C26   Looking Into Your Future: A Continuous Human Gait Prediction for the Near Future

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Learning Overview: After attending this presentation, attendees will better understand the advances in biometrics research and how it is possible to use everyday devices such as mobile phones to predict the future actions of people.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by introducing a novel method for activity prediction, behavior prediction, and identification using mobile sensors, which leads to security improvements in monitoring systems.

Motion sensor recordings from users' mobile phones can be used for several applications, including authentication, activity, and gesture recognition. One of the challenges of these applications is the availability of data and the ability to make decisions in a short amount of time. This availability is dependent on user movements, and one of the methods that can help faster decision-making in these systems is to make future data available earlier by predicting the future movements signal.

Deep neural networks have achieved notable results in predicting the future based on observing a history of available data. Among those, Long Short-Term Memory (LSTM) has been used to forecast speech, handwriting, and other time-series data. This research builds a prediction model based on an LSTM neural network that learns the user's phone movement patterns during gait activity and predicts the near-future gait movements. The proposed model generates a future signal without having information about the activity that is being performed. It is trained with data from several gait activities such as walking and biking and predicts when similar activities are performed. This prediction has multiple applications in security systems, such as continuous authentication. Earlier availability of data helps continuous authentication systems make faster decisions. As another application in forensic science, the ability to predict the future activity of people can be used to detect if the person is likely to commit a crime or malicious activity and take action to prevent it. In contrast, predicting future gait movement signals can be used to replicate user body motions using a limited amount of data in order to exploit a security system. On the other hand, it can also be used to prevent the attacks when the system learns to forecast and replicate the upcoming motions and unforeseen events better than a human replicator. In the case of a robot replicator (attacker), the winner is the system that is trained with more data, which is usually the genuine system.

The experimental results on a dataset of four different activities performed by nine different users show that the prediction model forecasts the near-future gait movement signal with a small Dynamic Time Warping (DTW) distance between the predicted and the real signal.

Biometric Security, Gait Identification, Movement Prediction

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