Institut de Technologie du Cambodge

Département de Génie Informatique et Communication

Khmer Air Writing Recognition (Prototype)

Organization Name   : ViLa Lab

Internship Supervisor   : Dr. VALY Dona

Student Name   : YORN Vanda

2022 - 2023

Agenda

1. Introduction
2. Project Overview
3. Analysis and Design
4. Implementation
5. Conclusion
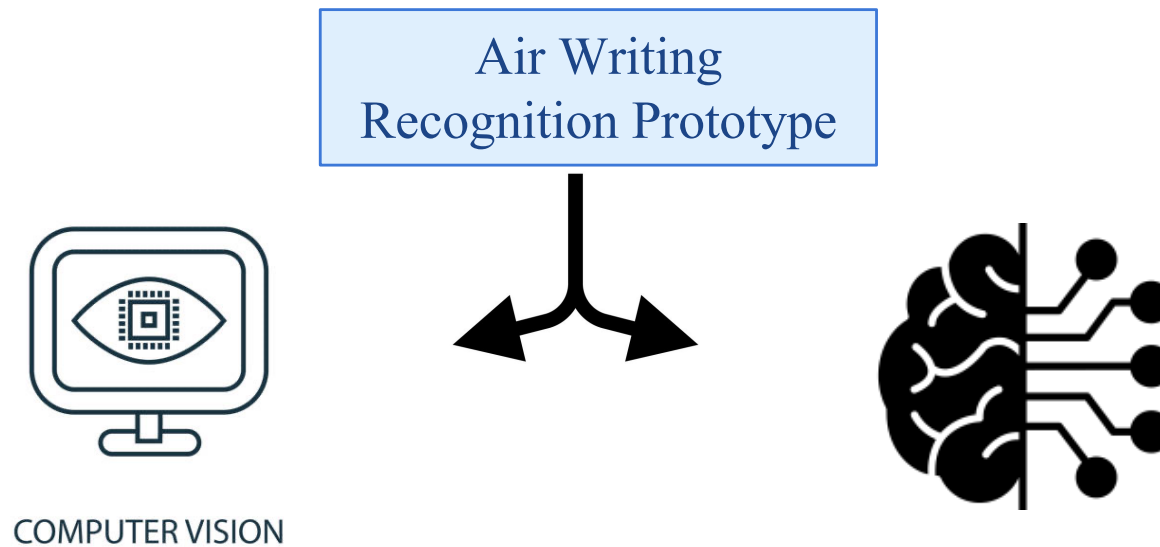6. Demo

01 Presentation of the Organization

➤ Name of laboratory: ViLa Lab – Computer Vision & Natural Language Processing Lab

➤ Research Location: 6th floor, Building I, ITC

➤ Head of Laboratory: Dr. VALY Dona

01 What is Khmer Air Writing Recognition?

➢ Computer Vision

➢ Artificial Neural Network

Air Writing
Recognition Prototype

COMPUTER VISION

02   **Presentation of the Internship Project**

❑   **Objective**

➢ To develop an tool to detect and tracking hand position

➢ Drawing without physical touch

➢ To make the prediction tool which could recognize Khmer character

➢ Be able to clear the screen just like clearing on board in real whiteboard.

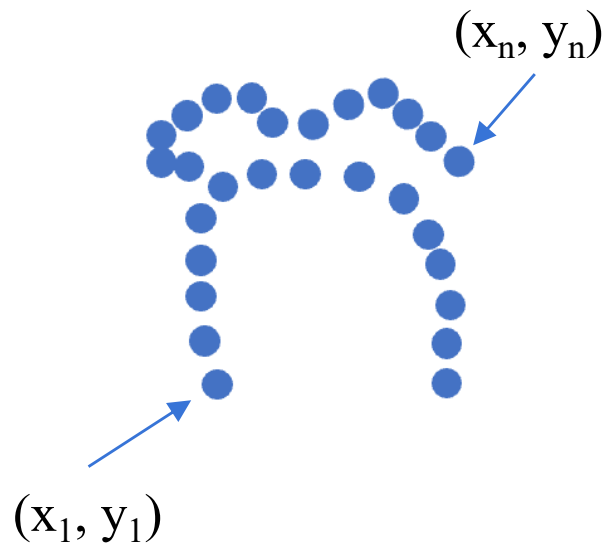## 02 Presentation of the Internship Project (Cont.)

