Ministry of Education
Superior And Scientific Research
*****
University of Carthage
*****
National Institute of Applied Science and Technology

Hand Motion Recognition

Developed by : MSEIBI souha
JABRI chaima
CHAABANI elaa
JLASSI wejden

Member of Jury : Mr. KETATA Raouf
Mme Fafa ben htira

Plan

01 Introduction

02 Requirement

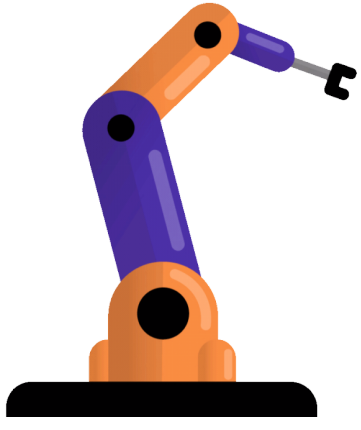
03 Mechanical/ electrical design

04 Code and implementation

05 Problem and solution

06 Conclusion

Cobot

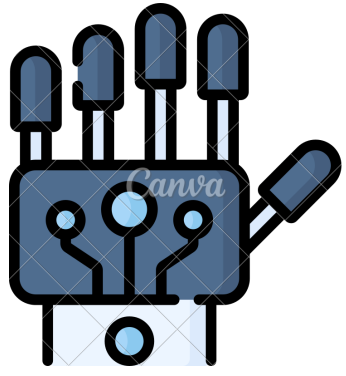


- collaborative robot
- gestures recognition
- Vision-based approaches rely on:
- image shaping
- RGB colors

Robotic glove

- sensors that detects all mouvements
- Send Data by Bluetooth module
- Control robotic hand
- Expensive
- Low precision

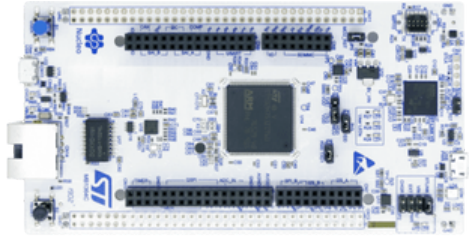
Hand gesture recognition



- based on models and articulation
- Detect hand mouvements,
- interpret hand gestures using models
- providing high speed robotic hand tracking
- Providing low cost

ARDUINO UNO

- Easy to use
- Has a lot of modules to simplify the work
- Less expensive
- Available



STM32H753ZI

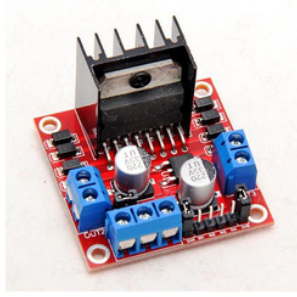
- More Professional
- It can work in real time
- Available

SG90 SERVO MOTOR

- Tiny and lightweight
- Operating voltage 5V /40mA
- 180° (90° in each direction)
- Speed 0.1s/60°
- Torque 2.5 KG
- Available

MG946R SERVO MOTOR

- ·Precise control
- 5 operating voltage/ 40mA current
- Rotate 360°
- Low speed
- 13 KG Torque
- ·High cost



L298N MODULE

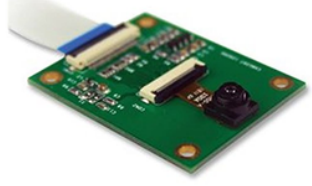
- Less expensive
- It can deliver up to 2A peak and 20W continuous.
- Unable to control one servo motors

MODULE XL4015

- 5A 75W
- Include short circuit protection
- It can deliver up to 4A peak and 50W continuous.
- Unable to control all the servo motors used

