



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 5, May 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Human Identification Using Multiview Gait Analysis

Prof. Jaychand Upadhyay¹, Kamal Maharana¹, Vishal Methri¹, Afzal Ahmad¹

Department of Information Technology, Xavier Institute of Engineering, Mumbai, Mumbai University,
Maharashtra, India¹

ABSTRACT: Biometric Identification systems have significantly improved the identification and security process by being both, reliable and secure. Human Identification using biometrics such as fingerprint access, face unlock systems have been on the rise in each sector where security is necessary. However each of these systems require active human participation or intervention to carry out the process. Automatic identification from a sufficient distance requires Gait analysis and its application. In this project we propose to carry out the identification process by capturing the data from multiple angles/views and apply the process of Gait analysis using 2D CNN for angle identification and CNN+LSTM for human identification process. The database used for analysis purpose is 'Gait Database A'. The results helps to improve the accuracy of identification in the case of single point analysis. The project is implemented using 3 analytical view, that is, 0°, 45° and 90°. Moving forward the same can be applied to varying degrees of angles to further improve on the project.

KEYWORDS : Multiview Gait Analysis, Convolutional Neural Network(CNN), Long Short-Term Memory(LSTM)

I. INTRODUCTION

Each individual human being has a unique set of biometrics which are used for analysis and identification process. These biometrics are subdivided into two categories: Physiological and Behavioral. The physiological biometrics include the unique physical characteristics such as fingerprints, retina scan, facial recognition etc. On the other hand patterns such as physical movements(Gait), engagement patterns, navigation pattern, etc which indicate a particular behavior of an individual's unique characteristics are included in behavioral biometrics.

Motivation and Challenges

In the current society, where Covid-19 has plagued the world, identification system requiring the direct intervention(Physiological Biometrics) of the subject in question has become a risk-prone approach. To avoid such a scenario where the spread of the virus hampers the identification process, the use of Gait analysis(Behavioral Biometric) provides an edge over other technologies. Since the Gait pattern of each individual is unique, the identification process on tuning and testing the models provides more and more accurate results. The use of multi-view analysis of Gait further improves the accuracy of the identification process and provides better results.

The Gait pattern, being unique for each individual human, helps in identification process without the direct interference or interaction between the system and the individual in question undergoing identification process. These pattern can be easily captured using a camera at a safe distance and further analyzed for identification.

Even if Gait analysis can be viewed as an alternative to physiological biometrics, there are certain challenges to the analysis process such as presence of foreign object in capturing the silhouette, getting the captured angles right, etc. Overcoming these challenges, to get an efficient and accurate analysis becomes an arduous task.

Multiview analysis becomes necessary since the viewing angle may not always comply to the identification process if the angle captured is different from the one used for the aforementioned process. Hence multi-view plays a great role in improving the system for single point gait analysis and provide better results.



II. LITERATURE REVIEW

Thapar et al. [2], used the spatio-temporal features to recognize the gait video sequence for recognition at various angles. The analysis is done by using the temporal domain to extract various surrounding features using CNN Models.

Wolf et al. [3], uses three different datasets having different clothing, walking speed and angle. It generalizes gait features across multiple viewing angles.

Nithyakani et al. [4], proposes a Deep CNN for extracting gait features. The Gait Energy Image(GEI) is used to train the model.

Birdal et al. [5], is a survey to study to various features that can be used for successful human identification using gait analysis. Also, Yusuf et al. [7], studies the various parameters for gait analysis and identifies their strength and limitations each.

Prakash et al. [6], a multi-model approach is proposed for gait recognition using sensors and markers. On the other hand Britto et al. [8], proposes a method of using Artificial Neural Network(ANN) for Human Gait analysis.

Zhang et al. [9], is a comprehensive study for human gait analysis using Convolutional Neural Network(CNN) based method.

Singh et al. [10], describes the measuring metrics used to measure the performance of gait recognition model. It also provides a review on existing gait recognition representations.

III. PROBLEM STATEMENT

The primary goal of the project is to improve on the existing single point Gait systems for identification process and to further improve the efficiency and accuracy of those systems.

The secondary goal of this project is to create a reliable and efficient system for human identification process which can be used to replace the existing system of physiological biometrics which requires direct interaction or intervention from the other party for completion of identification process.