❑ **Planning**

Weeks	Task
1 - 4	Learning new Technologies
5 - 8	Build Computer Vision Prototype
9 - 10	Analyze Function and Requirements to Prototype
11-12	ANN Model and Prototype Integration
13 - 16	Testing and Implementation

01   Data Preprocessing

❑ **Dataset File**

➢ Label, x_1, y_1, x_2, y_2, x_3, y_3, x_4, y_4, ...x_n, y_n

➢ Label: { 0, 1, 2, ... 32}

(x_n, y_n)

(x_1, y_1)

	A	B	C	D	E	F	G	H	I
1	23	0.261261	0.82716	0.261261	0.820988	0.255255	0.811728	0.237237	0.79629
2	19	0.335793	0.31003	0.335793	0.31003	0.335793	0.31003	0.335793	0.31003
3	18	0.14652	0.183406	0.14652	0.20524	0.14652	0.248908	0.14652	0.28821
4	24	0.312883	0.342105	0.312883	0.342105	0.312883	0.342105	0.312883	0.342105
5	25	0.062257	0.402174	0.062257	0.402174	0.062257	0.402174	0.062257	0.402174
6	5	0.35743	0.407186	0.35743	0.407186	0.349398	0.419162	0.337349	0.437126
7	11	0.307692	0.44403	0.307692	0.44403	0.307692	0.44403	0.307692	0.44403
8	26	0.907895	0.599222	0.697368	0.603113	0.565789	0.610895	0.447368	0.622568
9	12	0.044393	0.259905	0.044393	0.259905	0.044393	0.259905	0.044393	0.259905
10	0	0.125	0.971519	0.125	0.971519	0.125	0.971519	0.125	0.971519
11	1	0.467105	0.178451	0.467105	0.178451	0.467105	0.178451	0.473684	0.178451
12	16	0.269461	0.679487	0.263473	0.679487	0.215569	0.709402	0.161677	0.799145
13	9	0	0.410811	0	0.410811	0	0.410811	0	0.410811
14	20	0.1569	0.230263	0.1569	0.246711	0.160681	0.291118	0.166352	0.335526
15	17	0.167939	0.464286	0.137405	0.446429	0.10687	0.470238	0.053435	0.553571
16	8	0	0.732673	0	0.732673	0.005208	0.732673	0.020833	0.732673
17	18	0.227545	0.361702	0.233533	0.468085	0.233533	0.64539	0.233533	0.914894
18	6	0.390909	0.25	0.390909	0.25	0.390909	0.25	0.390909	0.25
19	5	0.233333	0.274554	0.233333	0.274554	0.230769	0.28125	0.215385	0.305804
20	32	0.174757	0.702532	0.174757	0.702532	0.174757	0.702532	0.174757	0.702532

