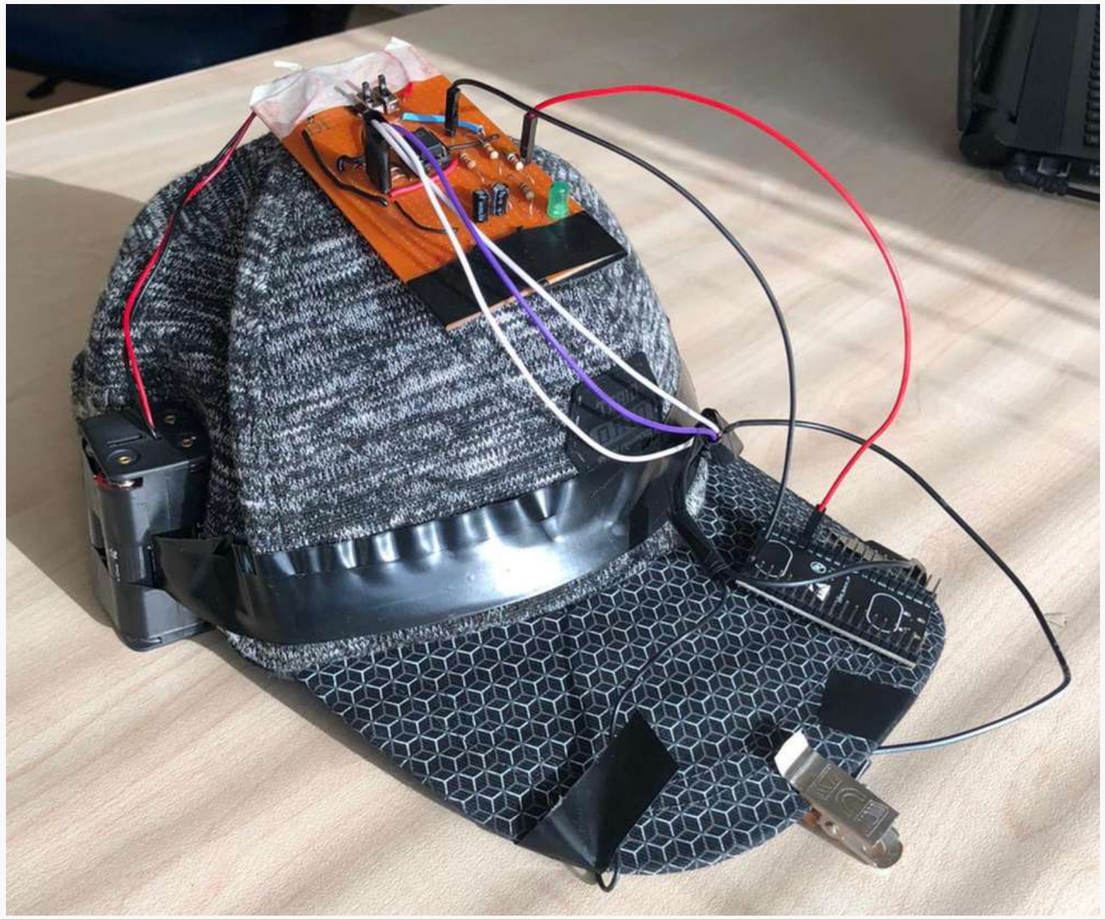
CSE396

Final Presentation

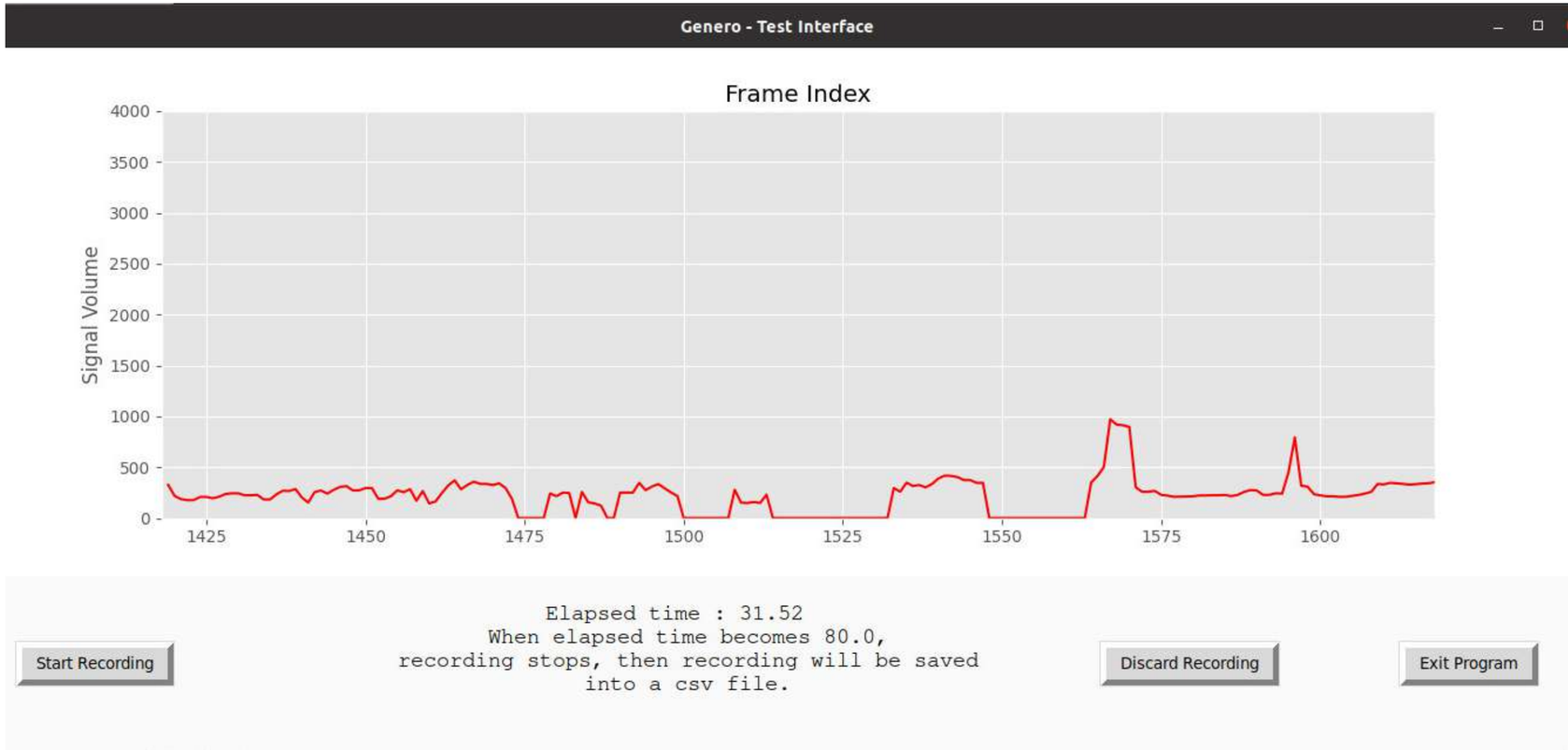
GENERO

HARDWARE



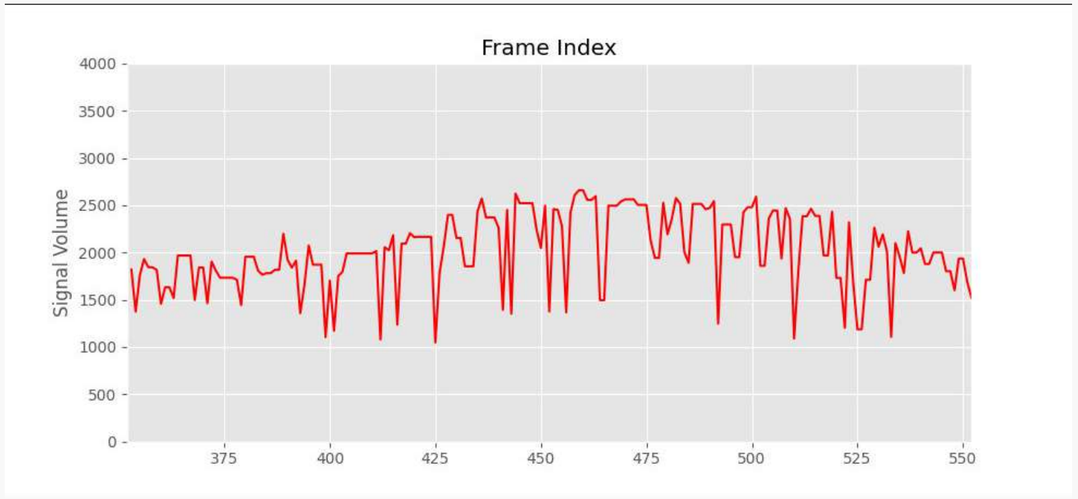
TEST INTERFACE