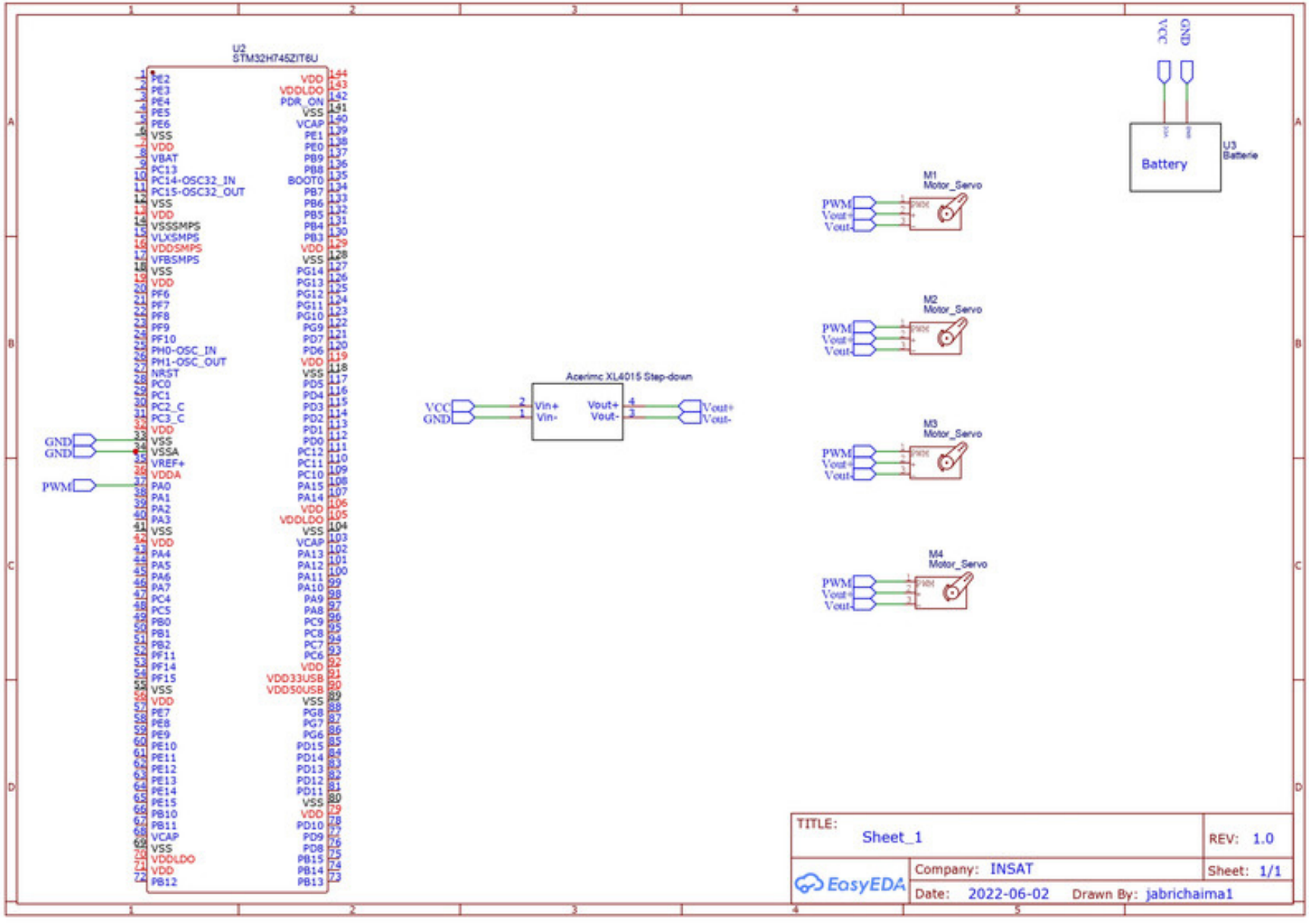
COMPUTER WEBCAM

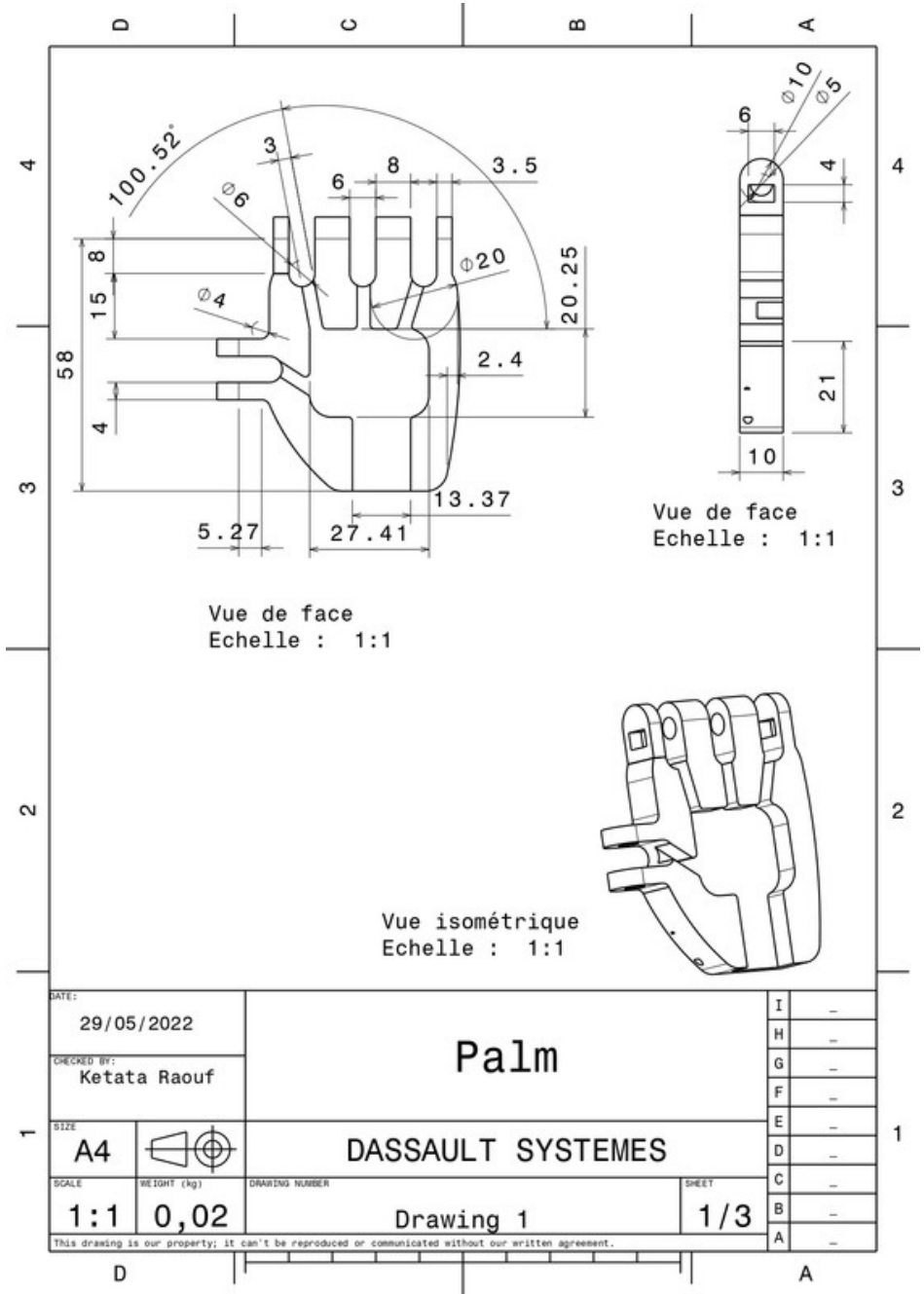
- Low cost
- Low resolution

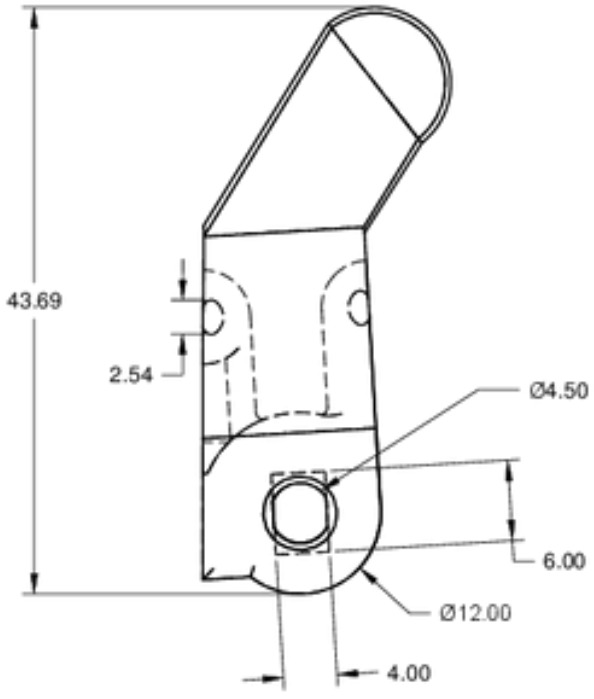


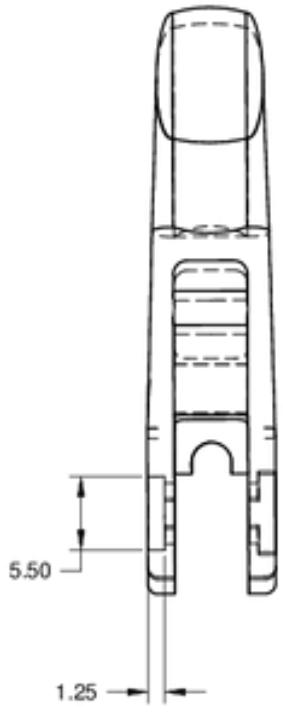
STM-CAM MODULE

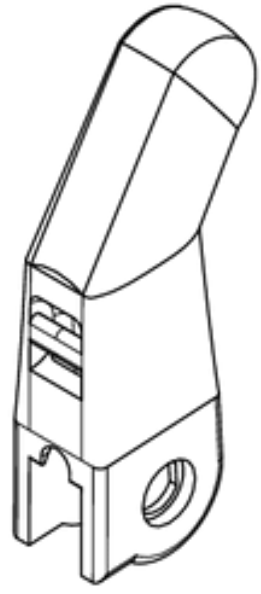
- High cost
- Resolution : Up to 1280 * 1024
- Up to 30 frames / second

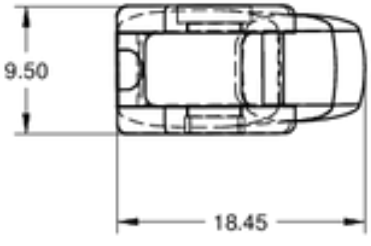

U2
STM32H745ZIT6U
Acerinc XL4015 Step-down
Vin+
Vin-
Vout+
Vout-
VCC
GND
PWM
M1
M2
M3
M4
Motor_Servo
Battery
U3
Batterie
TITLE:
Sheet_1
REV: 1.0
Company: INSAT
Sheet: 1/1
Date: 2022-06-02
Drawn By: jabrichaima1
EasyEDA


100.52°
3
6
8
3.5
Ø6
Ø20
Ø4
8
15
58
4
20.25
2.4
13.37
5.27
27.41
Vue de face
Echelle : 1:1
6
Ø10
Ø5
4
21
10
Vue de face
Echelle : 1:1
Vue isométrique
Echelle : 1:1
DATE: 29/05/2022
CHECKED BY: Ketata Raouf
Palm
SIZE A4
DASSAULT SYSTEMES
SCALE 1:1
WEIGHT (kg) 0,02
DRAWING NUMBER Drawing 1
SHEET 1/3
This drawing is our property; it can't be reproduced or communicated without our written agreement.