02 Prototype Development

❑ **Work Flow**
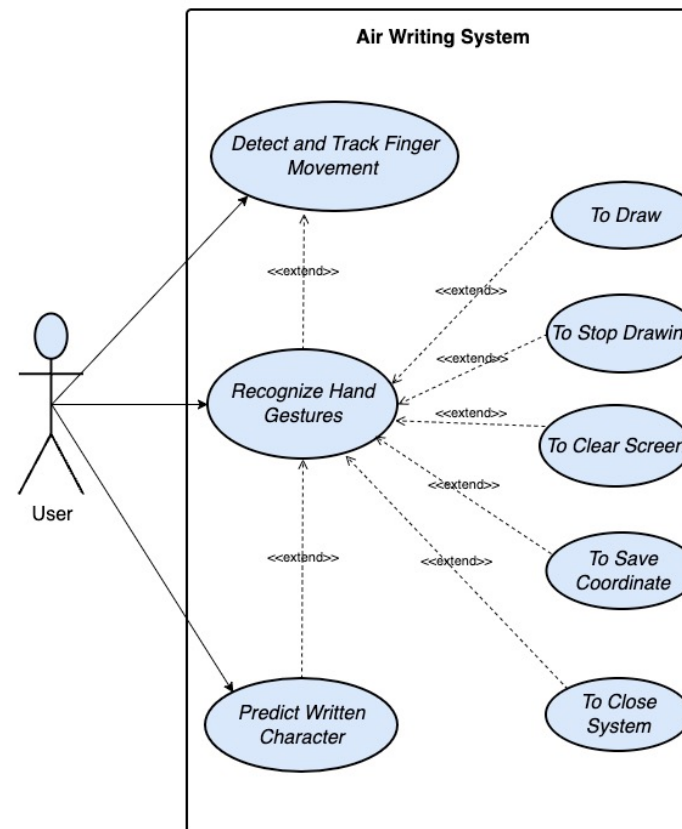
➢ Access to Prototype

➢ Prototype Operation

➢ Response

User

User

PC

Access to Prototype

Prototype Hand Tracking

Open Webcam

Tracking Hand

Get Position of Finger

Tracking Operation

Saved ANN Model

Response

Predicted Khmer Character
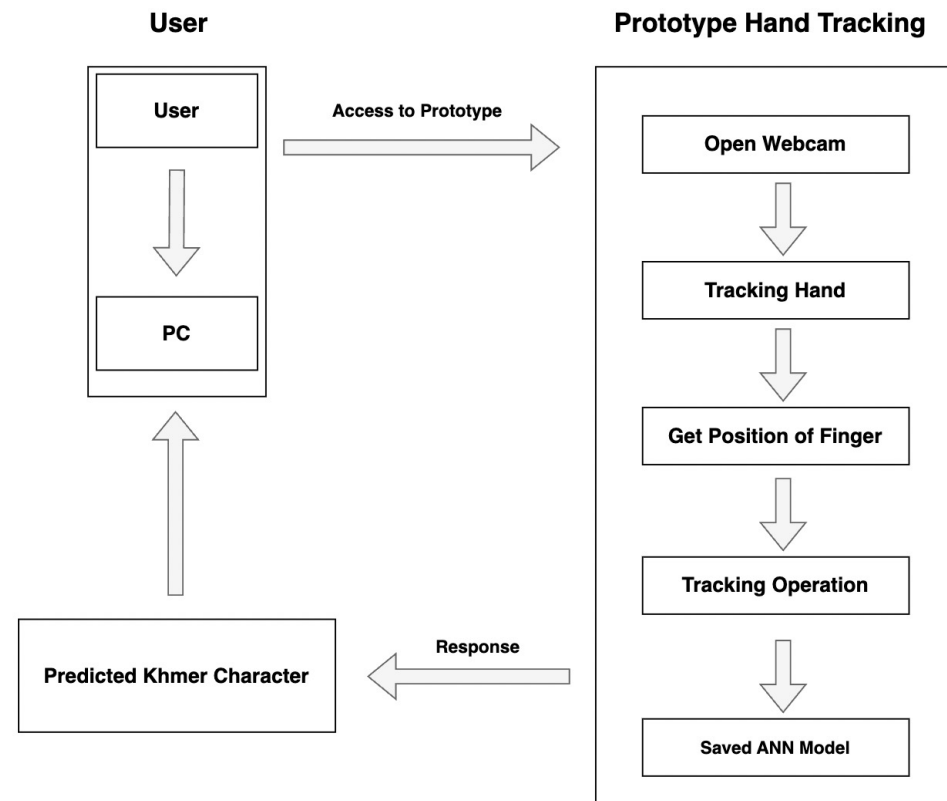
02 Prototype Development (Cont.)

