



FOOTBALL SHOT CLASSIFIER

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APLICACIONES IOT 23/24

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PROBLEM

Football shot classification problem



Target:

We want to use angular velocity and acceleration data to classify the different types of shots in football

HARDWARE

We use a Raspberry pi 4 + Sense Hat (includes acceleration and gyro sensors).
Power is supplied via PowerBank.



DATASET

Dataset:

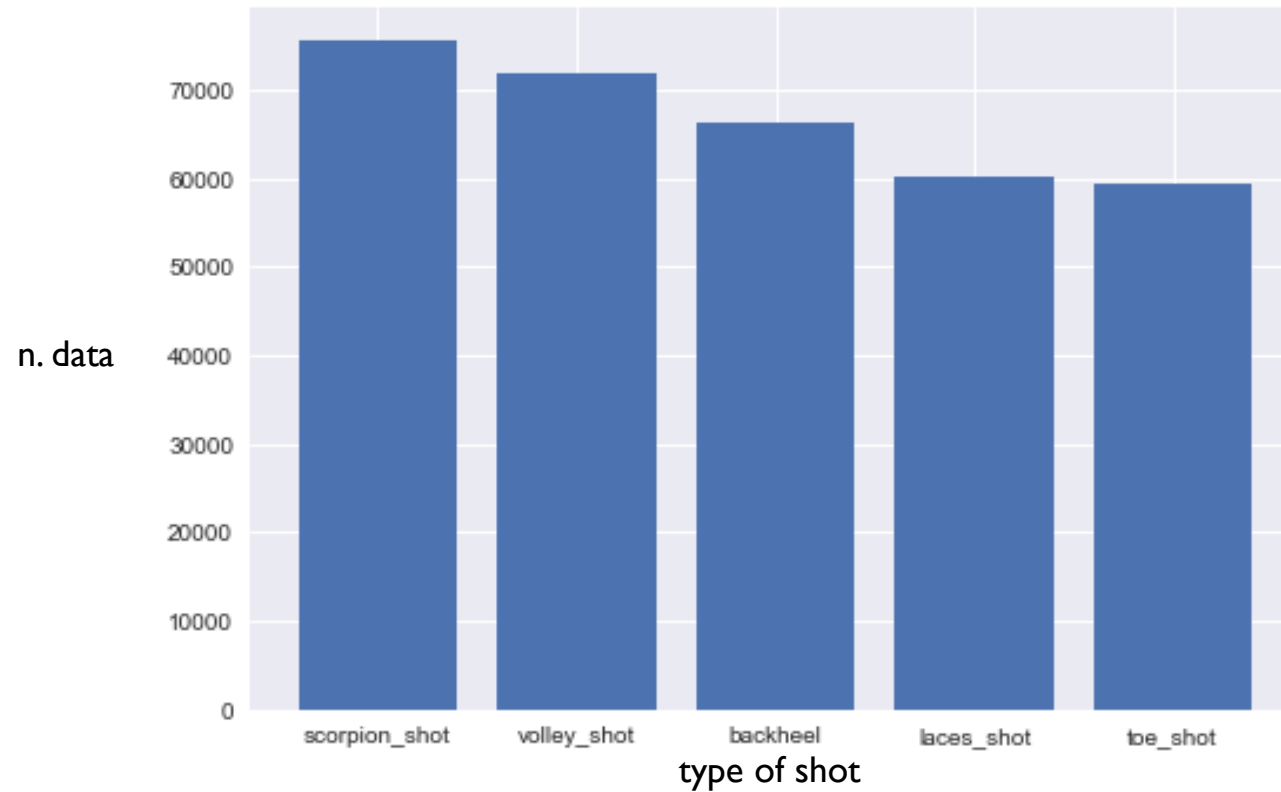
User ID	Sex	Foot	Age
1	M	Dx	23
2	M	Dx	24
3	F	Dx	21
4	M	Dx	22
5	M	Dx	23