- We used Python to make test interface
- For interactive objects (buttons, frame, etc.) we used Tkinter library.
- For the graph we used matplotlib library.
- Frame index shows which frame is received at the moment
- Signal value represents the size of the signal



DATA ACQUISITION

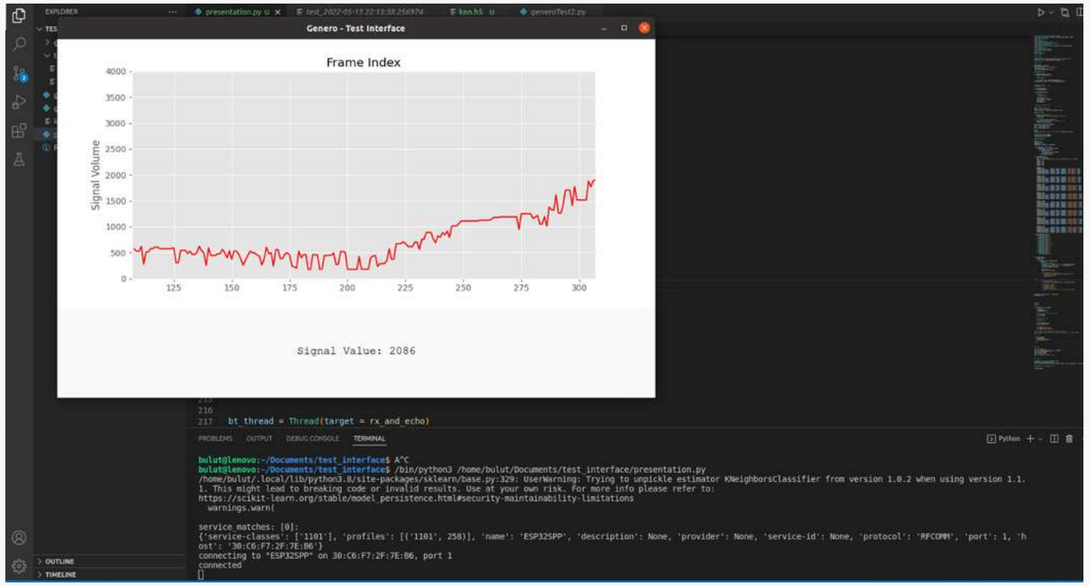
To collect data we used test interface and a video clip from our unity app simultaneously together.



