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## I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

- The International Affective Pictures System (IAPS) aims to collect pictures that evoke certain emotions in humans. Such pictures are chosen such that people looking at the pictures have the same (or very similar) emotional response. Along with the emotional response comes certain neurophysiological changes in the human body that can be potentially mapped to the evoked emotions. As a neuroscientist, such signals are of interest as they form an objective, measurable parameter representing human emotions. A dataset containing EEG (electroencephalogram) signals of participants viewing various IAPS pictures are analysed. The primary task is to ‘decode’ the emotional response from the neurophysiological signals of the participant. Using a combination of brain signals (EEG), muscle signals (EMG: electromyogram), eye signals (EOG: electrooculogram), and heart signals (ECG: electrocardiogram), the task is to predict what emotions were felt by the participants while viewing pictures from the IAPS. A combination of signal processing and machine learning algorithms to predict the emotional response from the collected neurophysiological signals is employed. The main research is done around Multimodal Data Analysis where neurophysiological signals from the four sources are used for predicting the emotions.
- A study on the emotions of people in the autism spectrum is performed where data is collected on where in their body, they feel an arousal based on different emotion scenarios.
  - A questionnaire website for putting up different emotion-arousing stories and an image of a body where participants can click to indicate where they feel the emotion, is created
  - The next task is to plot the various clicked positions to map an emotion to an area in the human body for people belonging to the autism spectrum
  - A comparison study is to be made against the locations of the emotions for the two groups of participants: regular people versus those diagnosed to be on the autism spectrum. Cluster analysis is proposed to find clusters of arousal points on the body that map to a specific emotion. This is done for both groups of participants. Cluster distance between the two groups will indicate if people in the autistic spectrum (neurodivergent group of people) feel somatic arousal for an emotion on similar areas of the body as regular people.
- A game-based experiment is designed to evoke stress and flow state of the mind in the participants. The objective is to take the participants into underwhelming, flow, and overwhelming state of minds during the game playing and simultaneously record EEG, ECG and GSR (Galvanic skin response) signals. These signals are to be analysed later to classify the three mental states: underwhelmed (bored), flow (perfect concentration) and overwhelmed (stress). The main research is the identification of effective features to identify the “flow” state that are robust enough to distinguish between “flow” versus the other more frequently observed mental states.



## II – PUBLICATION(S) DURING YOUR FELLOWSHIP

### Published:

- Kotoky, N., Singhal, S., Sharma, A., & Ajudia, D. (2022). Twitter Sentiment Analysis: A Survey in Cricket and Bollywood. DATA ANALYTICS 2022, 76.

### Abstract:

*Twitter has been the voice of the public for a long time now. With the rise in the usage of Twitter, the active participation of its users in expressing their views across all domains has significantly increased. This paper aims to perform sentiment analysis and study the influence of Bollywood and Cricket celebrities on Twitter users. Three different types of information are extracted from the tweets using sentiment analysis, namely, (1) sentiments of people towards cricket, cinema (Bollywood), and gender, (2) identifying the highly discussed individuals and events for each category, and (3) co-occurrence analysis for identifying closely discussed celebrities belonging to different categories. Our analysis identifies that females in the cricket sport are not as popular as compared to their male counterparts whereas females in the entertainment industry (Bollywood) are equally popular as the males. We also identify current trends that are the target of discussion in twitter using Network of Words analysis. In addition, the co-occurrence analysis shows very high association between male cricketers and female Bollywood stars. In essence, we try to determine the emotional tone of people to gain an insight of the hidden attitudes and opinions expressed in a tweet regarding cricket and Bollywood.*

### References:

- [1] A. Tumasjan, T. Sprenger, P. Sandner, and I. Welp, "Predicting Elections with Twitter: What 140 Characters Reveal about Political Sentiment," *The International AAAI Conference on Web and Social Media* 16 vol.4, No.1, May 2010, pp. 178-185, doi:10.1609/icwsm.v4i1.14009.
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- [3] S. Hori, "An exploratory analysis of the text mining of news articles about water and society," *WIT Transactions on The Built Environment*, 168, 2015, pp. 501-508, doi:10.2495/SD150441.
- [4] Automate Getting Twitter Data in Python Using Tweepy and API Access [Online], Available from: <https://www.earthdatascience.org/courses/use-data-open-source-python/intro-to-apis/twitter-data-in-python/>
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- [6] Orange widget catalog, <https://orangedatamining.com/widget-catalog/text-mining/twitter-widget/> [retrieved: November, 2022].
- [7] KH Coder 3 Reference Manual, Available from: [https://kncoder.net/en/manual\\_en\\_v3.pdf](https://kncoder.net/en/manual_en_v3.pdf) [retrieved: November, 2022].
- [8] Sentiment Analysis using TextBlob. Parthvi Shah. Available From: <https://towardsdatascience.com/my-absolute-go-to-for-sentiment-analysis-textblob-3ac3a11d524>.

### Under Preparation:

- Multimodal Data Fusion for Predicting Emotions from Neurophysiological Signals
- Analysis of Somatic Responses to Emotions for People in the Autistic Spectrum



### III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

None.

### IV – RESEARCH EXCHANGE PROGRAMME (REP)

**ERCIM REP Institute Visited:** Research Institutes of Sweden (RISE) (<https://www.ri.se/en>)

**Country:** Sweden

**Local Scientific Coordinator:** Dr. Petra Edoff, Director for User-Centric Digitalization unit, RISE

**Dates Attended:** 06-March-2023 to 10-March-2023

**Primary Location Visited:** Västerås office

- I was introduced to the Digicore lab, its design specifications as well as its technical inclusions. The lab was planned to include spaces to hold workshops or brainstorm ideas, another place to design concepts using cheap materials like cardboard, plastic pieces etc. before investing in the actual materials, and another space for actual technical experiments. The lab contained a virtual reality (VR) setup that simulated environments for training on handling industrial equipment, and a control room setup which was designed to test different technical parameters for making control rooms more user friendly for long hours and concentrated work output for controllers.
- I met with the Machine Learning team and exchanged research ideas. They introduced me to their way of exploring funding for project, and we also explored possibilities of collaboration between India and Sweden.
- I had attended a unit meeting where the teams discussed on how to disseminate their services to the outside world for effective use of their technical expertise.
- For one whole day, I went to RISE Kista office. I was introduced to 'Digital Twin', a project where the entire city was mapped, and its buildings and streets simulated. In the digital twin, researchers could visualise how a certain building could be created and what it would look like. The twin also simulated flooding with low to heavy rainfall, and it made easy to identify which areas of the city would flood quickly and thus need improved drainage. In other words, any planning for a place could be simulated first in its digital twin, and the pros and cons could be discussed, and the planning perfected before the actual implementation by the municipality.