Social signal processing for automated suicide prevention

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Abstract: Social signals are defined as observable behaviours displayed during the interaction of two of more people. The social signals of each individual in the interaction will influence the social signals of the others within said interaction [1]. By interpreting such social signals, it is possible to make predictions about future behaviour. In this project we aim to use social signal processing to detect suicidal individuals in the context of bridges and railway stations

What are social signals?

Social signals are defined as observable behaviours displayed during the interaction of two of more people. The social signals of each individual in the interaction will influence the social signals of the others within said interaction [1].

Figure 1 shows two boxers confronting each other before a fight. They both maintain eye contact, raise their shoulders and maintain a tense but composed expression. One would interpret these types of social signals **as indicators of conflict**.

As humans we often interpret and display such signals unconsciously, knowing instinctively how to act in response **without realizing the subtle signals that led to the decision.**

Figure 1: Rocky Balboa squaring off with Ivan Drago in "Rocky IV" United Artists 1985

How can we detect social signals?

Currently, the most popular method for describing body pose is in terms of **key points**, i.e. marking the positions of body parts such as the elbow, wrists, shoulder etc.

Figure 2 shows the key point markings for a Kung Fu fighter. By determining these joint positions, we can use machine learning algorithms to classify the action that is being displayed. **In this case the action on display is a kick**.

However, while the use of key points might be useful for describing body positions in a way that humans can understand, it wasn't clear they were the best method to train a predictive algorithm that generates qualitative descriptions of social signals

Therefore for our initial work we took the problem of head pose estimation and proved that the use of key points was better than state of the art HoG features for that task.

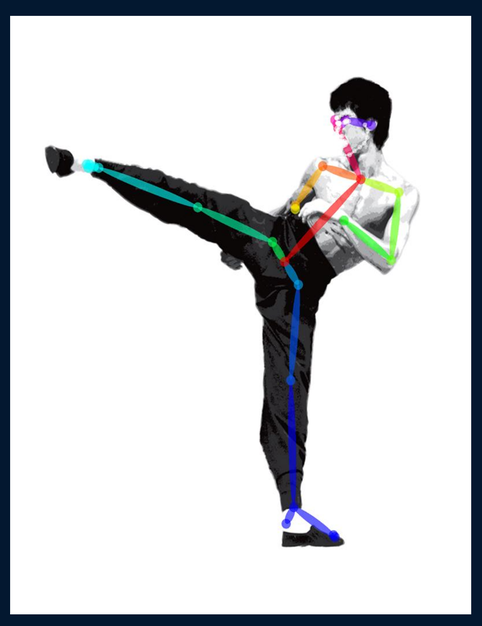

Figure 2: Bruce Lee with open pose key point skeleton.

References

[1] J J.K. Burgoon, N. Magnenat-Thalmann, M. Pantic, and A. Vinciarelli, Social Signal processing, Cambridge University Press, 2017

[2] S.Reid, S.Coleman, D.Kerr, P.Vance and S. O. Neill "Template Matching for Head Pose Estimation," in *Irish Machine Vision and image processing (IMVIP)*, 2018, pp. 178–184.

[3] S. Reid, S. Coleman, D. Kerr, P. Vance, and S. O. Neill, "Feature Extraction with Computational Intelligence for Head Pose Estimation," in *2018 IEEE Symposium Series on Computational Intelligence (SSCI)*, 2018, pp. 1269–1274.

Head pose estimation

Our first objective with this project was to determine the best approach to estimate human body pose.
To do this we took the sub problem of head pose estimation, and compared two approaches, one which used HOG's features, and one which used facial key points.
We compared these two approaches on a number of machine learning algorithms and from the results proved that the use of key points was a best approach for the problem of head pose estimation than state of the art HOG features. [2][3]

Figure 3: Photos of an individual with varying head poses

Activity recognition

After exploring the task of head pose estimation we then attempted to solve the problem of human activity recognition.

Human activity's can be classified into two category's, macro activities and micro activities. Macro activities occur over a large time frame, and typically include such as walking and running etc. Micro activities are more subtle and occur over a shorter time frame.

We propose an approach for activity recognition which uses an elastic sliding temporal window, which will allow for the detection of both macro and micro activities simultaneously.

Figure 4: Some of the earliest recorded video captured by Eadweard Muybridge in 1887 showing human locomotion. In our current work we will aim to automate the classification of human activities through computer analysis of video frames such as these

Future Work

For the final section of the project we will attempt to incorporate the current psychology literature in order to discover which activity's are most indicative of an individual who is at risk of suicide in the context of railways or bridges.

There is already evidence to show that individuals who are at risk show exhibit certain behaviours, such as pacing and leaving objects on the platform. Detecting these behaviours could allow us to intervene and possibly save lives if the system could function in real time.