

Assistive Wearable Sensing Technology for Prediction and Detection of Challenging Behaviour

Mohammed Taj-Eldin, PhD

Co-supervisors: Dr. Brendan O'Flynn and Dr. Paul Galvin, Tyndall National Institute
Collaborator: Dr. Geraldine Leader, NUI Galway

1. Research Challenge

- Individuals with Autistic Spectrum Disorder and/or Intellectual disability typically experience frequent form of challenging behaviour. Challenging behaviours such as aggression, self-injury have major impacts on the family and seriously affect the ability of such individuals to reside in more normalising environments. Existing approaches of treating and managing challenging behaviours rely mainly on direct observation. Although such approaches are useful, clinicians can mostly detect the challenging behaviour and then react and intervene once it is vividly displayed. These approaches rely on passive intervention with its own limitations.

2. Proposed Solution

- We develop an Assistive Technology that provides a proactive way of early prediction and detection of challenging behaviour.
- The sensing technology utilises real-time monitoring and diagnosis of challenging behaviours in service users with ASD/ID,
- The developed system will:
 - 1) Help to inform and optimise treatment programmes.
 - 2) Bridge the information gap between the clinical understanding underpinning the diagnosis of the different types of challenging behaviour, and the ability to have real-time monitoring of service users to measure the efficacy of a treatment programme
 - 3) Help carers adapt and optimise the treatment programme.
 - 4) Seek to enable early diagnosis of challenging behaviours, which could facilitate early intervention by carers/parents to remove the person or the source of anxiety, and thereby prevent occurrences of self-harm.

3. Utilisation of Physical Activity and Physiological data for Prediction of Challenging Behaviours

- Heart rate rhythm variability, respiration rate, and skin conductance will be utilised to assess the emotional status of the individual.
- Angular velocity data (gyroscope sensor) together with acceleration data allows for detection of the mechanical aspects accompanying stereotypical movement.

4. Wearable Assistive Technology

- Chest strap will be investigated for the possibility of embedding the electrocardiography (ECG) sensor where heart rate, heart rate rhythm variability, and respiration rate related data can be collected from. The wristband, on the other hand, will be utilised for integrating the galvanic skin response (GSR) sensor where the skin resistance data can be collected.



Fig. 1 Wearable chest strap for heart rate measurement



Fig. 2 Wearable wrist strap for skin conductance measurement

5. Multi-Sensor based Classification of and Detection of Challenging Behaviour



Fig. 3 Remote wireless monitoring and alert system used by care-givers

- Activity and emotional status classification algorithms (e.g., normal physical activity vs. stereotypical motor movements, calm vs. nervous) will be developed.
- Smart prediction of challenging behaviour and wireless alert system will be developed to early inform the caregiver and support the behavioural assessment and management of challenging behaviour.