Types of football shot:

1. Backheel
2. Laces shot
3. Toe shot
4. Volley shot
5. Scorpion shot

DATASET

Amount of data for each shot:



DATASET

Dataset file:

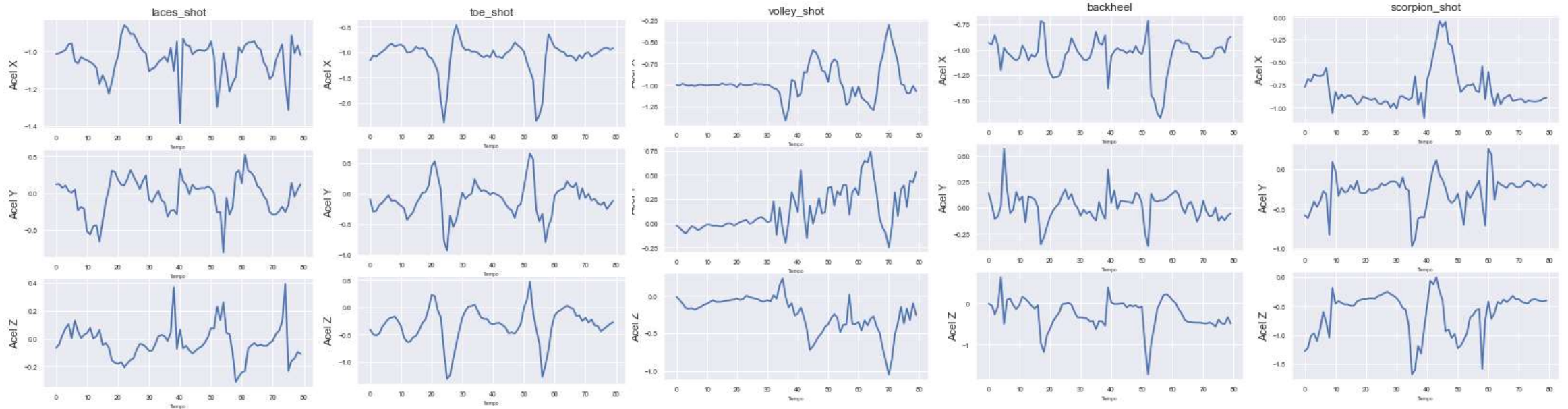
- football_dat.txt
- We have 333360 rows and 12 columns.
- 1200 rows correspond to a time window in which the shooting activity took place.
- 12 columns: 4 columns with players' data, 1 column with activity, 1 column with timestamp, 6 columns with acceleration and angular velocity data.

NEURAL NETWORK ID

- **Data Loading:** Data from a CSV file is loaded into a Pandas DataFrame.
- **Data Preprocessing:** Data cleaning and preparation operations are performed.
- **Data visualization:** displays the distribution of activities in the dataset and creates graphs to show the acceleration and gyroscope data for each activity.