IV. PROPOSED METHODOLOGY

In this project we have developed an architecture using a 2 step approach. In the first step we have the angle identification step, wherein the angle of identification for 0° , 45° and 90° is predicted. This step is done with the help of a 2D CNN model. Therefore there a total of 3 angles predicted and used for further evaluation. The next step includes sending the predicted angle frames through the CNN+LSTM model for evaluation of identification of human being. The output of the evaluation varies for different angle and can be used for final identification step.

DATASET

The dataset 'CASIA Gait Database A' consist of frame sets with variable number of frame for each individual. For example: Person 1 has 70 frames whereas Person 2 has 50 frame and so on. To standardize this randomness in he number of frames we have taken 35 frames for each individual and created a custom database to make use of in the project. On the base model we have performed 'Augmentation' to increase the size of dataset used for training that produces better accuracy. The augmentation are 1.2x zoom and 1.5x zoom. The dataset contains 4 sets of 35 frames each for each angle and person. For each person we have 4 original frames, 3 - 1.2x augmented frames and 3 - 1.5x augmented frames. The silhouette images are as shown in Figure 4.1.1 and Figure 4.1.2



Figure 4.1.1: Silhouette of 90° angle Image



Figure 4.1.2: Silhouette of 45° angle Image

DATASET SPLITTING

In Angle Identification Model for training with people 1-14 we have taken all images, for 15-17 we have taken images from 1.2x augmented images and for 18-20 we have 1.5x augmented images.

In Human Identification Model we have used a 80-20 split wherein each person has 12 sets of frames, 4 for each angle. Augmentation has been performed on first 3 sets of frames for each angle.

For training purpose in Human Identification Model we have taken 1-3 from original images, for first 10 people we have taken 1-2 from 1.2x and 1-3 for 1.5x augmented images. For last 10 people we have taken 1-3 from 1.2x and 1-2 from 1.5x augmented images.

For testing purpose of Human Identification Model we have taken 4th frame from original images, for first 10 people we have 3rd frame from 1.2x and for last 10 we have 3rd frame from 1.5x augmented images.

MODEL ARCHITECTURE

The project is implemented using two models: The Angle Identification Model and The Human Identification Model.

The Angle Identification Model is based on the 2D CNN Model for predicting the angles used for human identification process. The model gives a total of 3 outputs for each angle, 0°, 45° and 90°. For 20 epochs the output gives an accuracy approximately 98% - 99%. This can be seen as shown in Figure 4.3.1.



```

Epoch 1/20
263/263 [=====] - 28s 102ms/step - loss: 0.0848 - accuracy: 0.9687
Epoch 2/20
263/263 [=====] - 27s 102ms/step - loss: 0.0671 - accuracy: 0.9757
Epoch 3/20
263/263 [=====] - 27s 102ms/step - loss: 0.0452 - accuracy: 0.9851
Epoch 4/20
263/263 [=====] - 27s 102ms/step - loss: 0.0412 - accuracy: 0.9863
Epoch 5/20
263/263 [=====] - 27s 102ms/step - loss: 0.0258 - accuracy: 0.9908
Epoch 6/20
263/263 [=====] - 27s 102ms/step - loss: 0.0326 - accuracy: 0.9892
Epoch 7/20
263/263 [=====] - 27s 102ms/step - loss: 0.0257 - accuracy: 0.9907
Epoch 8/20
263/263 [=====] - 27s 102ms/step - loss: 0.0328 - accuracy: 0.9919
Epoch 9/20
263/263 [=====] - 27s 102ms/step - loss: 0.0304 - accuracy: 0.9903
Epoch 10/20
263/263 [=====] - 27s 102ms/step - loss: 0.0124 - accuracy: 0.9956
Epoch 11/20
263/263 [=====] - 27s 102ms/step - loss: 0.0123 - accuracy: 0.9947
Epoch 12/20
263/263 [=====] - 27s 102ms/step - loss: 0.0689 - accuracy: 0.9782
Epoch 13/20
263/263 [=====] - 27s 102ms/step - loss: 0.0218 - accuracy: 0.9932
Epoch 14/20
263/263 [=====] - 27s 102ms/step - loss: 0.0054 - accuracy: 0.9975
Epoch 15/20
263/263 [=====] - 27s 102ms/step - loss: 0.0332 - accuracy: 0.9889
Epoch 16/20
263/263 [=====] - 27s 102ms/step - loss: 0.0234 - accuracy: 0.9935
Epoch 17/20
263/263 [=====] - 27s 102ms/step - loss: 0.0157 - accuracy: 0.9952
Epoch 18/20
263/263 [=====] - 27s 102ms/step - loss: 0.0048 - accuracy: 0.9989
Epoch 19/20
263/263 [=====] - 27s 102ms/step - loss: 0.0090 - accuracy: 0.9970
Epoch 20/20
263/263 [=====] - 27s 102ms/step - loss: 0.0116 - accuracy: 0.9964
<tensorflow.python.keras.callbacks.History at 0x7f9f3ab3b240>
    
```

