

AI-TOP

An AI Tool to Predict Engagement and 'Meltdown' Events in Students with Autism

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Project Partnership

- Nottingham Trent University, UK
- Phoenix KM, Belgium
- NARHU, Bulgaria
- SoftQNR, Serbia
- Nottingham City Council, UK
- University of Thessaly, Greece

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Phoenix KM

SoftQNR





Project Background

- What is a 'meltdown'?
 - A meltdown is an intense response to overwhelming circumstances—a complete loss of behavioural control
 - People with Autism often have difficulty expressing when they are feeling overly anxious or overwhelmed, which leads to an involuntary coping mechanism—a meltdown
 - Common trigger points include:
 - Sensory Overload
 - Information Overload
 - Emotional Overload



Project Background

- What is a 'rumble stage'?
 - Initial stage of a **tantrum**, **rage**, or **meltdown**
 - Specific behavioural changes that **may not appear** to be directly related to a meltdown
 - Minor behaviours such as **nail biting**, **tensing muscles**, or otherwise **indicating discomfort**
 - Major behaviours such as **withdrawing from others** or **threatening others verbally or physically**.
 - Adult intervene is expected which include:
"antiseptic bouncing," "proximity control,"
"support from routine," and "home base."

Project Summary

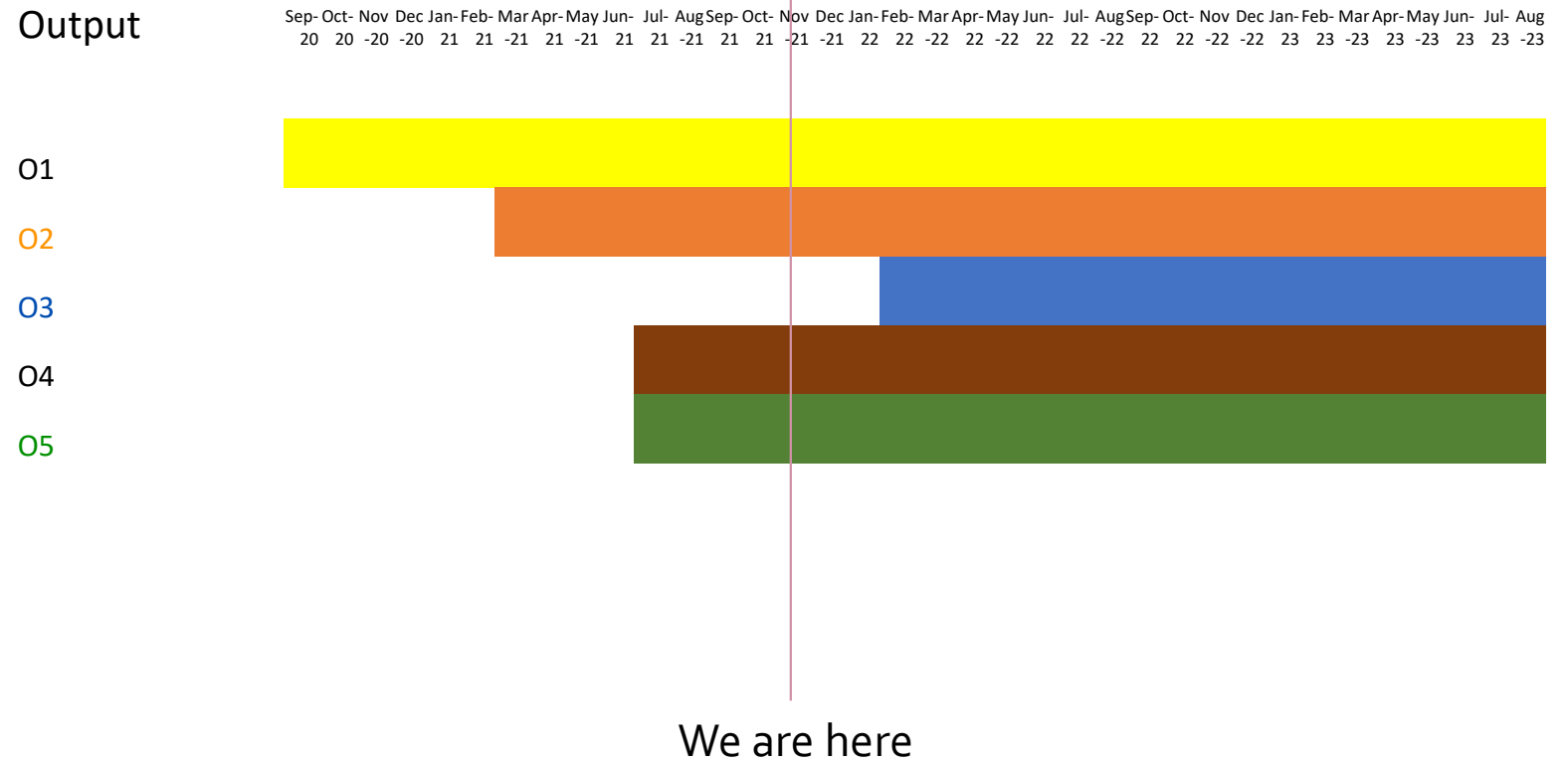
- The project has an iterative and incremental character, as it aims to develop:
 - a new innovative pedagogical methodology to provide a 'blueprint' on how AI technology can be introduced into classrooms for the benefit of students with Autism
 - an algorithm trained to infer the level of engagement of students with Autism and predict 'meltdown' events
 - an intuitive app for use by school staff and parents/carers with dashboard to give accessible visual feedback on these issues.