SUBJECT GROUP QUALITIES

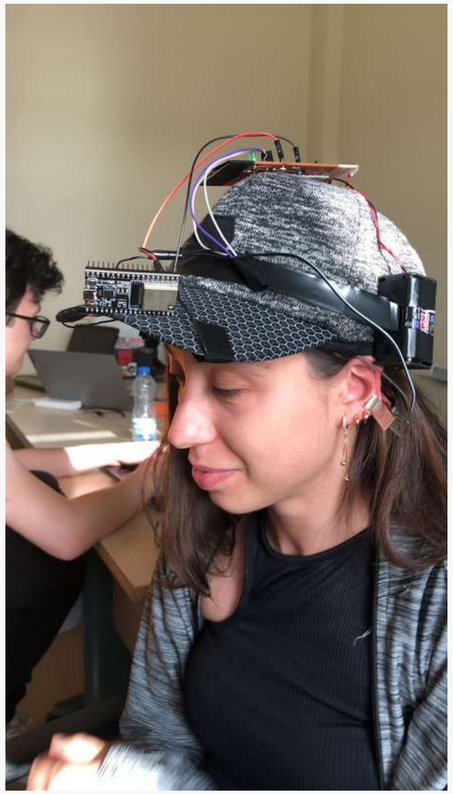
AGE : 19 - 24

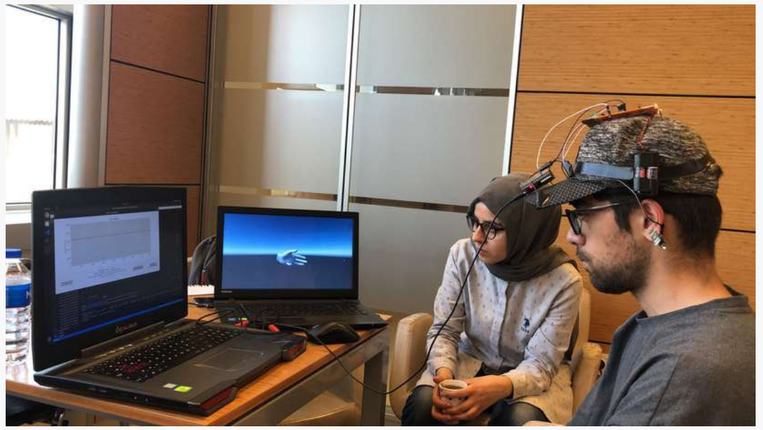
NUMBER : 115 PEOPLE



HOW DO WE COLLECT DATA

- Put the hat on the head (copper bands must be touching to forehead)
- Reference band must touch to the ear
- Ask people to focus and do some hand movements
- Receive and record the signals formed in the brain with the eeg sensor





A CLIP FROM DATA COLLECTION

DATA PRE PROCESSING

- We used machine learning methods to make the data meaningful
- We used keras python library
- All data from every person is in a file separately and results are labeled as parmak1_repeat1, parmak1_repeat2 etc.
- We did a pre-processing to make all the data ready for the learning model

DATA PROCESSING MODELS

- We used machine learning models to make the data meaningful
- Z Score Normalization
- test_size : 0.25
- **THESE MODELS:**

  - Decision tree
  - K-Nearest Neighbors
  - Best random forest model
  - Deep neural network model

RESULTS OF MODELS

DECISION TREE (14.3%)