Figure 4.3.1: Accuracy of Angle Identification Model for 20 epochs.

The accuracy of the model is as seen in Figure 4.3.2. The output of the Angle Identification model is fed to the Human Identification model.

The Human Identification Model is based on a combination of CNN(Convolutional Neural Network) and LSTM(Long Short-Term Memory) Model. The model is a specialized model used for video classifications The model consists of training and testing models for each angle, that is 0°,45° and 90°.

```

Model: "sequential"
Layer (type)                Output Shape              Param #
-----
time_distributed_1 (TimeDistri (None, 35, 148, 148, 128) 3584
time_distributed_2 (TimeDist (None, 35, 146, 146, 64) 73792
time_distributed_3 (TimeDist (None, 35, 71, 71, 64) 36928
time_distributed_4 (TimeDist (None, 35, 69, 69, 32) 18464
time_distributed_5 (TimeDist (None, 35, 34, 34, 32) 0
time_distributed_6 (TimeDist (None, 35, 34, 34, 32) 128
time_distributed_7 (TimeDist (None, 35, 36992) 0
dropout (Dropout)          (None, 35, 36992)        0
lstm (LSTM)                 (None, 32)                4739200
dense (Dense)               (None, 64)                2112
dense_1 (Dense)             (None, 32)                2080
dropout_1 (Dropout)         (None, 32)                0
dense_2 (Dense)             (None, 20)                660
-----
Total params: 4,876,948
Trainable params: 4,876,884
Non-trainable params: 64
    
```

Figure 4.3.2: Summary of Human Identification Model

V. IMPLEMENTATION METHODOLOGY

The implementation steps included in this project are as follows:

1. Load dataset ‘Gait Dataset’.
2. Perform ‘Standardization’(Taking equal number of frames for each image – in this project 35 frames are used) and ‘Augmentation’ of images for better efficiency of process.
3. This helps create a new database we further use as base dataset. We named this ‘Gait Dataset A’
4. Using the 2D CNN model inspired from VGG16 model for angle prediction predict the angles output.
5. Since there are 35 frames, the number of predictions obtained are 35. To overcome this we take the ‘Mode’ of the 35 predictions to get a single prediction.
6. The possible output for the angle are 0°,45° or 90°.
7. This output value is given as output for Human Identification Model.
8. There are 3 sub-models in this Model, one for each angle.
9. Based on the angle predicted earlier we select the model of that particular angle.
10. The model then performs the algorithm used for video classification i.e. a CNN and LSTM model combination.
11. The output is displayed for the predicted human being from the database Gait Database A.



The metrics for accuracy is varying for different angles and the number of epochs used. The Angle identification model gives an accuracy of 98-99% with epoch as 20. This was seen earlier in Figure 4.3.1. The metrics for Human identification model vary for each angles identification model. This can be seen in Table 4.4.1. below.