Project Outputs

- O1 - Online Searchable Database
- O2 - Transferred Mobile Engagement and Meltdown Measurement App
- O3 - Optimisation of Autism Engagement and Meltdown framework
- O4 - Handbook for Teachers and Parents
- O5 - Pedagogical Framework for Students with Autism

Project Timeline

Output



O₂ – Transferred Mobile Engagement and Meltdown Measurement App

T2.1: AI-driven algorithms to recognise whether a student with ASC is engaged even using unlabelled sensor data in the future.

T2.2: Observational Behavioural Checklists to label Arousal states ('rumble' and 'meltdown' events).











T2.3: Fine-tuning of the core AI "engine" for inference of engagement and to predict 'meltdown' events.

T2.4: Implementation of the Teacher/Parent facing Dashboard (Traffic Lights/Graph-over-Time).

Candidate Algorithm: ML - Decision Tree

Open Access Article

WearSense: Detecting Autism Stereotypic Behaviors through Smartwatches

by  Amir Mohammad Amiri ^{1,2,*}  ,  Nicholas Peltier ²,  Cody Goldberg ²,  Yan Sun ²,
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Healthcare **2017**, *5*(1), 11; <https://doi.org/10.3390/healthcare5010011>

Received: 14 December 2016 / Revised: 16 February 2017 / Accepted: 21 February 2017 / Published: 28 February 2017

- Decision Tree has been used
- 94.6% Accuracy
- Used smart watch
- Bagging methods were used
- Work with accelerometer data only
- Compound Emotion Recognition

Candidate Algorithm: Deep Learning (RNN)

Compound Emotion Recognition of Autistic Children During Meltdown Crisis Based on Deep Spatio-Temporal Analysis of Facial Geometric Features

Publisher: IEEE

[Cite This](#)

[PDF](#)

Salma Kammoun Jarraya  ; Marwa Masmoudi  ; Mohamed Hammami  [All Authors](#)