Z Score Normalization

Bütün özellikler dahil olacak şekilde sınıflandırma

Decission Tree

In 11

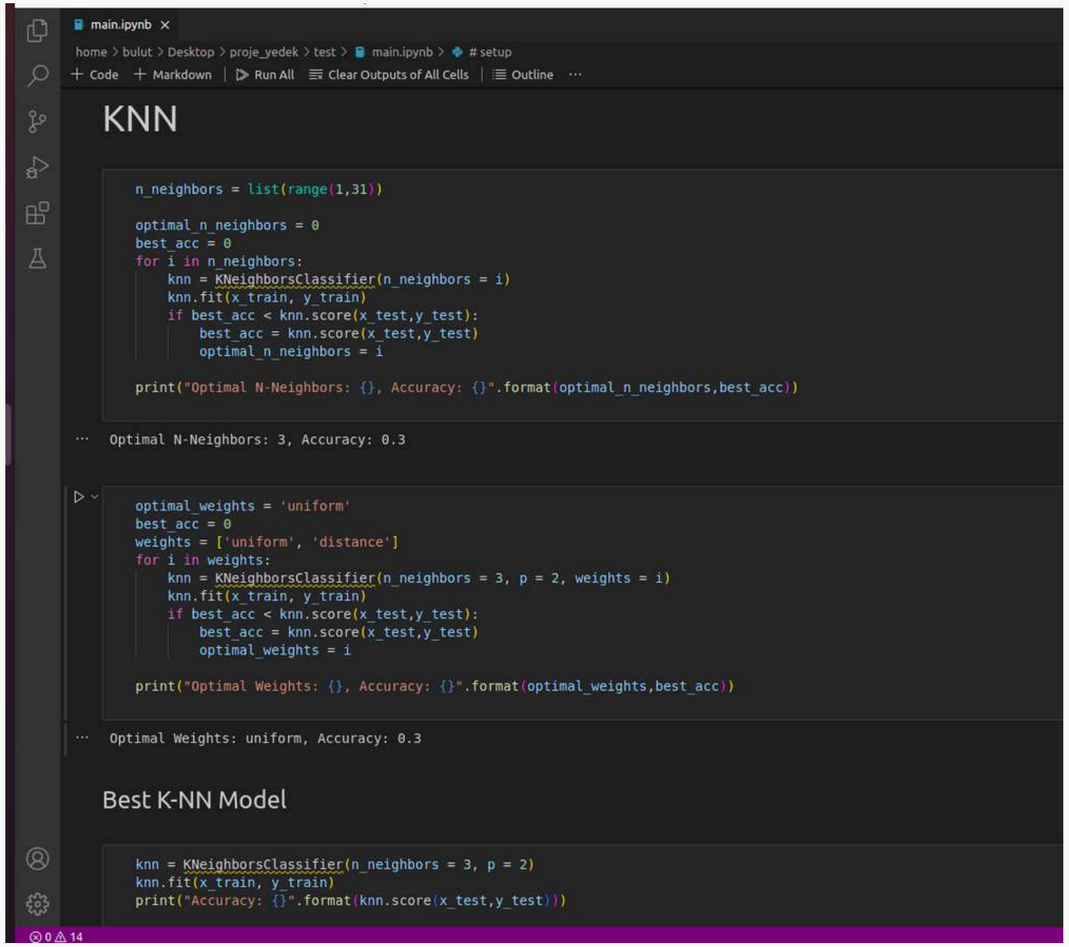
```
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import (precision_score, recall_score,f1_score, accuracy_score,mean_squared_error,mean_absolute_error, roc_curve,
 classification_report,auc)


model = DecisionTreeClassifier()
model.fit(x_train, y_train)


y_pred = model.predict(x_test)
accuracy = accuracy_score(y_test, y_pred)
recall = recall_score(y_test, y_pred , average="weighted")
precision = precision_score(y_test, y_pred , average="weighted")
f1 = f1_score(y_test, y_pred, average="weighted")

```

```
print("accuracy")
print("%.3f" %accuracy)
print("precision")
print("%.3f" %precision)
print("recall")
print("%.3f" %recall)
print("f1score")
print("%.3f" %f1)
```