❑ **Use Case Diagram**

➤ Tracking Hand

➤ Recognize Hand Gestures

➤ Predict Written Character

Air Writing System

- Detect and Track Finger Movement
- Recognize Hand Gestures
- Predict Written Character
- To Draw
- To Stop Drawing
- To Clear Screen
- To Save Coordinate
- To Close System

User

<<extend>>

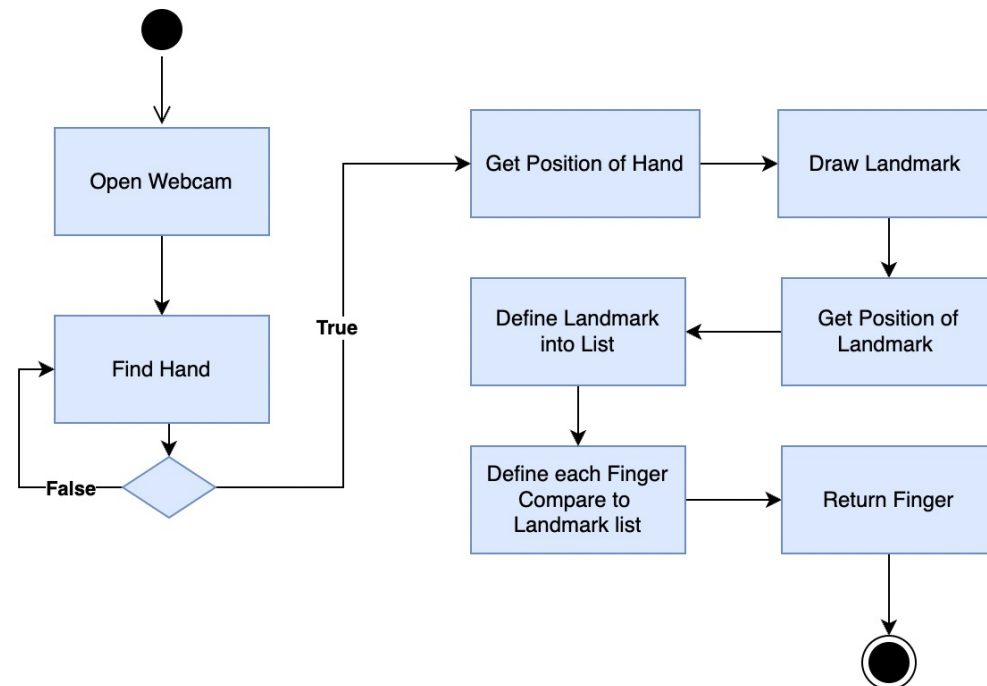## 02 Prototype Development (Cont.)