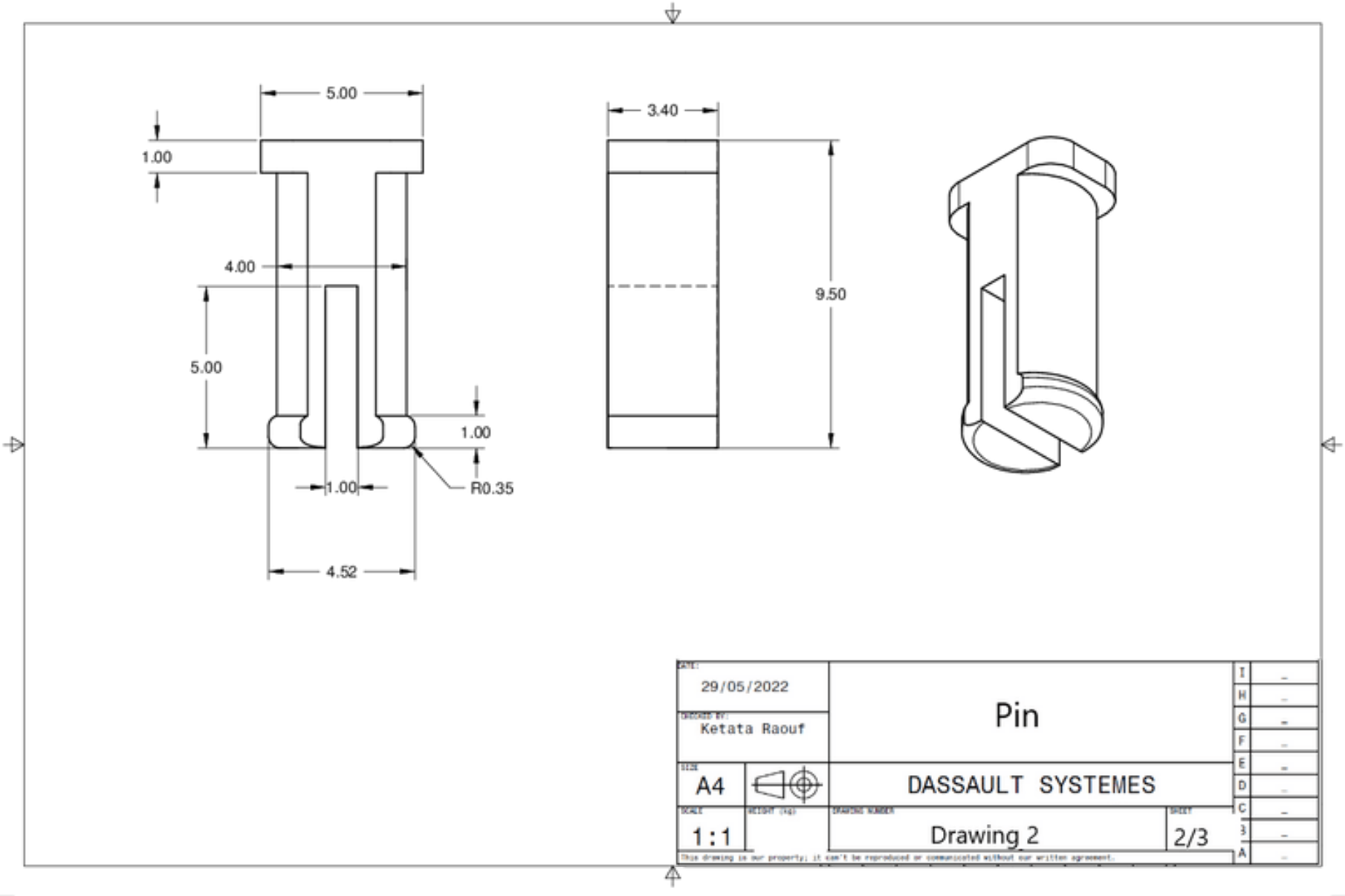


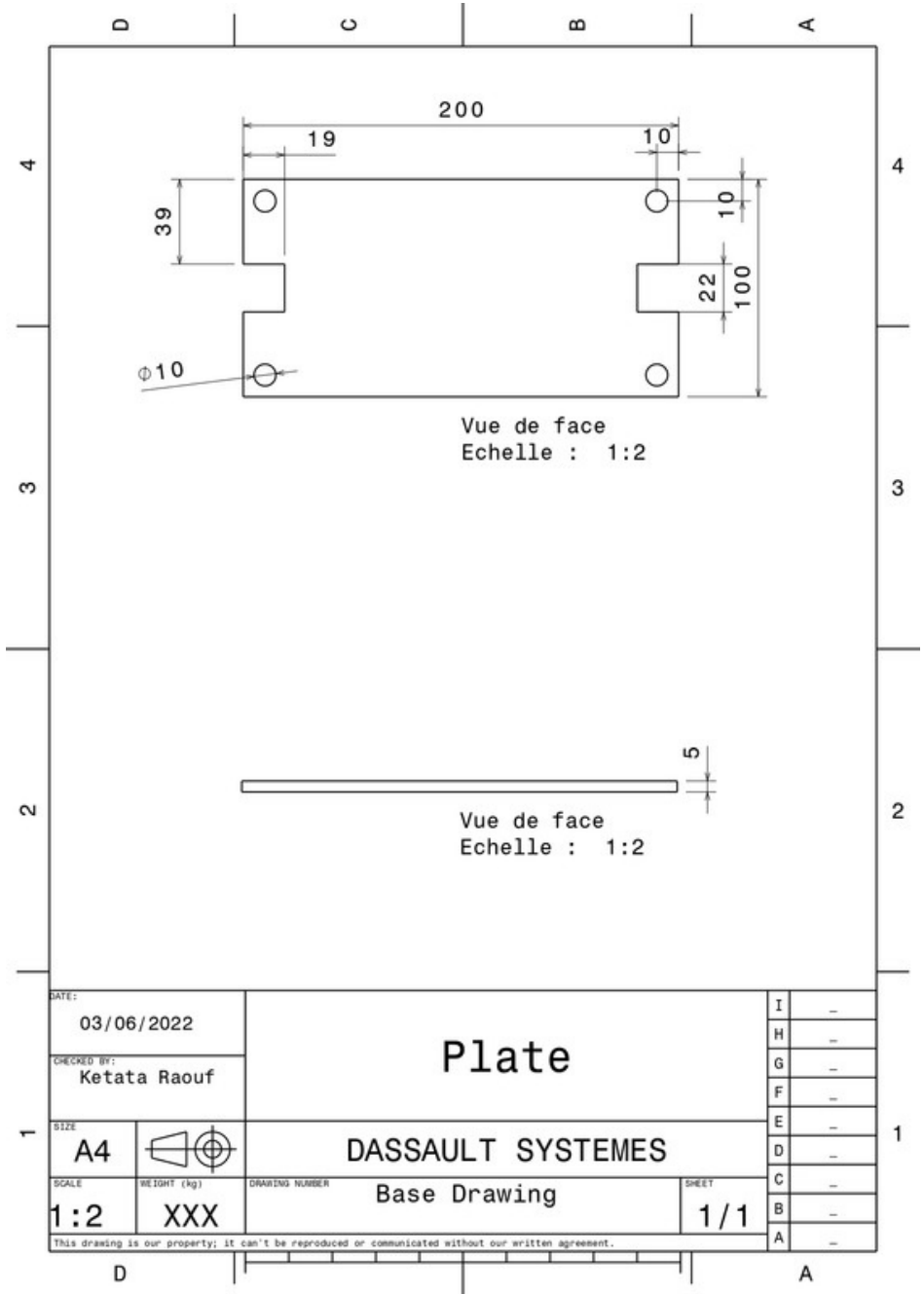






DATE: 29/05/2022	Fingers	I, H, G, F, E, D, C, B, A
CHECKED BY: Ketata Raouf		
SIZE: A4	DASSAULT SYSTEMES	
SCALE: 1:1	DRAWING NUMBER: Drawing 3	SHEET: 3/3


5.00
1.00
4.00
5.00
1.00
1.00
R0.35
4.52
3.40
9.50
29/05/2022
Ketata Raouf
Pin
A4
DASSAULT SYSTEMES
1:1
Drawing 2
2/3
This drawing is our property; it can't be reproduced or communicated without our written agreement.


200
19
10
39
10
22
100
ϕ10
Vue de face
Echelle : 1:2
5
Vue de face
Echelle : 1:2
DATE:
03/06/2022
CHECKED BY:
Ketata Raouf
Plate
SIZE
A4
DASSAULT SYSTEMES
SCALE
1:2
WEIGHT (kg)
XXX
DRAWING NUMBER
Base Drawing
SHEET
1/1
This drawing is our property; it can't be reproduced or communicated without our written agreement.