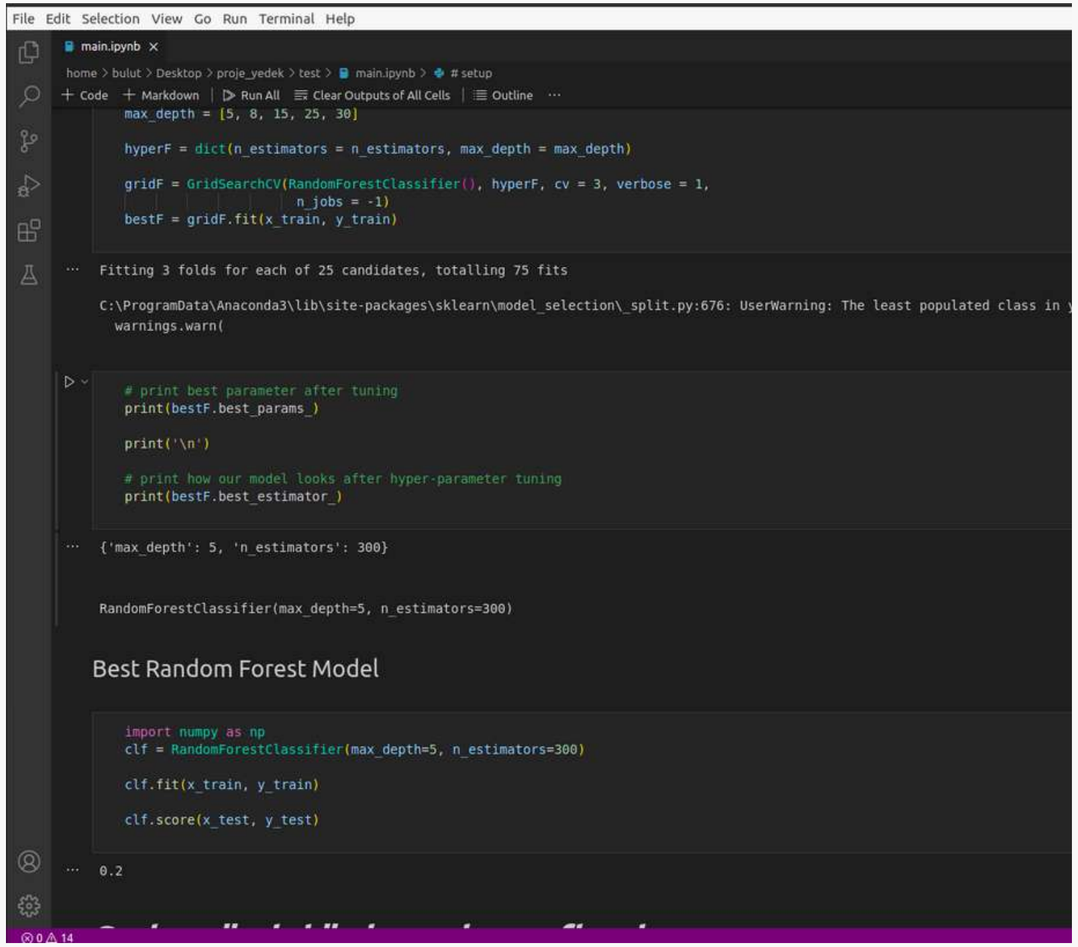
```
accuracy
0.143
precision
0.145
recall
0.143
f1score
0.143
```

RESULTS OF MODELS

KNN (30%)



BEST RANDOM FOREST (20%)



RESULTS OF MODELS

DNN (10.78%)