❑ **Hand Tracking Activity Diagram**

➢ Open Webcam

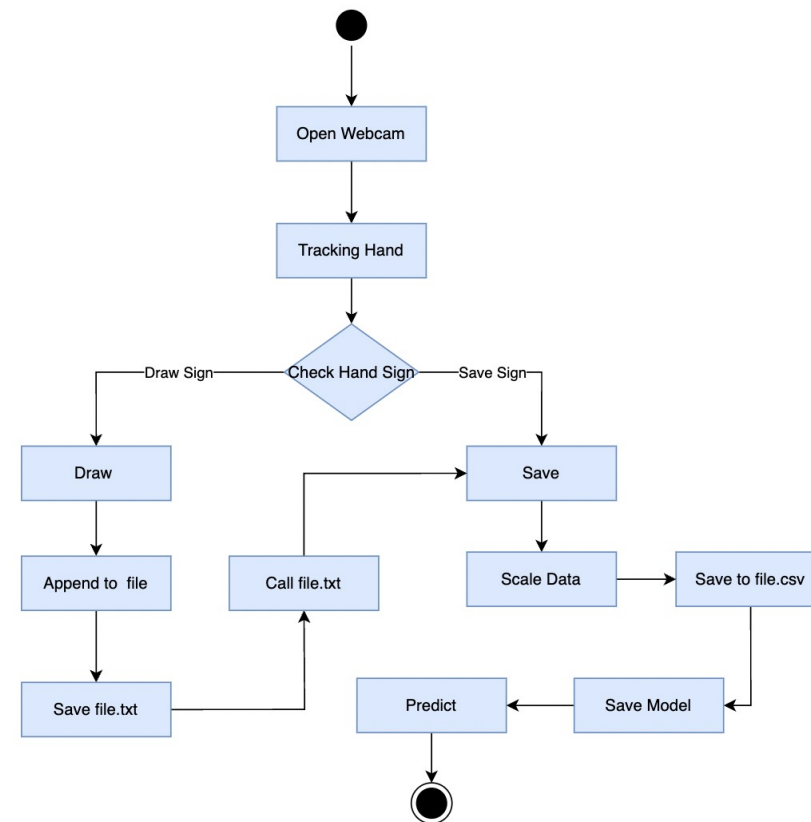➢ Detect Hand

➢ Getting Hand Information

➢ Drawing Landmark

```
        ●
        │
        ▼
  ┌──────────────┐                    ┌──────────────────┐     ┌──────────────┐
  │ Open Webcam  │───────────────────▶│ Get Position of  │────▶│ Draw Landmark│
  └──────────────┘                    │      Hand        │     └──────────────┘
        │                             └──────────────────┘            │
        ▼                   True                                      ▼
  ┌──────────────┐          ┌──────────────────┐          ┌──────────────────┐
  │  Find Hand   │          │ Define Landmark  │◀─────────│ Get Position of  │
  └──────────────┘          │    into List     │          │    Landmark      │
        │                   └──────────────────┘          └──────────────────┘
        ▼                           │
     ◇ ◇  False                     ▼
                          ┌──────────────────┐          ┌──────────────┐
                          │ Define each Finger│────────▶│ Return Finger│
                          │ Compare to        │          └──────────────┘
                          │ Landmark list     │                 │
                          └──────────────────┘                 ▼
                                                               ◉
```

8

02 Prototype Development (Cont.)

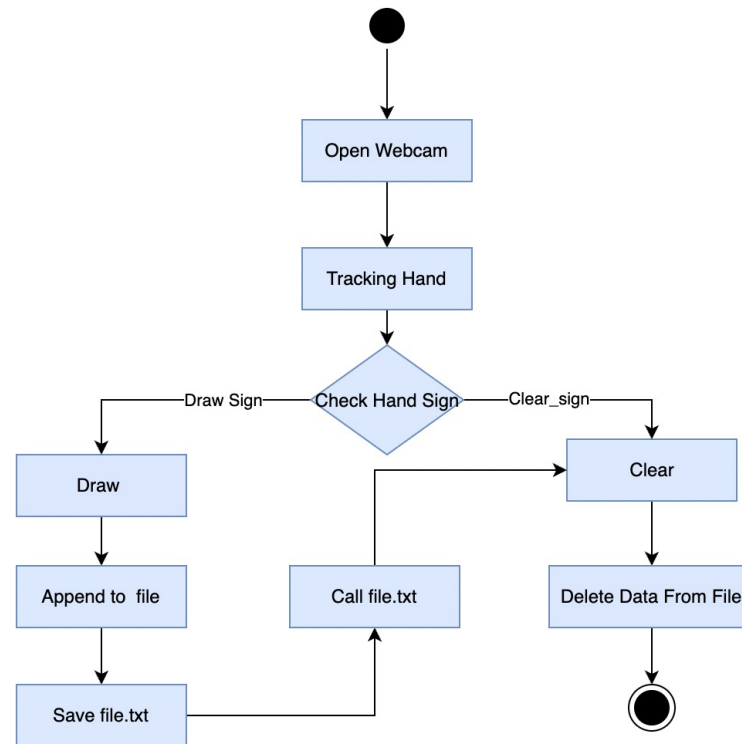❑ **Drawing and Prediction Activity Diagram**