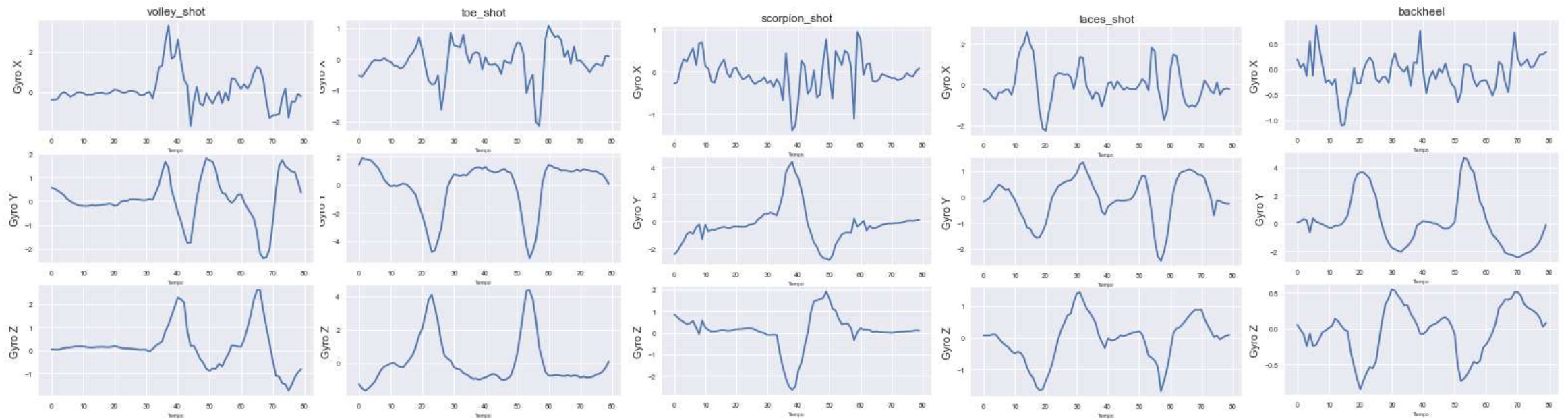
NEURAL NETWORK ID

Acceleration:



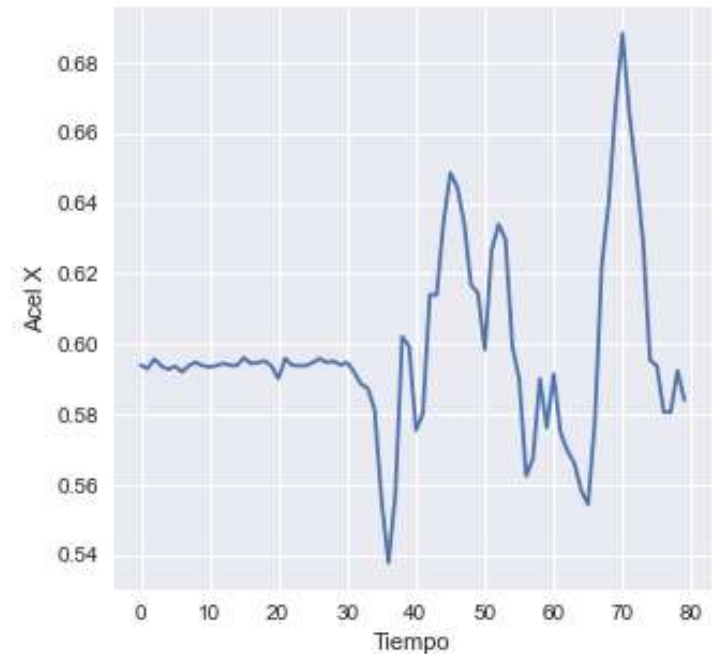
NEURAL NETWORK ID

Angular velocity:



NEURAL NETWORK ID

- **Data normalization:** for each column of interest (e.g. 'x-axis'), the minimum column value is subtracted from each value, and the result is divided by the difference between the maximum and minimum column value. This normalization process ensures that all values fall within the range [0, 1].



Estandarización	Normalización
$x_{stand} = \frac{x - \text{mean}(x)}{\text{Standard Dev}(x)}$	$x_{norm} = \frac{x - \min(x)}{\max(x) - \min(x)}$

NEURAL NETWORK ID

- **Data division:** data sequences and their labels are created for training and testing. The labels are also converted into one-hot encoding format.

```
memory usage: 30.5+ MB  
None  
(333360, 12)
```

```
Entrenamiento (267024, 13)  
Test (66324, 13)  
Entrenamiento 0.8010367543828072  
Test 0.19896324561719284
```

NEURAL NETWORK ID

- **Neural network definition:** A convolutional neural network (CNN) with Conv1D and Dense layers is used. The network is designed to learn relevant features from time sequences of acceleration and gyroscope data.