2
Paper
Citations

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Abstract

Document Sections

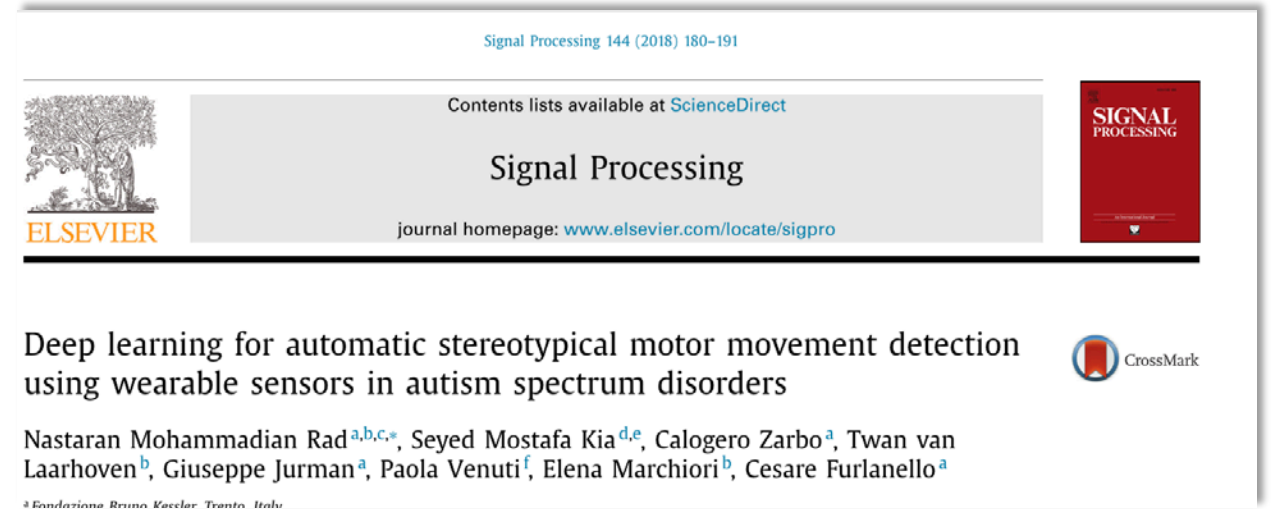
Abstract:

An important contribution to computer vision applications has been made by recognizing human emotion. Although it is very significant, this work considers the security of autistic people while in meltdown crisis by introducing a new system to warn caregivers through facial expressions detection. A

- Deep Learning Using RNN
- 85.8% Accuracy
- Training Loss: 0.04%
- Work with Image only
- Compound Emotion Recognition!!
- Not explainable!

Candidate Algorithm: Deep Learning

(CNN, LSTM)



- Deep Learning Using CNN and LSTM
- Improved the Stereotypical Motor Movements (SMM) detection rate in real-world scenarios for unbalanced data
- Works with Stereotypical Motor Movements (SMMs) data
- SMM detection is problematic for its online adaptation!!
- The system has no access to the labels of incoming samples during usage by a new user.

Candidate Algorithm: Deep Learning

(RCNN)

Deep Learning Based Recognition of Meltdown in Autistic Kids

Publisher: IEEE

[Cite This](#)

[PDF](#)

Venkata Sindhoor Preetham Patnam ; Feba Thankachan George ; Kiran George ; Abhishek Verma [All Authors](#)

1
Paper
Citation

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Abstract

Abstract:

Children with autism often experience sudden meltdowns which not only makes the moment tough for the caretakers/parents but also make the children hurt themselves physically. Studies have discovered that children with autistic spectrum disorder exhibit certain actions through which we can anticipate

Document Sections

1 Introduction

- Deep Learning Using RCNN
- 93% Accuracy
- Work with Image only
- Run time is high
- Not explainable!

Candidate Algorithms: A Comparison

PLOS ONE



[PLOS One](#). 2019; 14(9): e0222907.

PMCID: PMC6760799

Published online 2019 Sep 25. doi: [10.1371/journal.pone.0222907](https://doi.org/10.1371/journal.pone.0222907)

PMID: [31553774](https://pubmed.ncbi.nlm.nih.gov/31553774/)

A comparison of machine learning algorithms for the surveillance of autism spectrum disorder

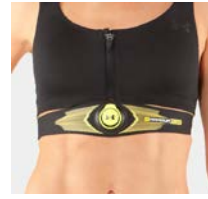
[Scott H. Lee](#), Conceptualization, Formal analysis, Investigation, Methodology, Software, Validation, Writing – original draft, * [Matthew J. Maenner](#), Conceptualization, Data curation, Project administration, Writing – review & editing, and [Charles M. Heilig](#), Methodology, Supervision, Writing – review & editing

Model	Accuracy (95% CI)
Latent Dirichlet Allocation (LDA)	58.6 (55.0, 62.2)
Multinomial Naive Bayes (MNB)	77.3 (73.9, 80.7)
Support Vector Machine (SVM)	84.0 (80.8, 87.2)
Latent Semantic Analysis (LSA)	85.1 (83.1, 87.0)
Random Forest (RF)	87.1 (83.8, 90.4)
Naive Bayes SVM (NB-SVM)	87.6 (85.2, 90.1)

