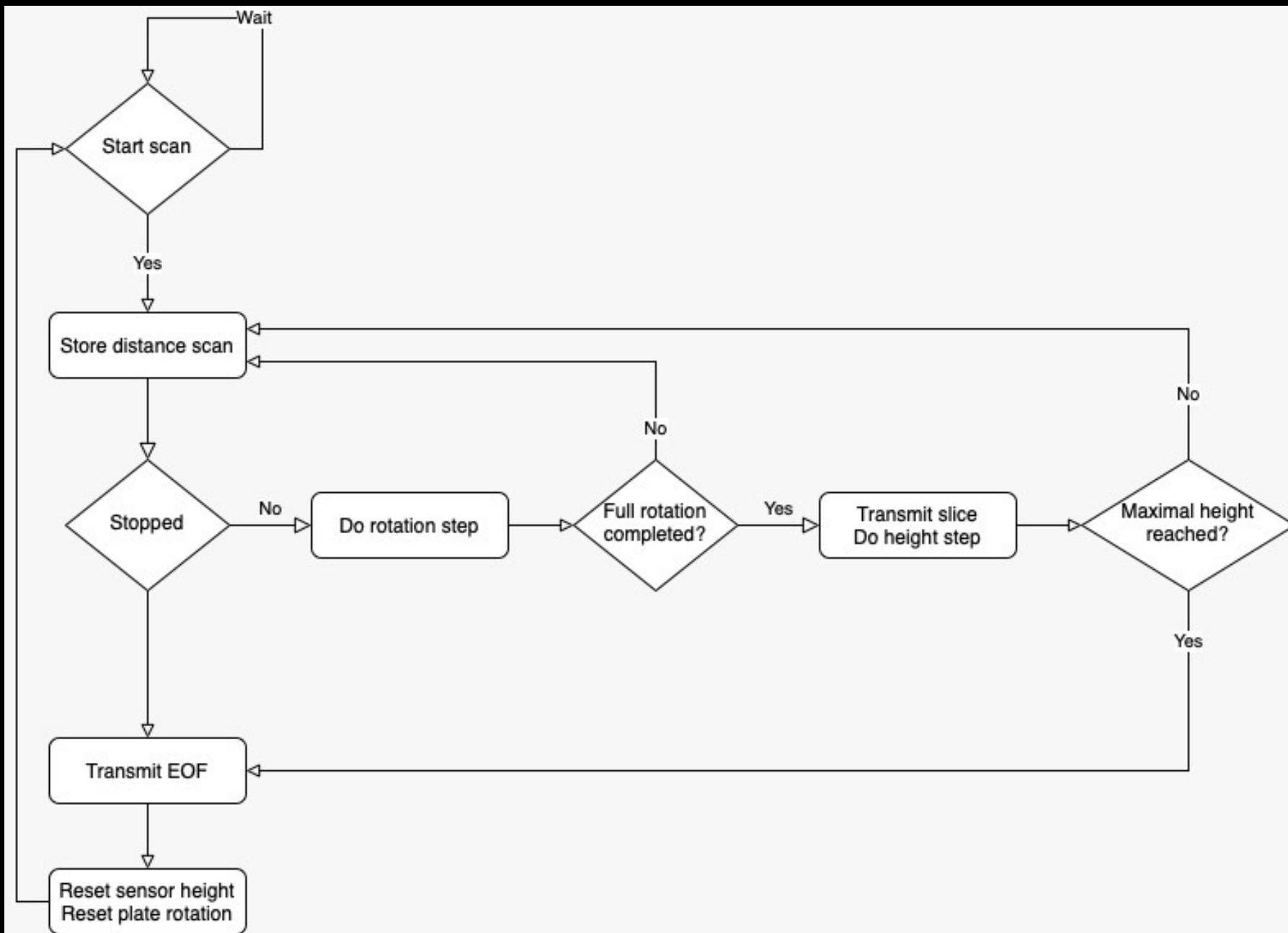
- SCANNER3D_PORTENTA_CORE CONTAINS THE CODE FOR THE PORTENTA BOARD,
- SCANNER3D_NANO_CORE CONTAINS THE CODE FOR THE ARDUINO NANO,
- SCANNER3D_READER CONTAINS THE CODE FOR THE DESKTOP INTERFACE.