Table 4.4.1

Angle of Model	Number of Epoch	Accuracy
0°	145	92.5%
45°	185	85%
90°	185	70%

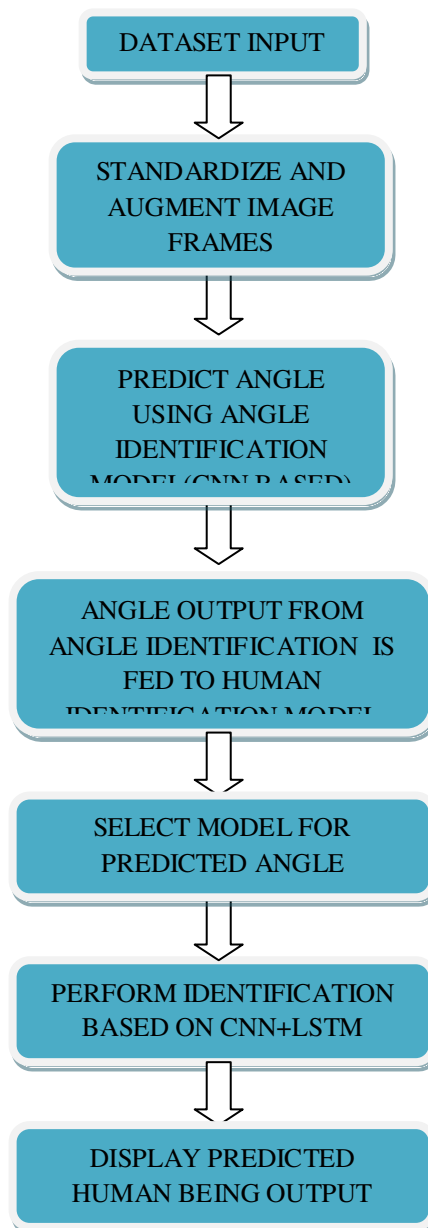


Figure 4.4.1. Simple Flowchart for Human Identification Model



VI. CONCLUSION

The project is proposed to provide an efficient and easier way for identification of individuals without the necessity of the person to directly participate in the process as in the case of physiological biometrics. During the pandemic of Covid – 19 where sanitization and lesser contact have become a norm, the implementation of this method becomes more feasible.

Most Gait Identification systems have single point identification for processing the output. This might not be feasible for cases where another angle is captured for the process. To overcome this, the use of Multiview identification becomes necessary. Our project aims at identifying the angle captured as input. This angle is predicted using a model based on 2D CNN and given as an output to the second model for Human Identification made up of CNN and LSTM. This overcomes the problem that is faced when using a single view gait system.

REFERENCES

- [1] CASIA Gait Dataset – Dataset for Multi-view Gait Data. <http://www.cbsr.ia.ac.cn/english/Gait%20Databases.asp>, 2005
- [2] D. Thapar, A. Nigam, D. Aggarwal and P. Agarwal. VGR-Net: A View Invariant Gait Recognition Network, 2018 IEEE 4th International Conference on Security and Behavior Analysis (ISBA), IEEE 2018.
- [3] T. Wolf, M. Babaei and G. Rigoll. Multi-view Gait Recognition using 3D Convolutional Neural Networks, 2016 IEEE International Conference on Image Processing (ICIP), IEEE 2016.
- [4] P. Nithyakani, A. Shanthini and G. Ponsam, "Human Gait Recognition using Deep Convolutional Neural Network," 2019 3rd International Conference on Computing and Communications Technologies (ICCCCT), Chennai, India, 2019, pp. 208-211, doi: 10.1109/ICCCCT2.2019.8824836.
- [5] R. G. Birdal, A. Sertbaş and B. Mihendisliđi, "Human Identification Based on Gait Analysis: A survey," 2018 3rd International Conference on Computer Science and Engineering (UBMK), Sarajevo, Bosnia and Herzegovina, 2018, pp. 489-493, doi: 10.1109/UBMK.2018.8566368.
- [6] C. Prakash, A. Mittal, S. Tripathi, R. Kumar and N. Mittal, "A framework for human recognition using a multimodel Gait analysis approach," 2016 International Conference on Computing, Communication and Automation (ICCCA), Greater Noida, India, 2016, pp. 348-353, doi: 10.1109/CCAA.2016.7813743.
- [7] S. I. Yusuf, S. Adeshina and M. M. BOUKAR, "Parameters for Human Gait Analysis: A Review," 2019 15th International Conference on Electronics, Computer and Computation (ICECCO), Abuja, Nigeria, 2019, pp. 1-4, doi: 10.1109/ICECCO48375.2019.9043216.
- [8] A. V. Britto and V. Ansari, "Human Gait Analysis using Artificial Neural Networks," 2018 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC), Madurai, India, 2018, pp. 1-6, doi: 10.1109/ICCIC.2018.8782401.



INNO  **SPACE**
SJIF Scientific Journal Impact Factor

Impact Factor:
7.512

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details