Sensors / Devices



Chest Strap



Patches



Smart Watch/
Wristband

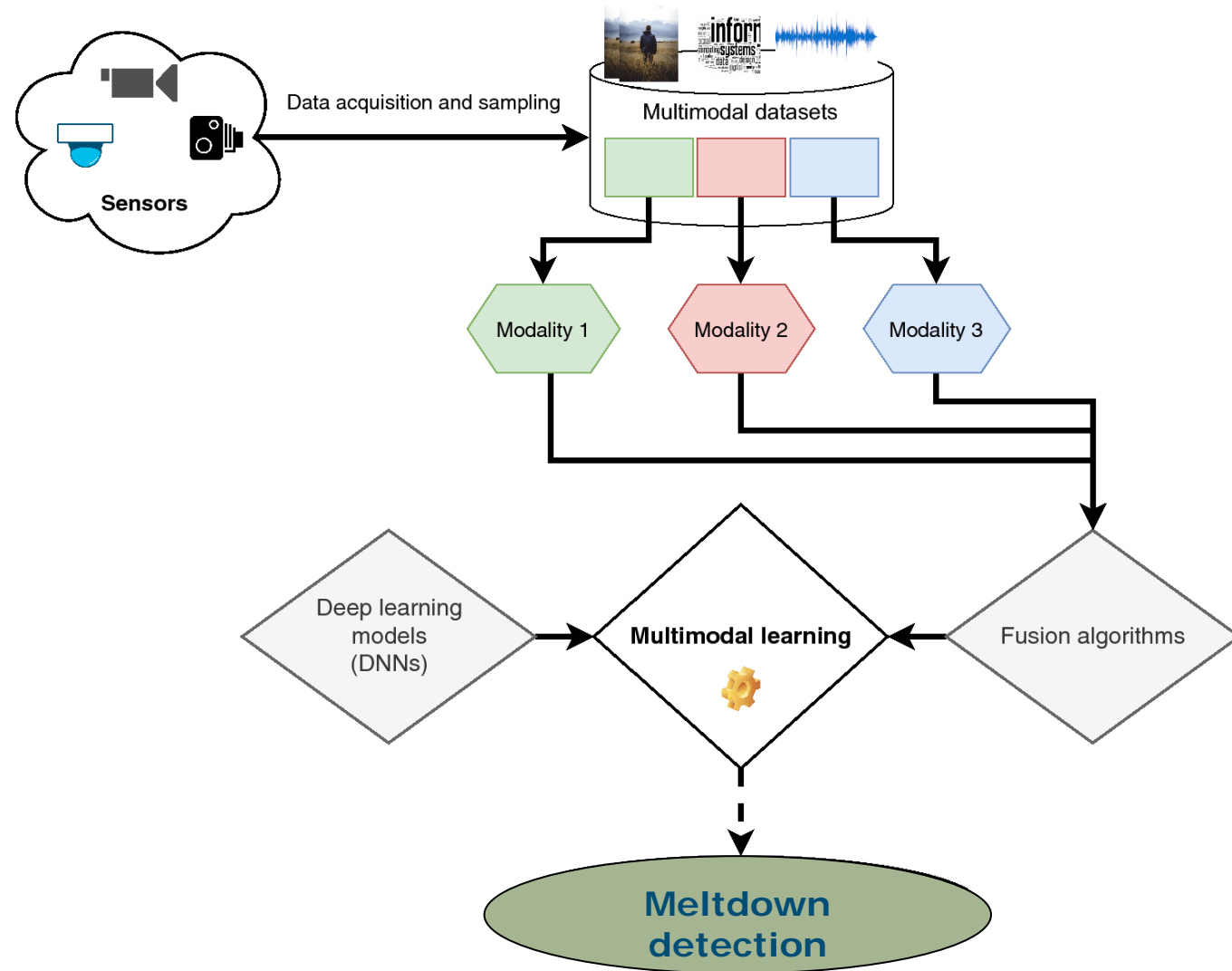


Eye Gaze Tracker



NAO Robots

Multimodal Analysis: General Idea



Thank You!

Any Questions?
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