SOFTWARE DETAILS

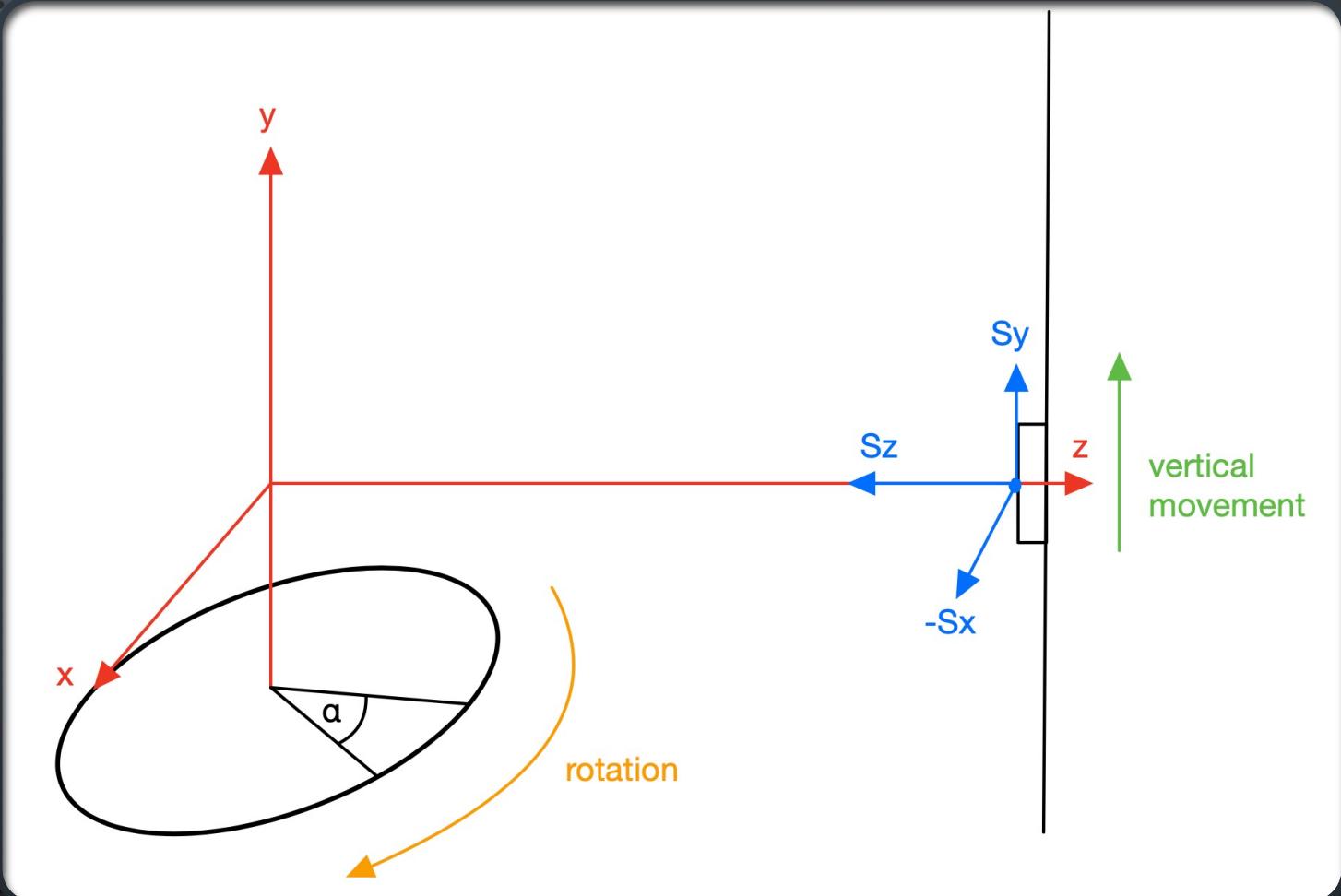
CONNECTIONS

- THE PORTENTA H7 IS CONNECTED TO A COMPUTER THROUGH A USC-C CABLE (SERIAL CONNECTION, 9600 BITS PER SECOND)
- THE PORTENTA H7 IS WIRED TO THE ARDUINO NANO (SERIAL1 CONNECTION THROUGH THE TX AND RX PINS, 9600 BITS PER SECOND)
- ALL DATA EXCHANGES ARE PROMPTED BY THE PORTENTA
- THE NANO BOARD SENDS SINGLE MEASUREMENTS
- THE PORTENTA SENDS THE DATA OF AN ENTIRE SLICE