SOFTWARE PROCESS

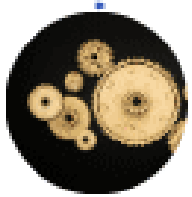
Matrix of Data

Hand Gesture Recognition Algorithm

Sending data

Communication with STM32

Binary values



Commanding servo motors depending on received values

Hand motion tracking

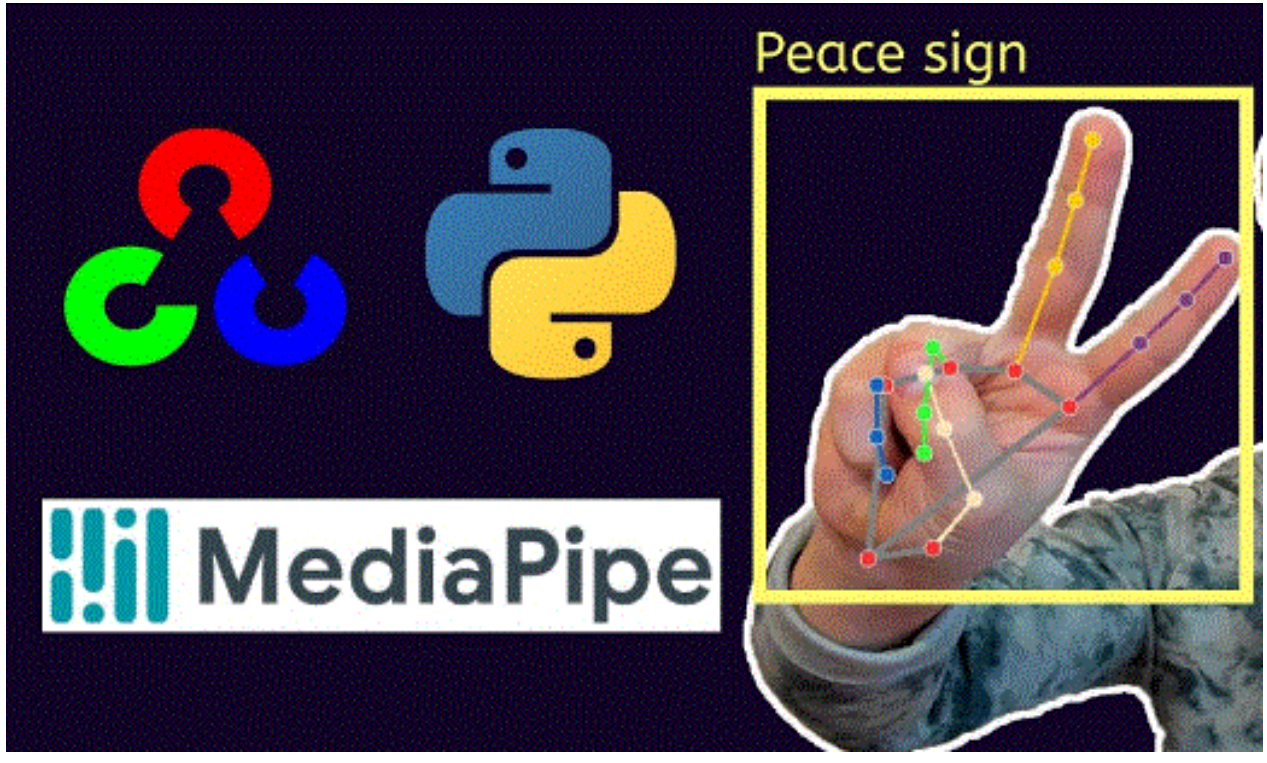
Object Detection Pipeline

- Data collection
- Label the Data
- Data Preprocessing
- Train the model
- Evaluate the model

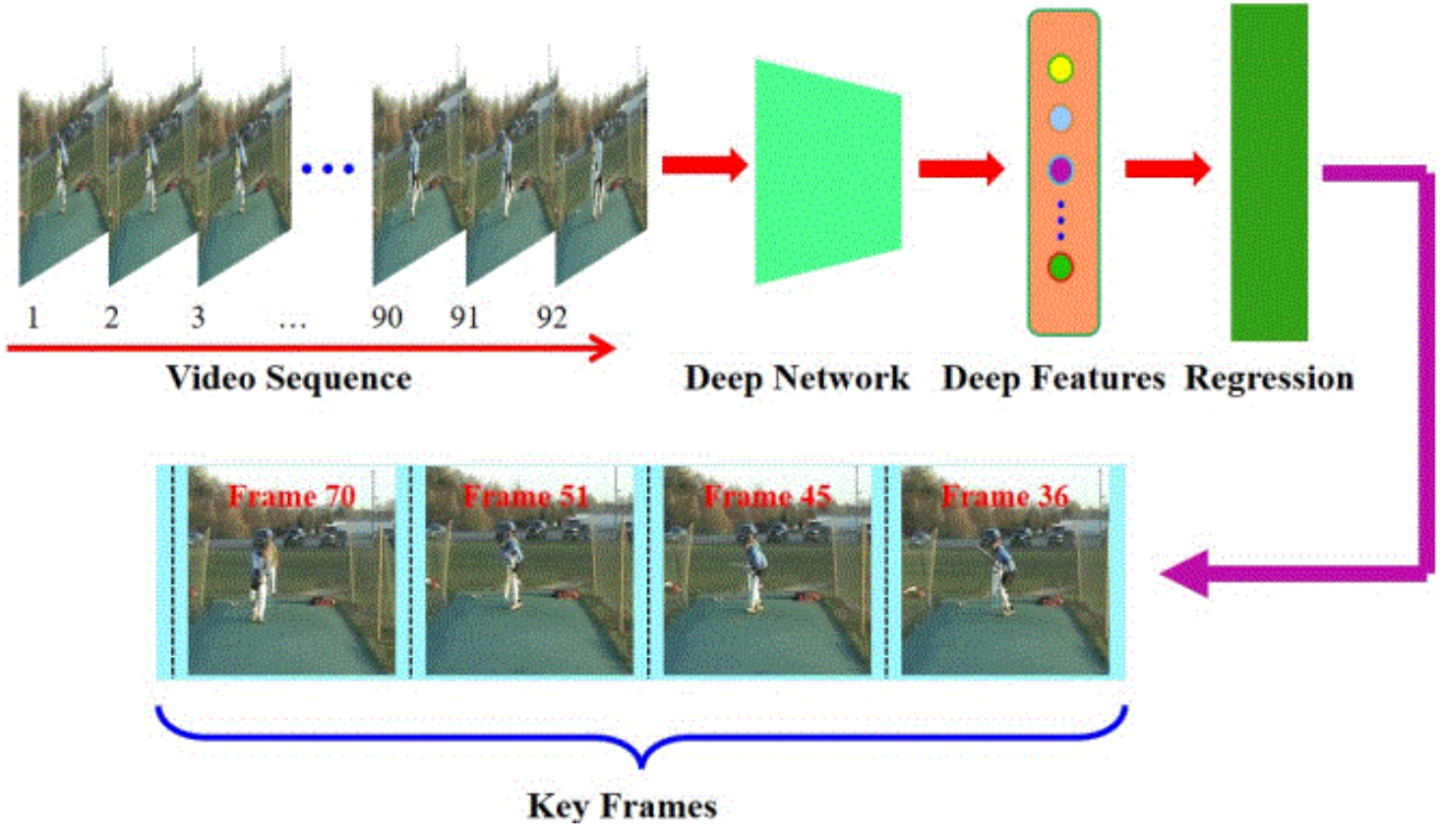
Our approach

We broke down the problem into subproblems that we solved seperately.