➢ Open Webcam

➢ Tracking Hand

➢ Check Hand Sign

02 Prototype Development (Cont.)
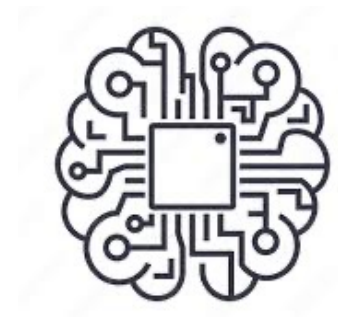
❑ **Drawing and Clear Activity Diagram**

03   # Choices and Related Technologies

❑ **Technologies**

   ➢ Artificial Neural Network

   ➢ Computer Vision

❑ **Pge and Framework**

   ➢ Python

   ➢ Pytorch

   ➢ OpenCV

03   Choice and Related Technologies (Cont.)

❑ **Library**

➢ Mediapipe

➢ Numpy

➢ Pandas

❑ **Tool**

➢ Visual Studio Code

➢ Anaconda

01 Prototype Implementation

❑ **Initialization of the Hand Tracker**

➤ Find Hand

➤ Draw Landmark

➤ Determine Fingers
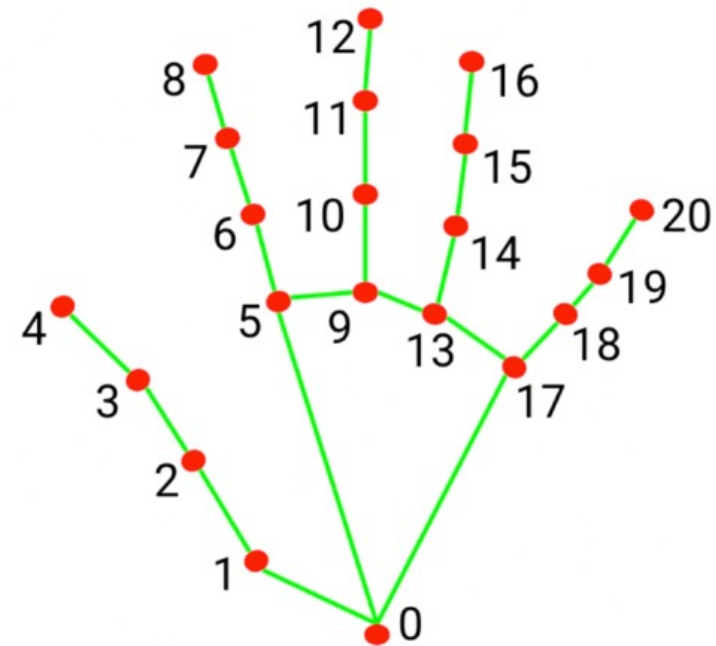
01 Prototype Implementation (Cont.)

❑ **Capturing Video Frame**

➤ Draw Bounding Box
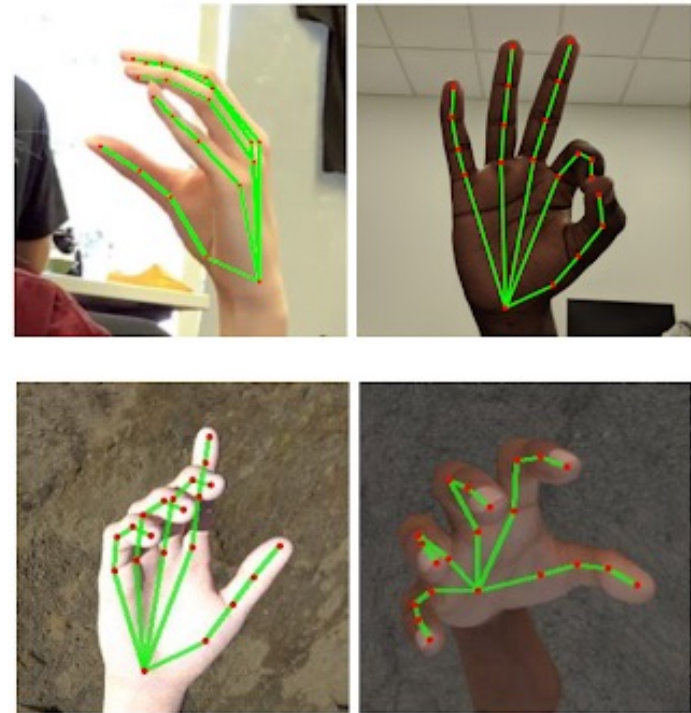
➤ Display Text and Image on Frame