NEURAL NETWORK ID

Layer (type)	Output Shape	Param #
conv1d_20 (Conv1D)	(None, 71, 100)	6100
conv1d_21 (Conv1D)	(None, 62, 100)	100100
max_pooling1d_5 (MaxPooling1D)	(None, 20, 100)	0
conv1d_22 (Conv1D)	(None, 11, 160)	160160
conv1d_23 (Conv1D)	(None, 2, 160)	256160
global_average_pooling1d_5 (GlobalAveragePooling1D)	(None, 160)	0
dropout_5 (Dropout)	(None, 160)	0
dense_5 (Dense)	(None, 5)	805

=====
Total params: 523325 (2.00 MB)
Trainable params: 523325 (2.00 MB)
Non-trainable params: 0 (0.00 Byte)

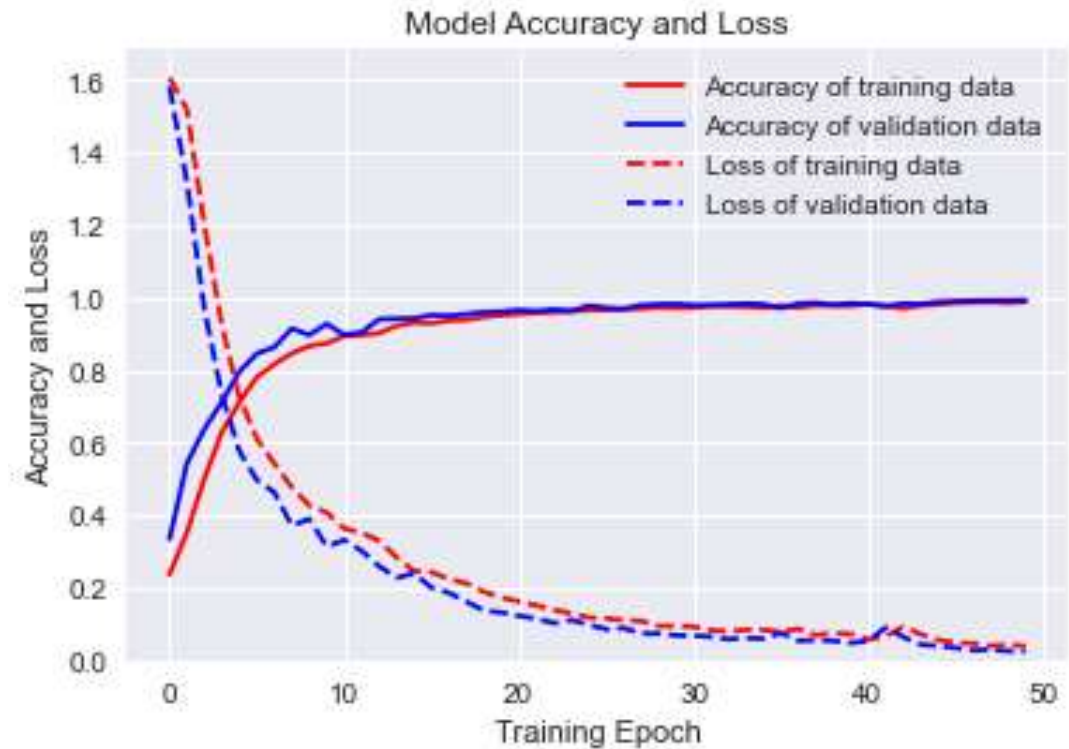
NEURAL NETWORK ID

- **Training the model:** The model is trained using the training data. The optimiser 'adam' and the loss function 'categorical_crossentropy' are used. ModelCheckpoint is also used to save the best model during training.
- **Evaluation of the model on test data:** The trained model is evaluated using test data. Accuracy and loss metrics are displayed, and a confusion matrix is created to evaluate the model's performance in classifying physical activities.