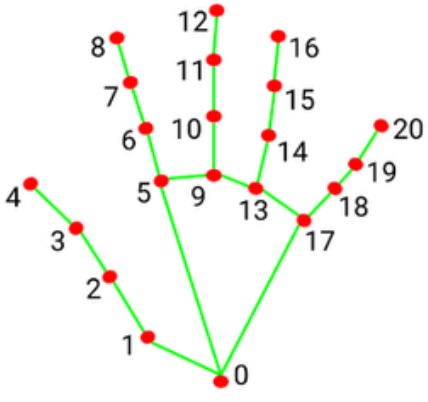
Technologies and frameworks



Frame Selection

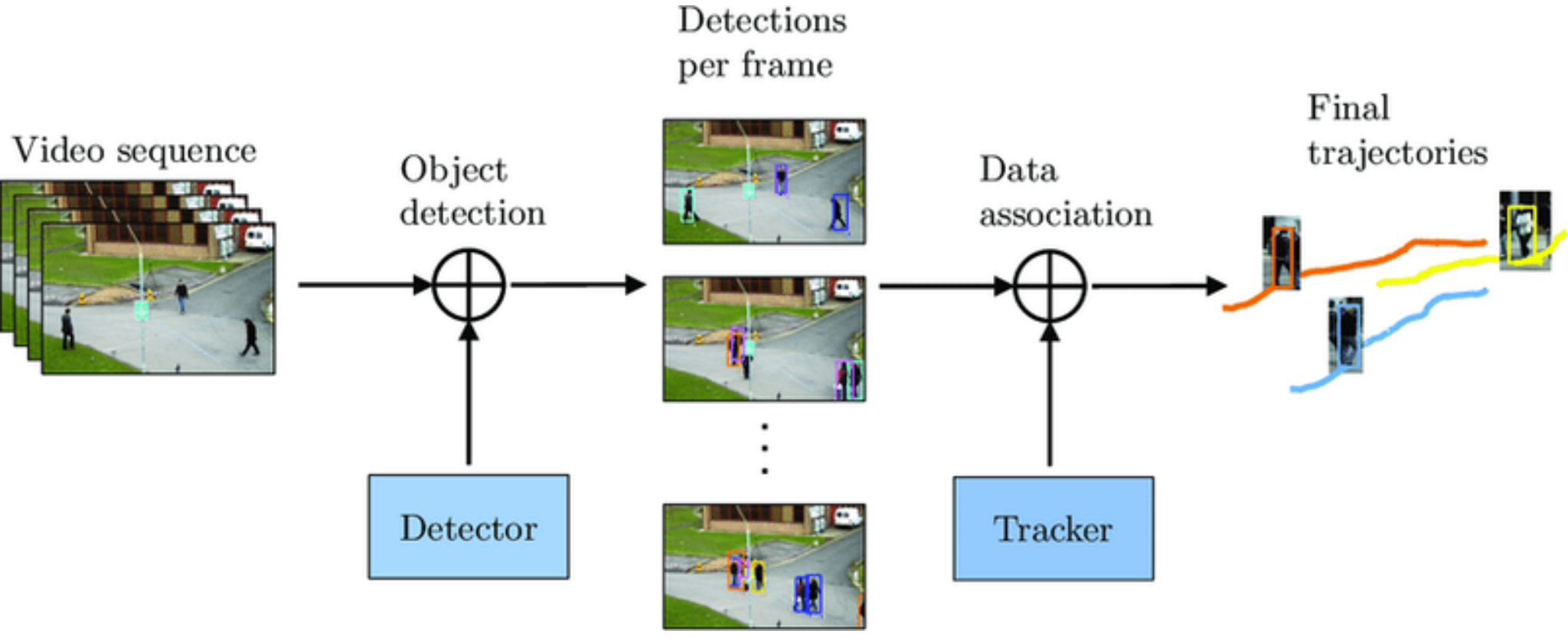


Data Labelling

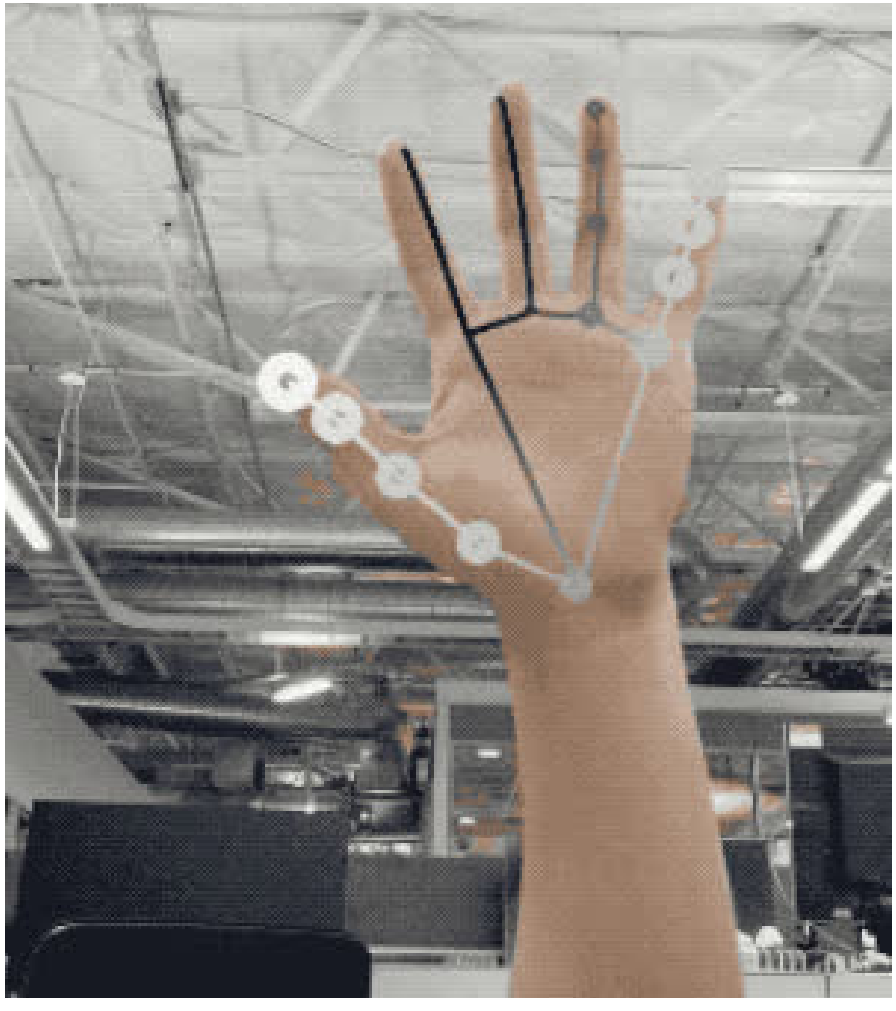


0. WRIST
1. THUMB_CMC
2. THUMB_MCP
3. THUMB_IP
4. THUMB_TIP
5. INDEX_FINGER_MCP
6. INDEX_FINGER_PIP
7. INDEX_FINGER_DIP
8. INDEX_FINGER_TIP
9. MIDDLE_FINGER_MCP
10. MIDDLE_FINGER_PIP
11. MIDDLE_FINGER_DIP
12. MIDDLE_FINGER_TIP
13. RING_FINGER_MCP
14. RING_FINGER_PIP
15. RING_FINGER_DIP
16. RING_FINGER_TIP
17. PINKY_MCP
18. PINKY_PIP
19. PINKY_DIP
20. PINKY_TIP

Object Detection and tracking



Model Output



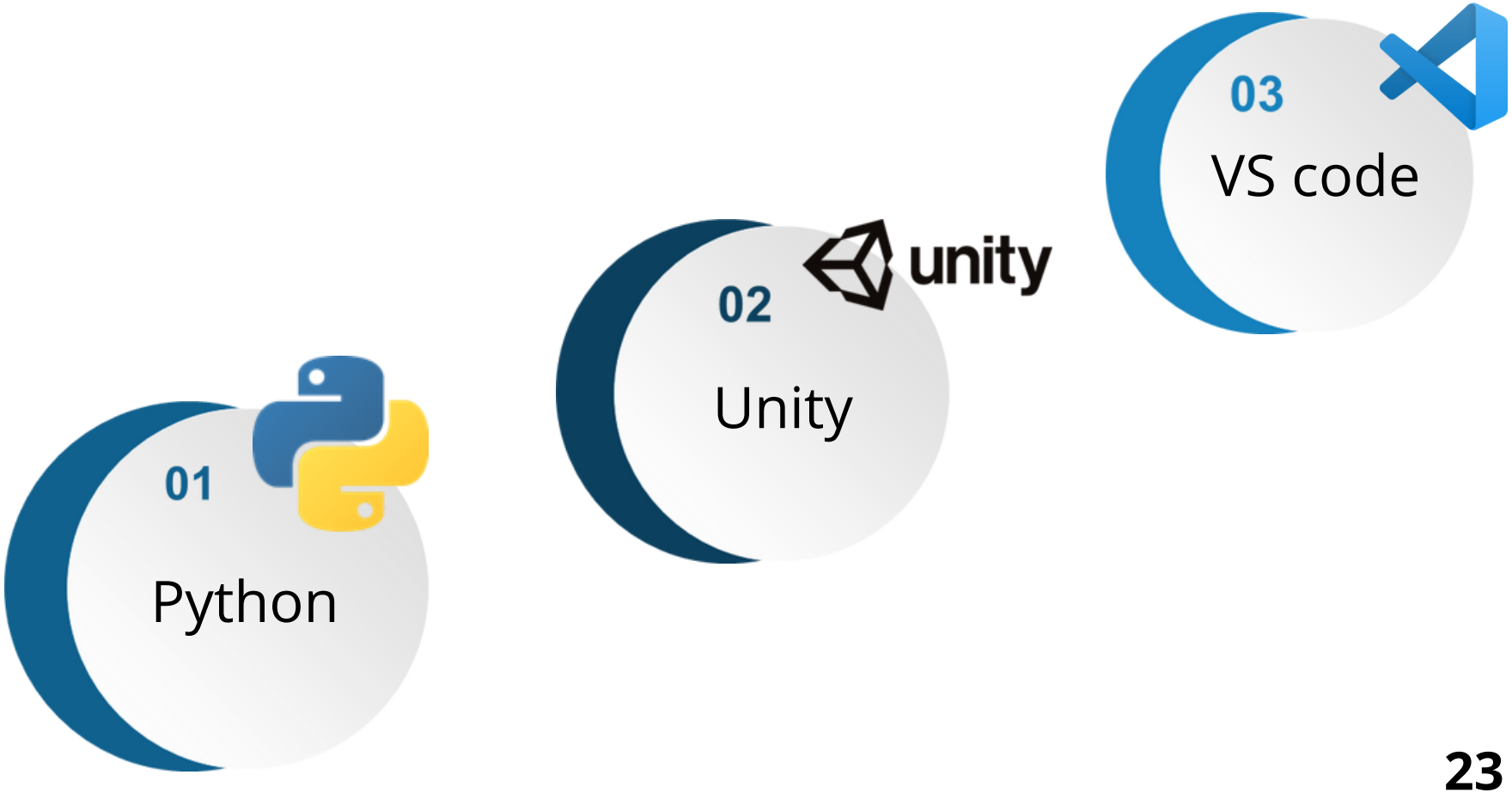
3D hand motion recogintion environment:

The accuracy: How close the acquired data are to their real value

The real time aquisition: How reliable is my model**.**

3D hand tracking environment:

Software choice

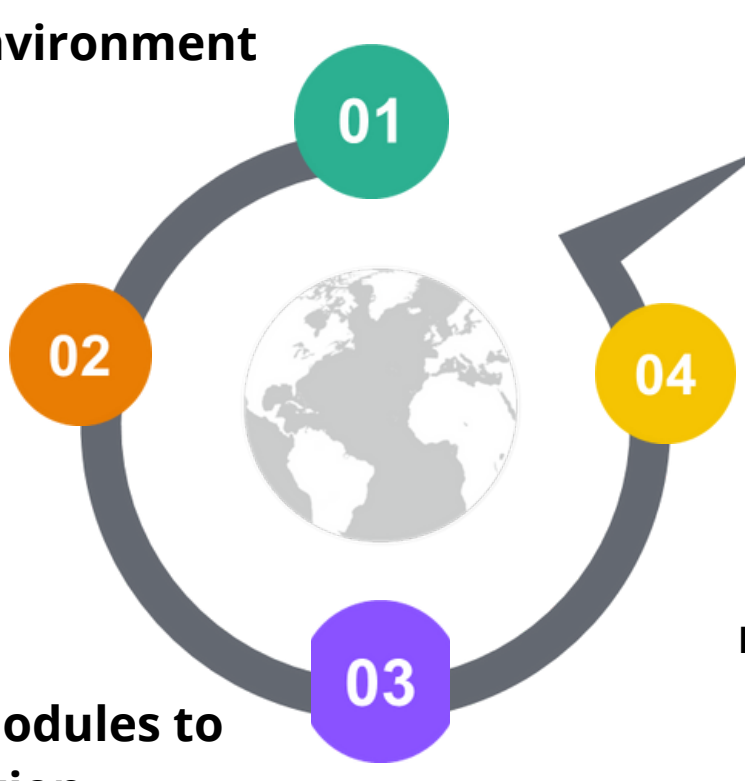


3D hand tracking environment:

Steps to create the environment

Communication :

Send data to the Unity environment



Hand design:

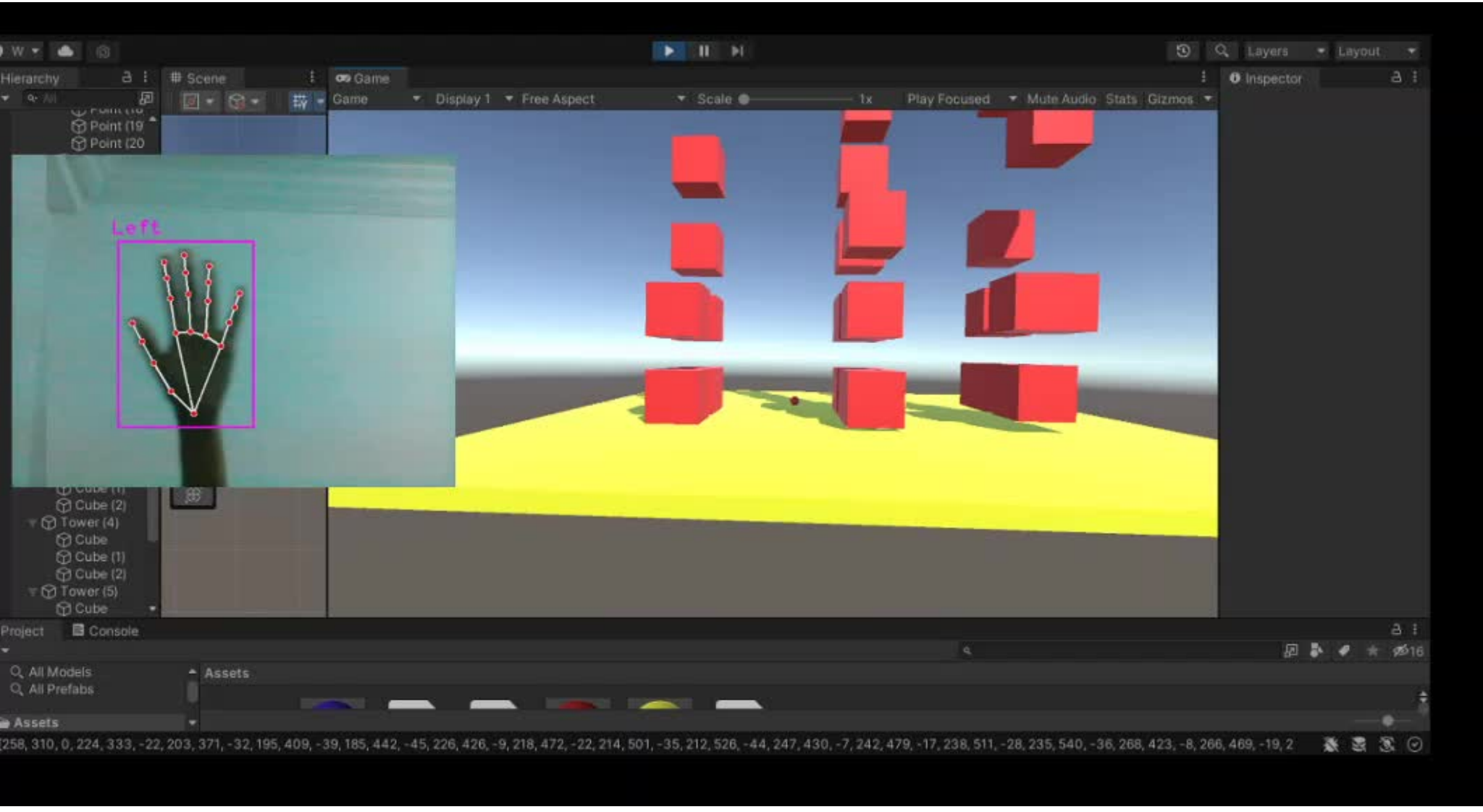
design the 21 Landmarks and the lines

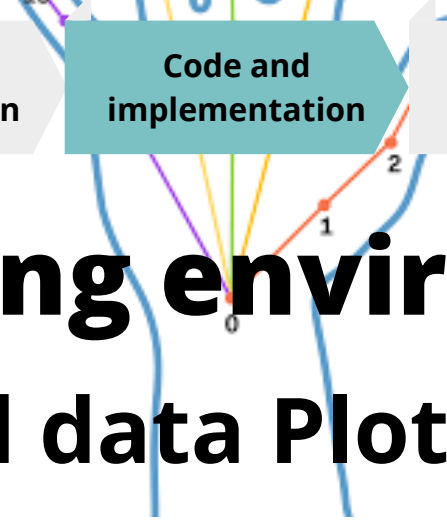
Coding:

C# program broken into modules to perform cetain function

Interact with object

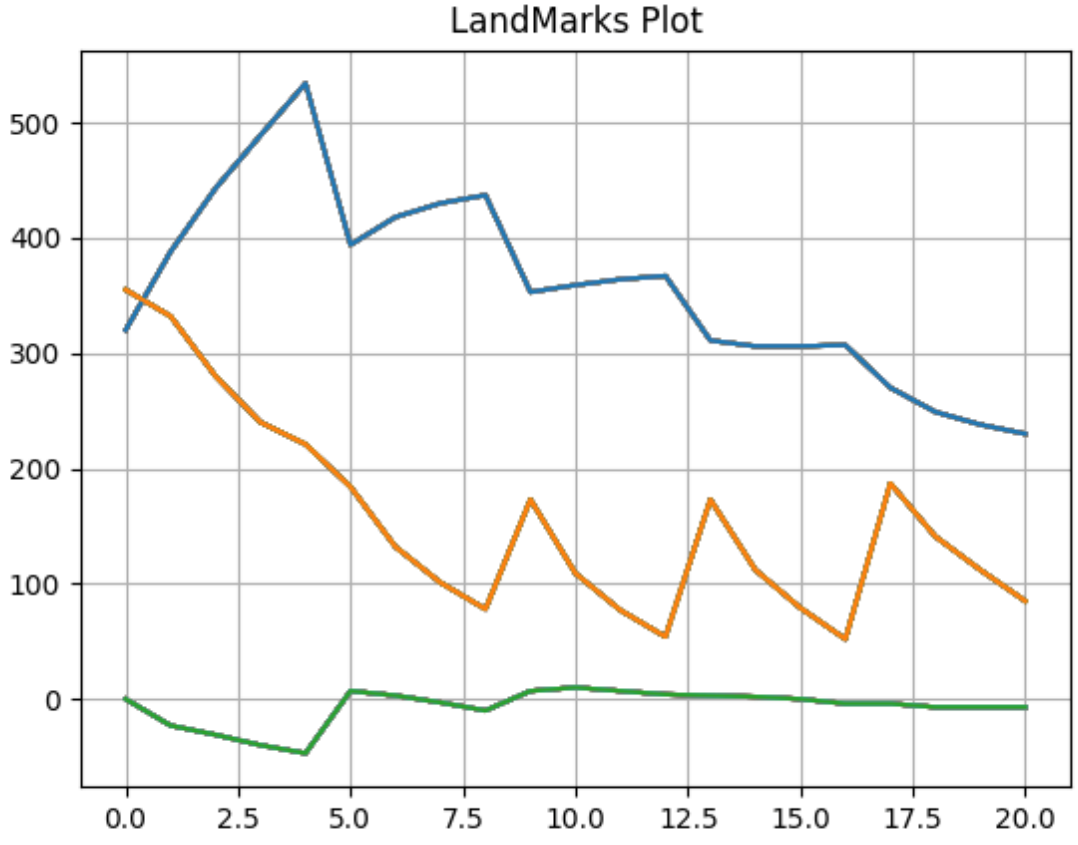
Add cubic objrct to the enviroment to make the application more interessting