➤ Call Hand Tracker

Text

Image

Bounding Box

Hand Tracker
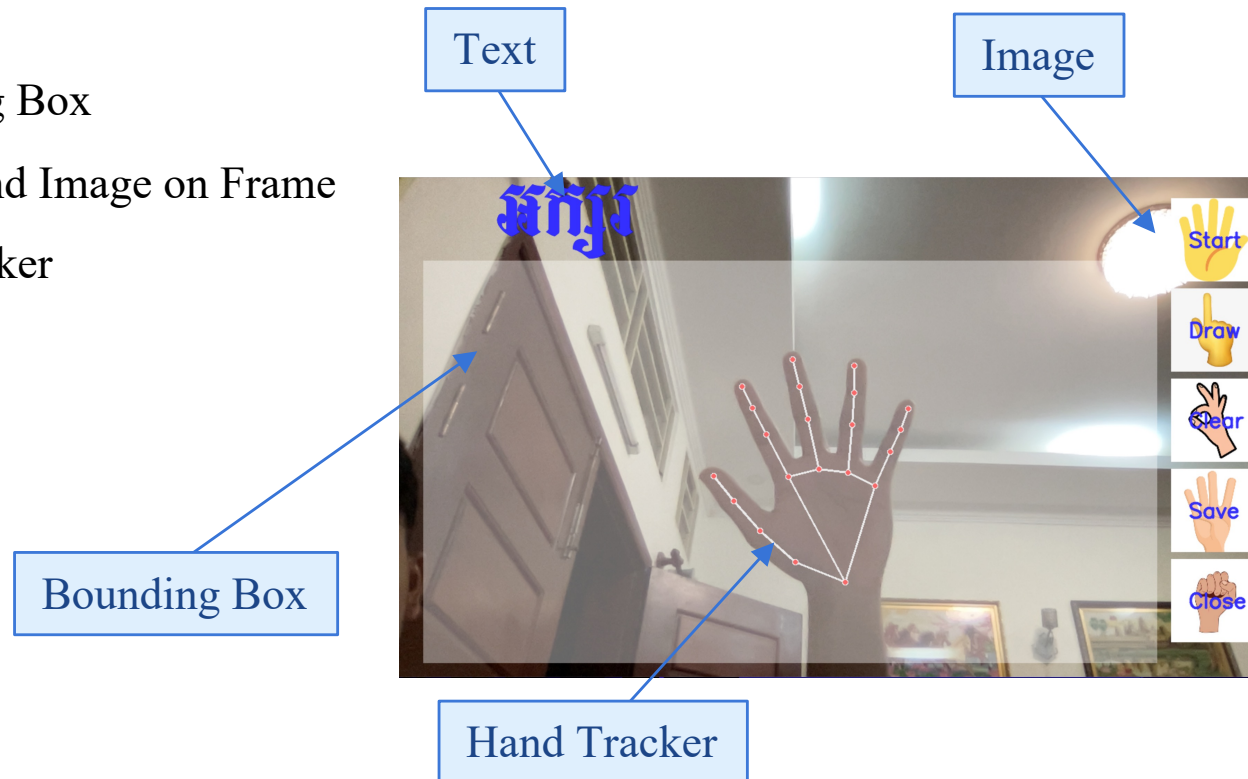
01   Prototype Implementation (Cont.)