- activation : 'softmax'
- optimizer : 'adam'
- loss : 'categorical_crossentropy'
- epochs : 10
- batch_size : 1024

```
3450/3450 [==============================] - 0s 100us/step - loss: 2.1727 - acc: 0.1229 - val_loss: 2.1220 - val_acc: 0.1200
...
3450/3450 [==============================] - 0s 6us/step - loss: 2.0822 - acc: 0.1386 - val_loss: 2.0858 - val_acc: 0.1191
Epoch 51/100
3450/3450 [==============================] - 0s 6us/step - loss: 2.0805 - acc: 0.1342 - val_loss: 2.0853 - val_acc: 0.1287
Epoch 52/100                                                    Output exceeds the size limit. Open the full output data in
a text editor
3450/3450 [==============================] - 0s 6us/step - loss: 2.0837 - acc: 0.1371 - val_loss: 2.0841 - val_acc: 0.1296 Epoch 53/100 3450/3450 [==============================] - 0s 6us/step - loss: 2.0826 - acc:
0.1359 - val_loss: 2.0836 - val_acc: 0.1139 Epoch 54/100 3450/3450 [==============================] - 0s 6us/step - loss: 2.0861 - acc: 0.1165 - val_loss: 2.0871 - val_acc: 0.1061 Epoch 55/100 3450/3450
[==============================] - 0s 7us/step - loss: 2.0830 - acc: 0.1258 - val_loss: 2.0850 - val_acc: 0.1217 Epoch 56/100 3450/3450 [==============================] - 0s 6us/step - loss: 2.0820 - acc: 0.1348 -
val_loss: 2.0835 - val_acc: 0.1226 Epoch 57/100 3450/3450 [==============================] - 0s 6us/step - loss: 2.0793 - acc: 0.1400 - val_loss: 2.0849 - val_acc: 0.1026 Epoch 58/100 3450/3450
[==============================] - 0s 6us/step - loss: 2.0824 - acc: 0.1241 - val_loss: 2.0864 - val_acc: 0.1043 Epoch 59/100 3450/3450 [==============================] - 0s 6us/step - loss: 2.0820 - acc: 0.1313 -
val_loss: 2.0843 - val_acc: 0.1217 Epoch 60/100 3450/3450 [==============================] - 0s 6us/step - loss: 2.0787 - acc: 0.1333 - val_loss: 2.0841 - val_acc: 0.1183 Epoch 61/100 3450/3450
[==============================] - 0s 6us/step - loss: 2.0804 - acc: 0.1243 - val_loss: 2.0867 - val_acc: 0.1096 Epoch 62/100 3450/3450 [==============================] - 0s 6us/step - loss: 2.0817 - acc: 0.1342 -
val_loss: 2.0836 - val_acc: 0.1096 Epoch 63/100 3450/3450 [==============================] - 0s 6us/step - loss: 2.0823 - acc: 0.1278 - val_loss: 2.0848 - val_acc: 0.1052 Epoch 64/100 3450/3450
[==============================] - 0s 6us/step - loss: 2.0816 - acc: 0.1267 - val_loss: 2.0882 - val_acc: 0.1052
...
Epoch 99/100 3450/3450 [==============================] - 0s 6us/step - loss: 2.0782 - acc: 0.1345 - val_loss: 2.0852 - val_acc: 0.1183 Epoch 100/100 3450/3450 [==============================] - 0s 6us/step - loss:
2.0776 - acc: 0.1313 - val_loss: 2.0853 - val_acc: 0.1078

<keras.callbacks.History at 0x256cb1e4940>
```

```
y_pred = dnn.predict(x_test)
y_pred= np.argmax(y_pred, axis=1)
acc = accuracy_score(np.argmax(y_test, axis=1), y_pred)
print('DNN Test Accuracy: %.4f' % acc)
```

Python

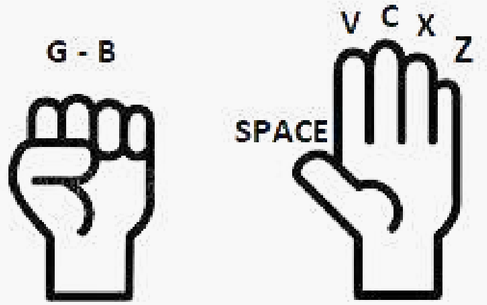
```
DNN Test Accuracy: 0.1078
```

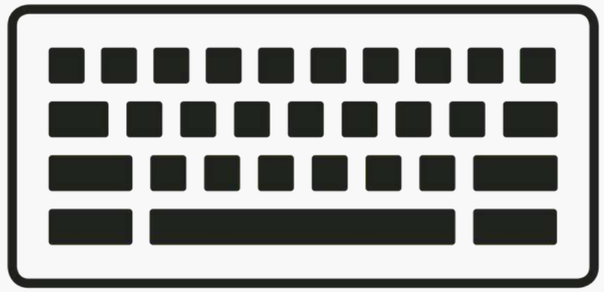
RESULT OF DATA PROCESSING

- After compiling the model we made a real-time working script that communicates with esp-32 to get signals.