Left
Hierarchy
Scene
Game
Inspector
Project
Console
Assets



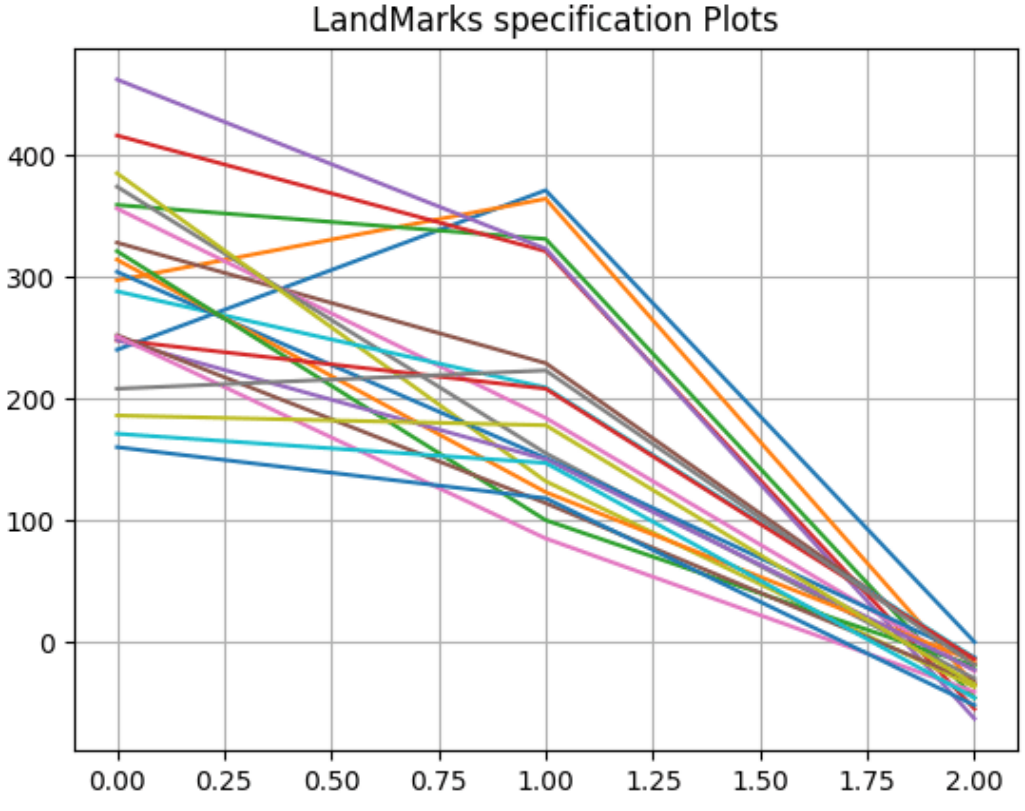
3D hand tracking environment:

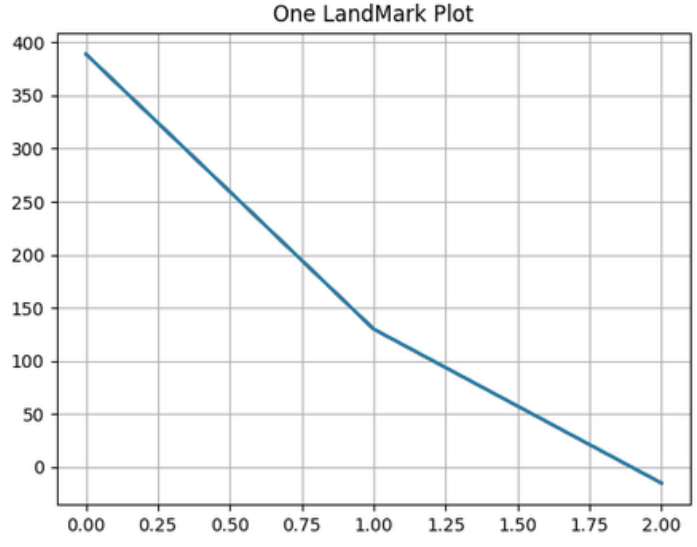
Acquired data Plots



3D hand tracking environment:

Acquired data Plots



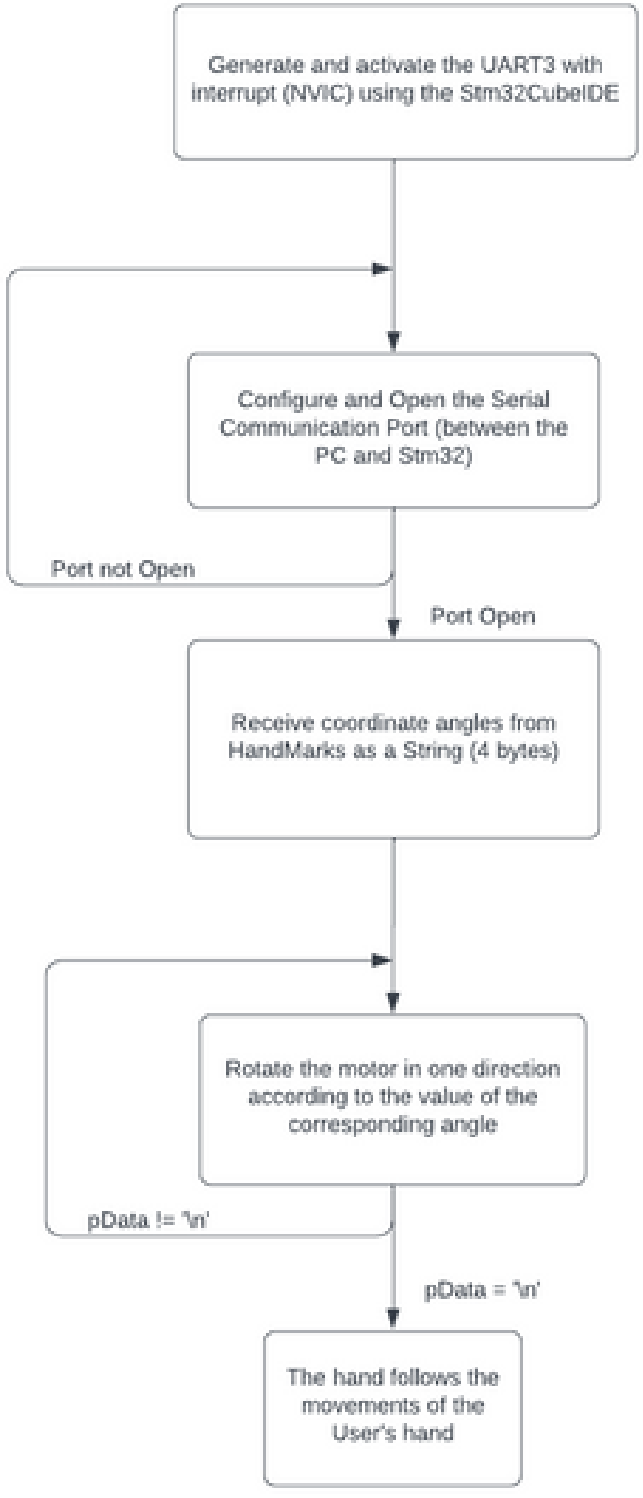


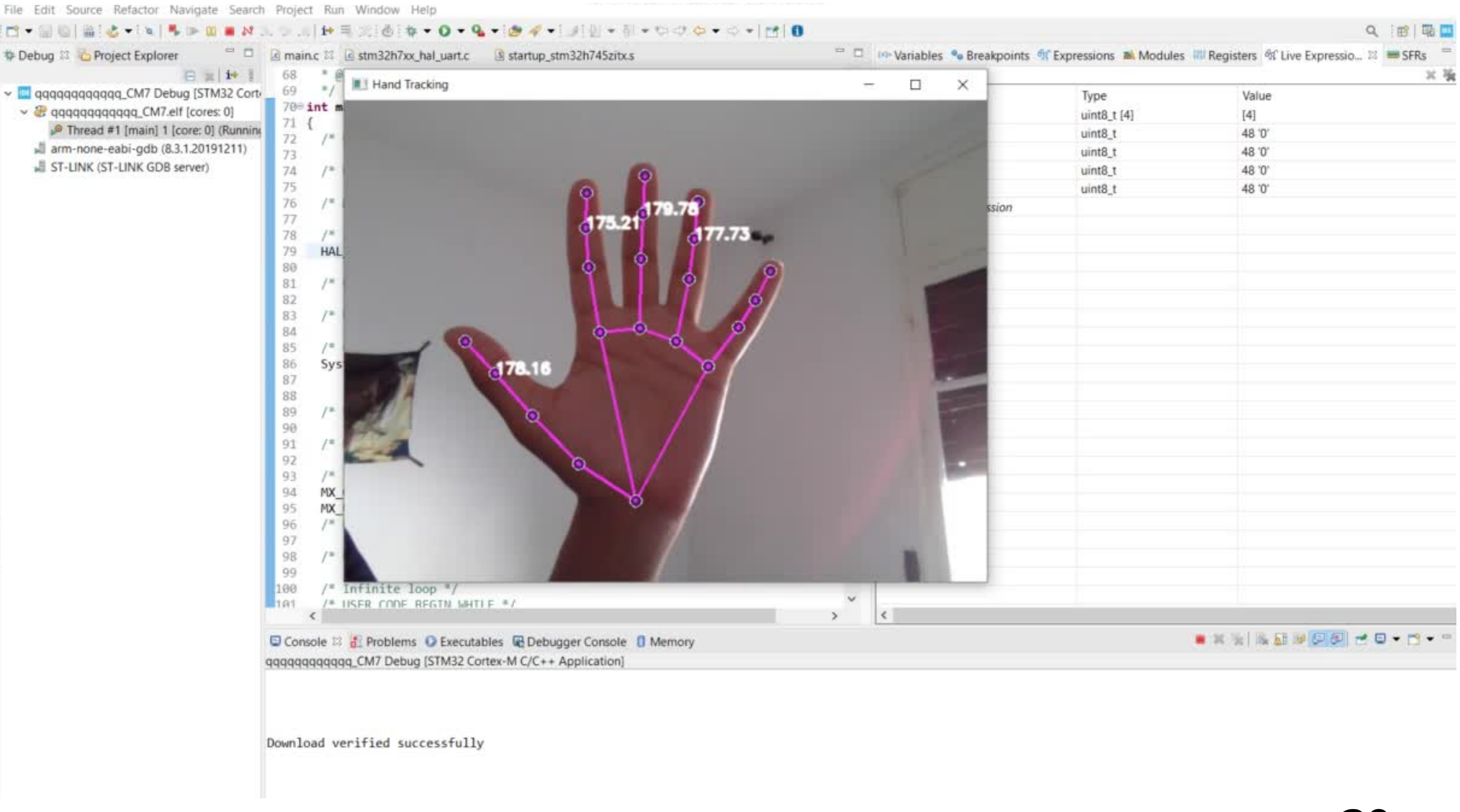
UART hardware is devised into two forms:

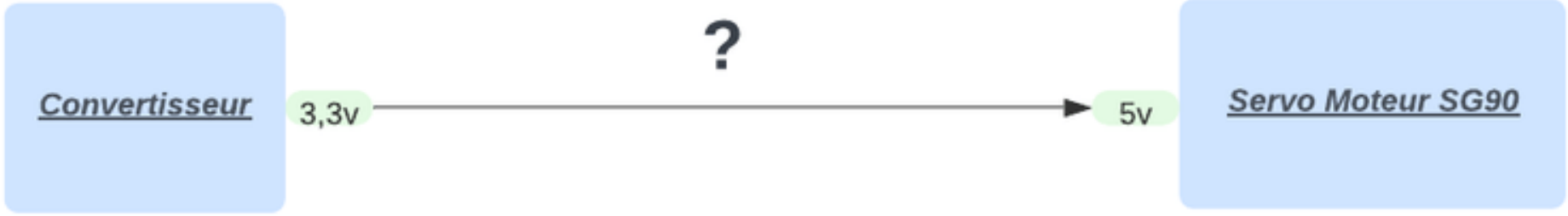
- UART – Universal Asynchronous Receiver/Transmitter
- USART – Universal Synchronous/Asynchronous Receiver/Transmitter

USART COMMUNICATION

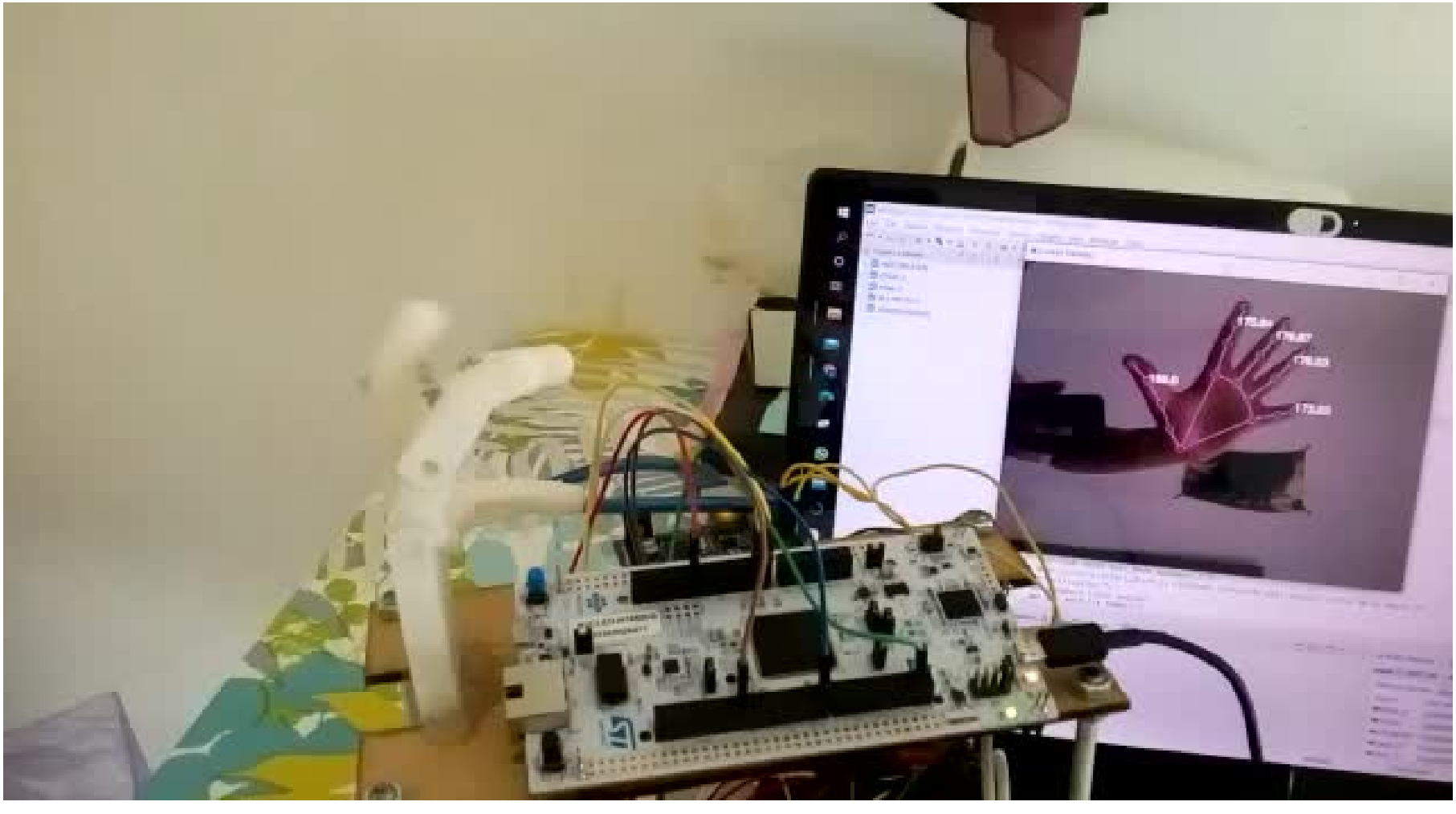
we have established USART communication between STM32H745ZI high-performance MCU and python. The module is used over a USB link which allows the transmission of data from python to the board.


Generate and activate the UART3 with interrupt (NVIC) using the Stm32CubeIDE
Configure and Open the Serial Communication Port (between the PC and Stm32)
Port not Open
Port Open
Receive coordinate angles from HandMarks as a String (4 bytes)
Rotate the motor in one direction according to the value of the corresponding angle
pData != '\n'
pData = '\n'
The hand follows the movements of the User's hand


Hand Tracking
175.21
179.78
177.73
178.16
Download verified successfully


Convertisseur
3,3v
?
5v
Servo Moteur SG90


Convertisseur
3,3v
5v
Servo Moteur SG90



The main goal of this project is to create and set up a system of hand motion recognition allowing the user to detect to and track the hand gesture in real time using computer vision technology and adding IoT funtionalities. Howerver , this project always remains open for evolution as an example we can add piezelectric sensors allowing the system to manipulate objects in real world.