❑ **Recognizing Finger Gestures**

➢ Drawing

➢ Stop Drawing

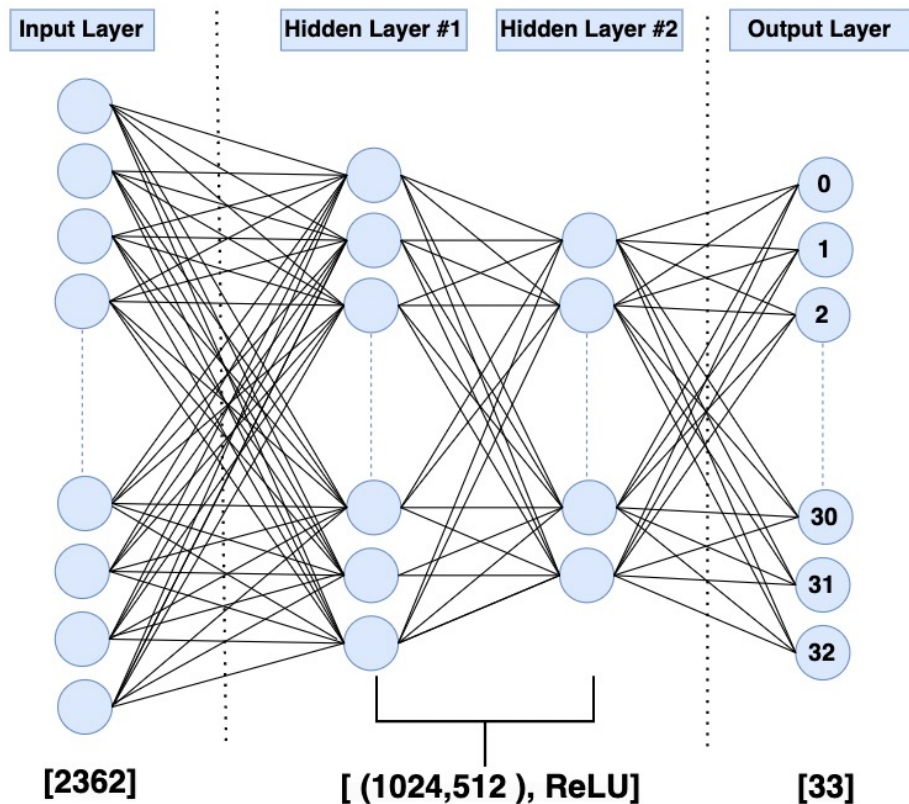➢ Save and Predict

➢ Clear

➢ Close prototype

02　Artificial Neural Network Architecture

❑ **Architecture:**

We use simple feedforward neural network, Artificial Neural Network (ANN).

➢ Input Layer

➢ Hidden Layers

➢ Output Layer

| Input Layer | Hidden Layer #1 | Hidden Layer #2 | Output Layer |

[2362]　　[(1024,512), ReLU]　　[33]

03 ANN Model and Prototype Integration

❑ **How does an ANN model work with a prototype?**

➢ Training Model

➢ Save Model

➢ Load Saved Model in Prototype

01　Conclusion

❑ **Results**

➢ Get acceptable Layers Size

➢ High Accuracy

➢ Working Well

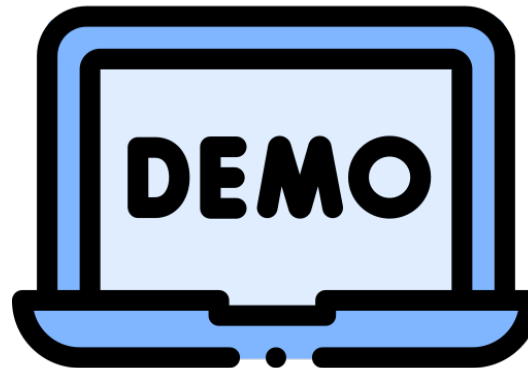| Hyper parameter			Highest accuracy of each experiment
Layer size	N-epoch	B_size	
1024,512	100	200	94.78%
1024,512	15	100	89.06%
1024,512,256	15	30	88.52%
512,256	15	30	87.85%
1024,512,256,128	15	30	85.32%
256,128	15	30	85.26%
512,256,128	15	30	85.02%
1024,512,256,128,64	15	30	82.96%
512,256,128,64	15	30	82.54%
128,64,32	15	30	78.97%

01   Conclusion (Cont.)

❑ **Experience:**

➢ Time and Process Management

➢ Soft skills, working with the teammates

➢ Learning new technologies related to AI

➢ Acquire new technical skills in coding and research

❑ **Perspectives:**

➢ Construct larger datasets to improve the performance of the recognition model

➢ Extend to word and short phrase recognition

➢ Integrate Khmer Air Writing to other applications or systems

Click Here To See the Demo

Thanks for your attention !