NEURAL NETWORK ID

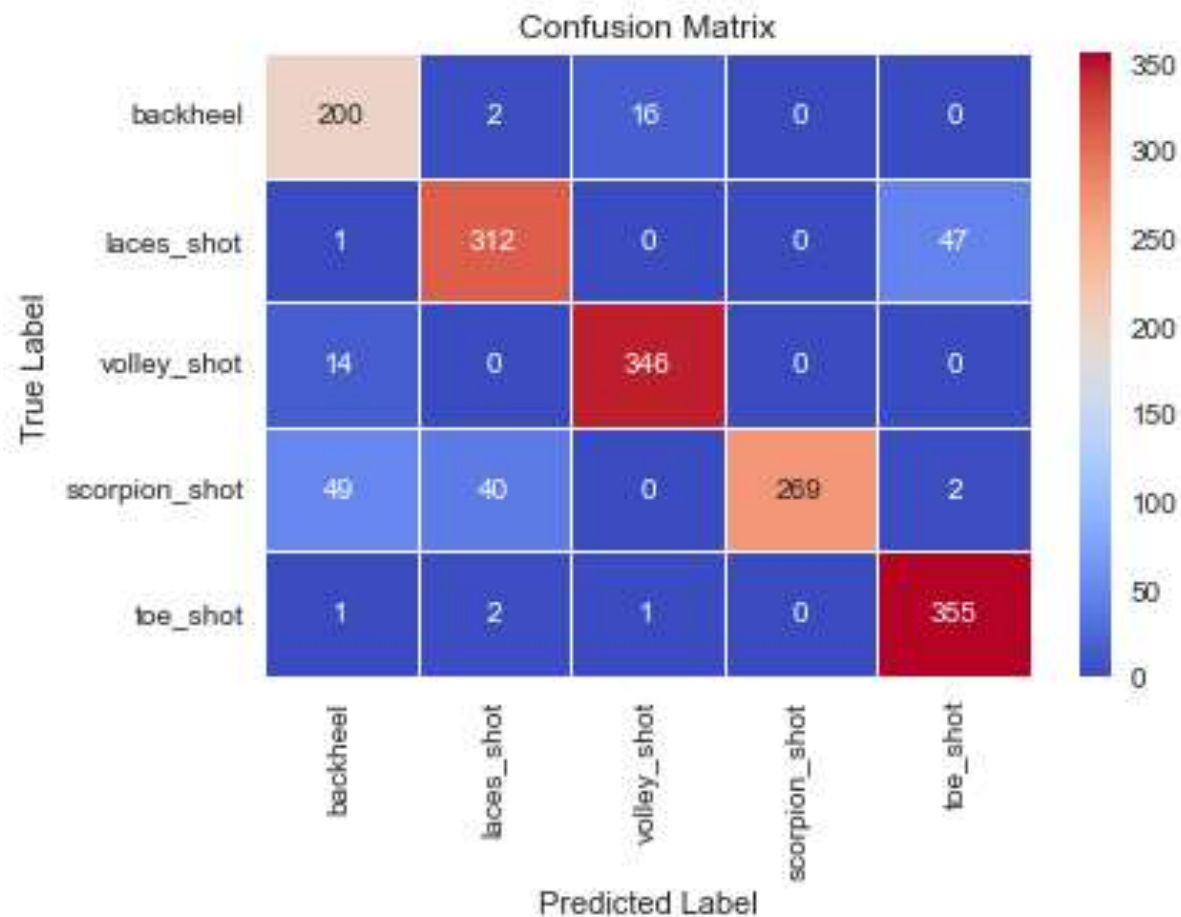
Test results:

```
52/52 [=====] - 0s 6ms/step - loss: 0.3705  
accuracy: 0.8944  
Test accuracy 0.894387423992157  
Test loss 0.37045466899871826
```



NEURAL NETWORK ID

Confusion Matrix:



CONTACT

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GitHub:
<https://github.com/Antonio3005/FootballShotClassifier>



THANK YOU
ANY DOUBTS?