FLOWCHART



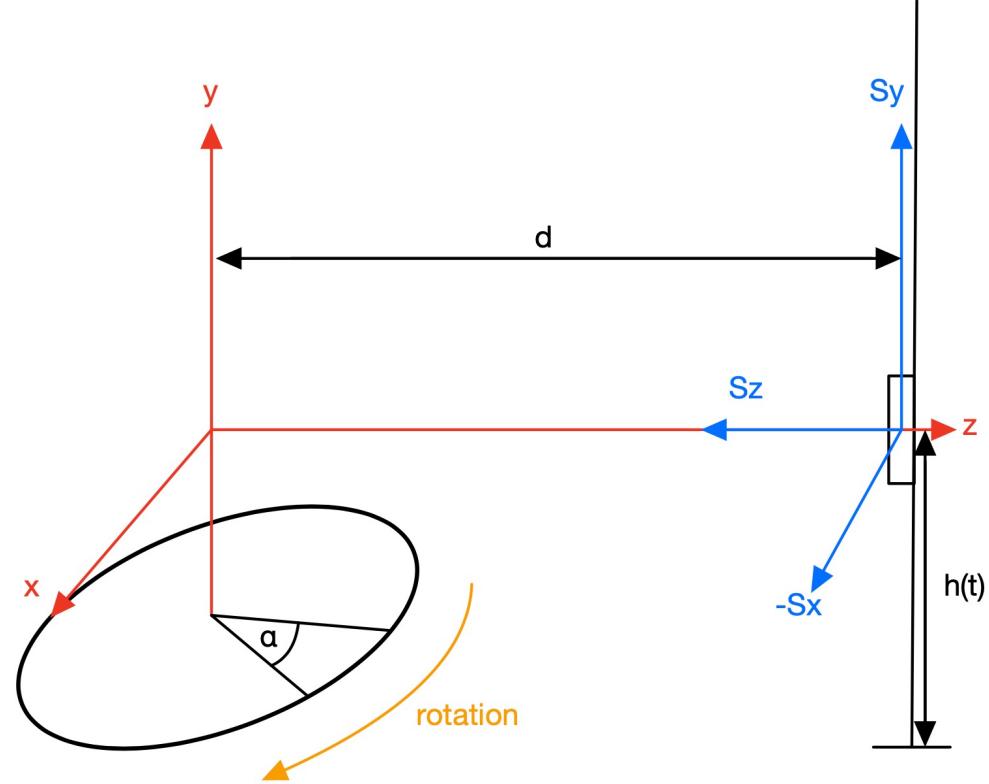
MATHEMATICAL MODEL



FIRST TRANSFORMATION

FIRST TRANSFORMATION

- $x = s_x$
- $y = s_y + h(t)$
- $z = d - s_z$



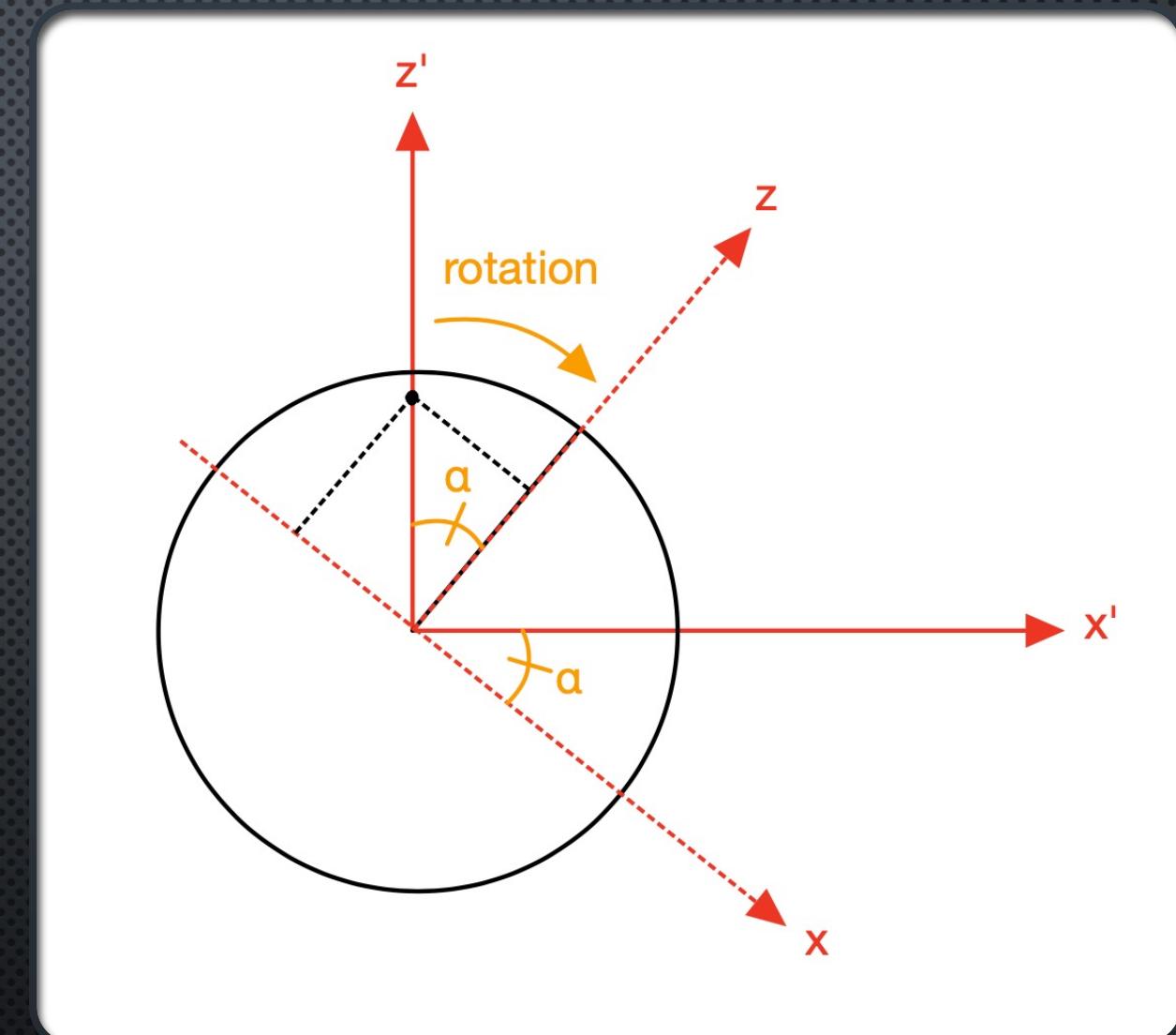
SECOND TRANSFORMATION

SECOND TRANSFORMATION

$$x = -(d - s_z) * \sin(A)$$

$$y = s_y + h(t)$$

$$z = (d - s_z) * \cos(A)$$



POSSIBLE IMPROVEMENTS

