Gender and Personal Identification using CNN

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Abstract

In this project we used our own collected data set to to build a CNN model to test the data. We build two models predict the gender and person's gait. Our data gives a great results with this simple model.

I. Introduction

The Gait term refers to the displacement of the center of gravity during motion. In humans, it is achieved through the synchronized movement of the lower limbs and the trunk, resulting in a move from one position to the other [1]. every human has a unique way of movement is influenced according to the gender, age and weight factors [1]. The history of gait analysis is returning back to Aristotle, reaching out to Newton and Leonardo da Vinci [1]. As Walking, it self, is considered one of the complex process of the daily activities of the Human being it combined the effort of the brain, nerves, and muscles [2], which makes the scientists, physiotherapists, orthopedists, and neurologists have been examining human motion for a long time to analysis the walking and how it differs from human being to another which we know as Gait. Gait analysis is still on its way to maturity, and there is no fixed standard sensing or data processing method.

In this paper we will discuss how the data is constructed and being processed to get the Gait Energy Image from the Visual Sensors we used.

II. Data collection

Our data is collected in a unique way with the simplest equipment's possible to give the best results. The data is divided into two sections the Visual Sensors data (VS) and the Wearable Sensors data (WS). The VS is collected by using two iPhone 7 cameras with Quality 1080P with 30 FP, the videos were taken from two different angels, one is 90 degree to the subject and the other is approximately 60 degree. while the WS data is collected using four sensors three are inertial sensors and the fourth one is an apple watch.

The motion in the data is only walking. The field of collecting the data is a squash playground, the subject walks the length of the playground 6 times (3 cycles).

III. Data construction

The data set has 45 subjects, 13 females and 32 males, their age ranges from 18 to 24 years old, only one subject is above 30 years old. The VS data is consisted of 90 videos, two videos for each subject. The WS data is consisted of 10 files; each IMU sensor output three files: 1) Accelerometer 2) Gyroscope 3) Magnotometer. Each file has the readings of the movement in

x,y and z.

i. Data Processing

In this paper we will take about the processing of the VS data of only 14 subjects. The videos are cut using Adobe premiere application to gait cycles, the cycle of walking is 8 gait cycles, and as each subject has 2 videos, so each subject has 48 gait cycles. Those gait cycles are then converted to a GEI by the algorithm proposed by developer Chunfeng Song [3], by some changes we validate the code to be usable in our case. According to the prediction model we use in this phase the data is segmented.

A)Gender Recognition Model: this is a binary mode, so the segmentation of the data is done accordingly; the GEI is imported, then we use the openCV library to take out the excess around the subject then its imported into a two index array, the GEI is in index[0] and then index[1] is labeled 0 or 1 if its male or female respectively.

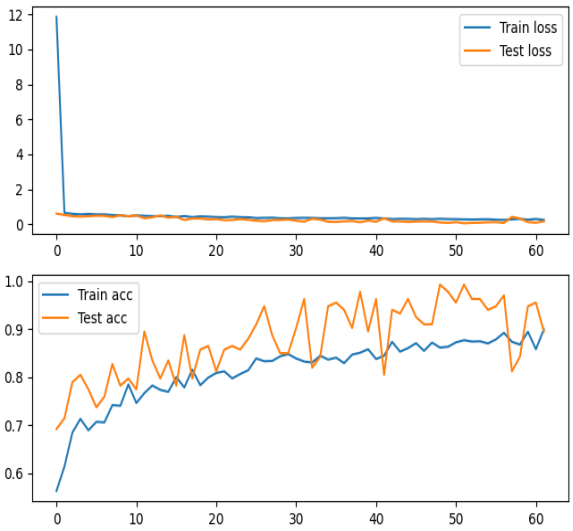
B)Person identification Model: This model is multi subject model it pass by the same process as the previous model put the label here is numbered according to the number of the subjects imported.

Then, we divided the data into three main data sets: 1)Training set, 2) Validation set, and 3) Testing set.

IV. Experiments

i. Gender Recognition Model

The CNN model is two layers maxpool, one hidden layer and one flatten layer, the activation function is relu. The output layer's activation layer is sigmoid function as this is a binary model which outputs 1 or 0. We trained the model for 500 epochs, with early stopping patience function for 10 epocs if the testing loss is still decreasing to prevent over fitting. Then we saved the best model according to the validation accuracy during training. This model gives a train accuracy 95.9% and validation accuracy : 99.2%. By importing the best saved model and test it on the test set the accuracy is 93.00%. And as we see in Fig(a) the training and testing loss are nearlly equal and there is no over fitting in the training loss curve.



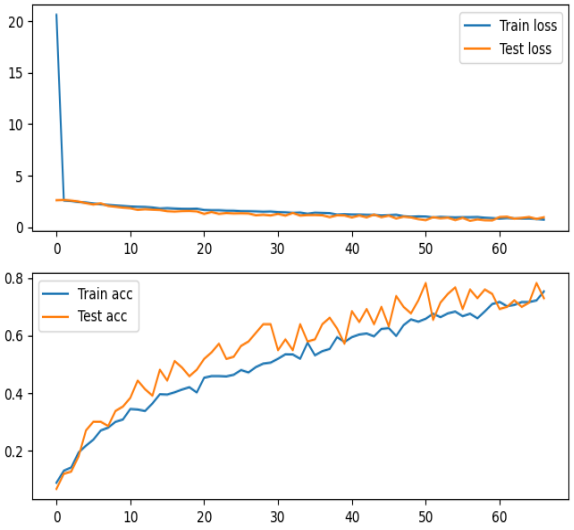
(a) *Test and Train accuracy and loss for the gender recognition model*

ii. Person Identification Model

The CNN model is two layers maxpool, one hidden layer and one flatten layer, the activation function is relu. The output layer's activation layer is softmax function as this is multi subject model. We trained the model for 500 epochs, with early stopping patience function for 10 epocs if the testing loss is still decreasing to prevent over fitting. Then we saved the best model according to the validation accuracy during training. This model gives a train accuracy 86.1% and validation accuracy : 78.2%. By importing the best saved model and test it on the test set the accuracy is 80.00%. And as we see in Fig(a) the training and testing loss are nearlly equal and there is no over fitting in the training loss curve.

V. Future Work

The true aim of this project is to make a fully synchronized data set between the VS data and the WS data. So, in the next steps we will do



(a) *Test and Train accuracy and loss for the person identification model*

this step and also try to increase the subjects in our data.

VI. Acknowledgments

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[3] EI extraction code repository on GitHub https://github.com/developfeng/GaitRecognition.git