- Puts all 50 inputs to the model and redirects the output to the unity simulation and simulation shows the finger movements.

HARDWARE - UNITY COMMUNICATION

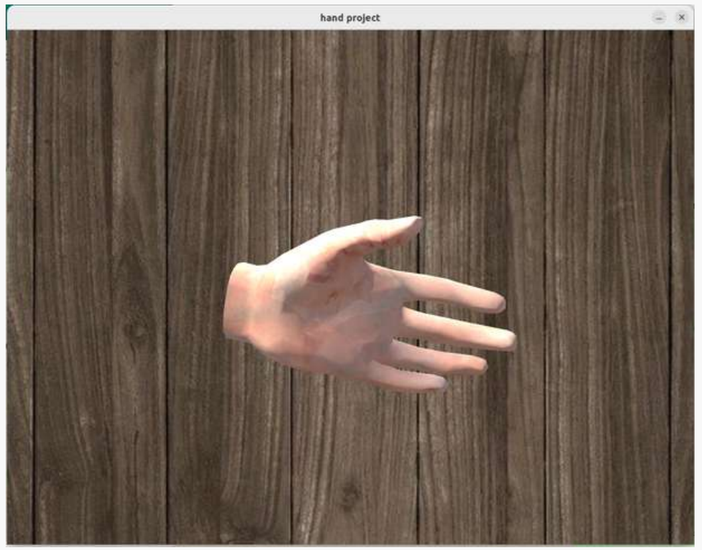


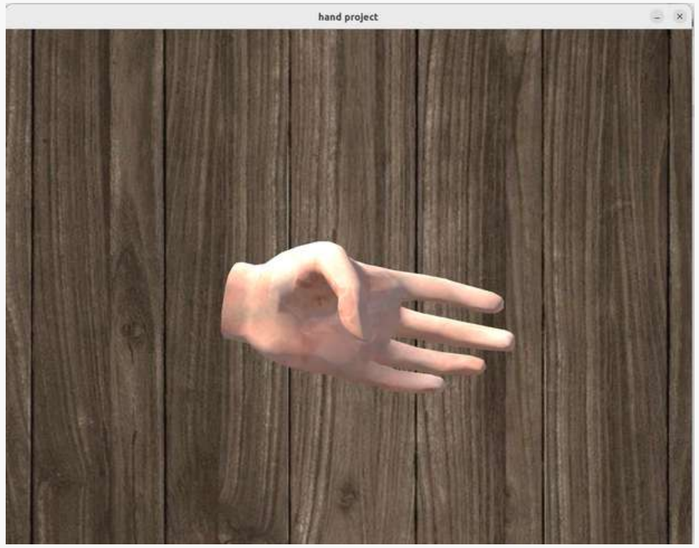


- CLASSIFICATION OF OUTPUTS AFTER DATA PROCESSING
- ACCORDING TO THE DATA WE HAVE CLASSIFIED, DIFFERENT KEYS ARE PRESSED.
- ASSIGNING THE KEYS FOR THE NECESSARY HAND MOVEMENTS.

UNITY

- **DIFFERENT HAND COMBINATIONS ARE SHOWN IN UNITY**
- **DIFFERENT KEYS ARE USED FOR EACH HAND MOVEMENT**





OUR TEAM

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- Ömer Faruk Erol
- Özlem Sevri
- Yusuf Fatih Şişman
- Yusuf Talha Altun
- Yunus Emre Yumşak

THANK YOU