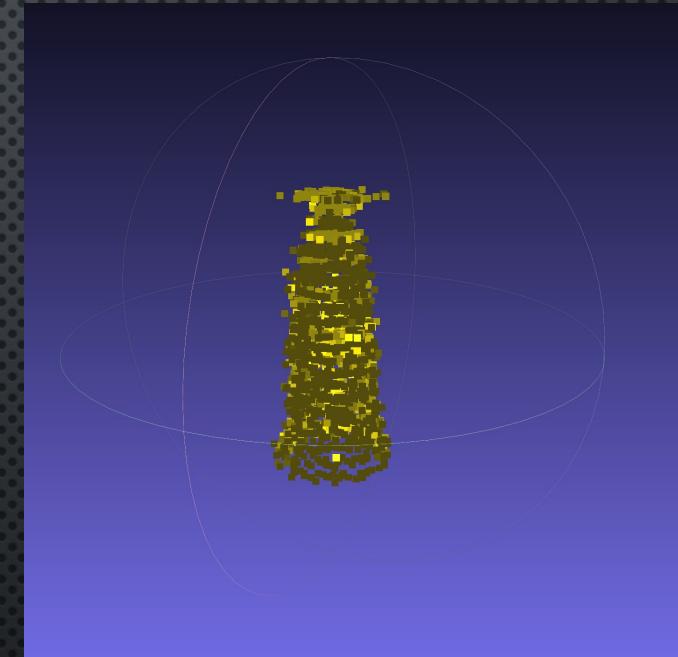
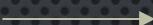
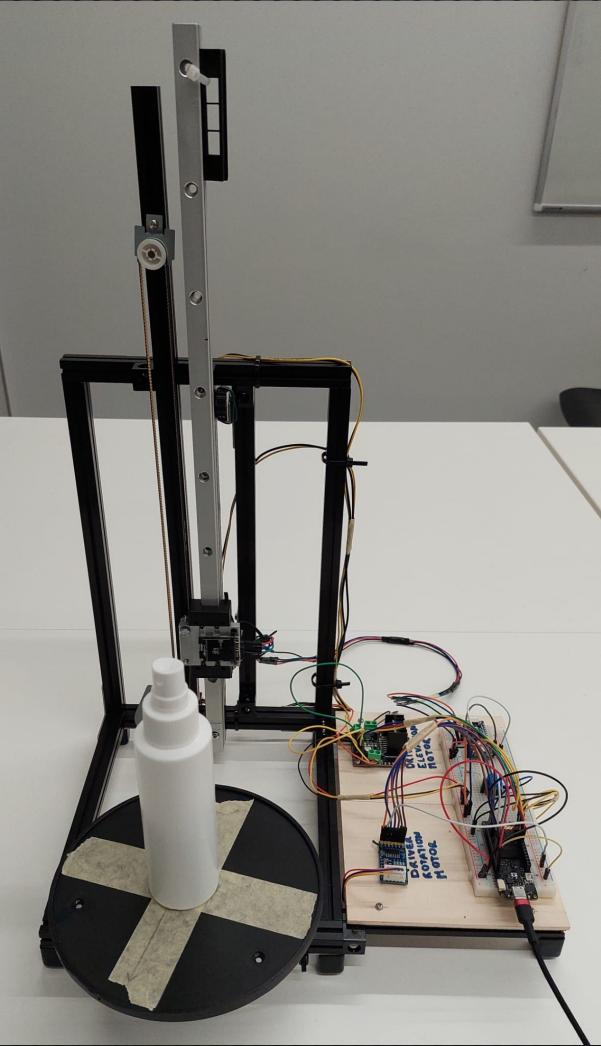
HARDWARE

- STABLE ROTATING PLATE
- PRECISE ROTATION ANGLE THROUGH A SENSOR
- EXTENSION OF THE VERTICAL RANGE
- DIRECT SENSOR TO PORTENTA CONNECTION

SOFTWARE

- DESKTOP INTERFACE WITH CONTROLS
- MORE ROBUST COMMUNICATION PROTOCOLS (DISCONNECTION, DATA LOSS,...)
- WIRELESS UPLOAD (NO CONNECTED COMPUTER REQUIRED)

RESULTS



CONCLUSIONS

- THE PROTOTYPE WORKS
- IT IS STILL POSSIBLE TO GET A DECENT SCAN USING A DISTANCE SENSOR THAT IS MEANT FOR COMPLETELY DIFFERENT APPLICATIONS
- THE SCANNER CAN RECREATE THE MAIN GEOMETRICAL SHAPE EVEN LOSING MOST OF THE DETAILS