EuroHPC JU Information Day for AI on Supercomputers

26.09.2023
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TIS Group, Croatia
www.tis.hr
About TIS Group, Croatia

• 30+ years, 3 companies, Croatia, Slovenia, UK

• 120+ certified experts: IT development, integration, business analysis & project management, AI/ML

• Financial, telco, health, public & healthcare sectors - worldwide

• A business build on partnerships
OBJECTIVE:

to develop an artificial intelligence (A.I.) system to automatically assess quality of general movements in infant

ARTIFICIAL INTELLIGENCE PROTECTS BABY'S HEALTH
Imagine there is a method...

- Simple, early available and repeatable
- Non-invasive and safe
- Reliable and standardized
- Evidence based proven
- Possibility of telemedicine
- We just need to watch

www.sendd.eu
When you watch a child with fidgety movements, do you know that you are actually watching how it learns?

Expected General Movements
- include all parts of the body
- complex, variable, fluent
- wax and wane in intensity, force and speed
- have a gradual beginning and end
System for Early Neurological Deviation Detection

A unique AI solution for assessing the quality of spontaneous movements (fidgeting).

**The target:** Children in early infancy (2-3m) with neurological deviation

**The purpose:** detecting infants at high risk of neurodevelopmental disorders or expected normal outcome in a group of neuro risky children

**Collaboration:**
Pediatric Clinic Sabol & TIS Grupa
EU funding and cofinancing
RESEARCH AND DEVELOPMENT CHALLENGES

HOW TO GATHER REPRESENTATIVE DATASET OF VIDEOS WITH FIDGETY MOVEMENTS?

MEDICALLY PROVEN 30 YEARS OLD METHOD COMPLETELY HARMLESS AND NON-INVASIVE IN BABY’S KNOWN (HOME) ENVIRONMENT ACCORDING TO PROF. M. HADDER-ALGRA CLASSIFICATION SYSTEM

www.sendd.eu

FIDGETY MOVEMENTS ARE SO IMPORTANT!

"there is no two babies with the same fidgety, not even identical twins who have the same genes do not fidget identically."
WEB APP
for PARENTs, ASSISTENTs, DOCTORs, AI RESEARCHERs
www.sendd.eu
Mobile Apps for PARENTs

www.sendd.eu
Mobile Apps for PARENTs

www.sendd.eu
RESEARCH AND DEVELOPMENT CHALLENGES

SENDD.AI: VIDEO POSE ESTIMATION

1.TIS@

2. KEY POINTS #15, #3 per extremity & eyes & nose
INPUT: GM video
OUTPUT: 1/3 annotation video and JSON file

OUTPUT 2/3 Composite map: displays movement of 15 key points throughout the video

OUTPUT 3/3: maps of individual key points

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OUTPUT: 1/3 annotation video and JSON file

OUTPUT 2/3 Composite map: displays movement of 15 key points throughout the video

OUTPUT 3/3: maps of individual key points

1.TIS@
2.KEY POINTS
3.OUTPUT
RESEARCH AND DEVELOPMENT CHALLENGES

SENDD.AI ASSESSMENT

FIND THE BEST MACHINE LEARNING MODEL

- different models and algorithms vs different inputs
- ML models with best results:
  - Convolutional Neural Network,
  - kNN, SVM, Logistic Regression...
- days of training
- GMs videos from 15 countries (EU, USA, UAE..)

www.sendd.eu
GMs videos used in the SENDD AI training iterations - 2023.May

<table>
<thead>
<tr>
<th></th>
<th>TRAINING &amp; VALIDATION SET</th>
<th>TESTING SET</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total No. of videos</strong></td>
<td>492</td>
<td>151</td>
</tr>
<tr>
<td>No. of videos with normal movements</td>
<td>262</td>
<td>109</td>
</tr>
<tr>
<td>No. of videos with abnormal movements</td>
<td>230</td>
<td>42</td>
</tr>
<tr>
<td><strong>Total No. of children</strong></td>
<td>194</td>
<td>39</td>
</tr>
<tr>
<td>No. of children with normal movements</td>
<td>119</td>
<td>29</td>
</tr>
<tr>
<td>No. of children with abnormal movements</td>
<td>75</td>
<td>10</td>
</tr>
</tbody>
</table>
CURRENT RESULTS

### Logistic Regression vs. k-Nearest Neighbors (KNN) vs. Convolutional Neural Network (CNN)

<table>
<thead>
<tr>
<th></th>
<th>Logistic Regression</th>
<th>k-Nearest Neighbors (KNN)</th>
<th>Convolutional Neural Network (CNN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truly assessed abnormal movements</td>
<td>9</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Truly assessed normal movements</td>
<td>21</td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>Falsely assessed as abnormal movements</td>
<td>8</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Falsely assessed as normal movements</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

### Classification

- Normal-optimal GMs
- Normal-suboptimal GMs
- Mildly abnormal GMs
- Definitely abnormal GMs

Hadders Algra, 2004

### Performance Metrics

<table>
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<tr>
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<th>Logistic Regression</th>
<th>k-Nearest Neighbors (KNN)</th>
<th>Convolutional Neural Network (CNN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPV</td>
<td>53%</td>
<td>38%</td>
<td>38%</td>
</tr>
<tr>
<td>NPV</td>
<td>95%</td>
<td>83%</td>
<td>100%</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>90%</td>
<td>60%</td>
<td>100%</td>
</tr>
<tr>
<td>Specificity</td>
<td>72%</td>
<td>66%</td>
<td>45%</td>
</tr>
</tbody>
</table>
Take away...

➢ The results of the product is:

➢ automated screening tool that will **save time** and human resources,

  but not self-diagnostic tool

➢ **not to miss** infants with abnormal GMs

➢ B2C & B2B offer

➢ Future development should be:

  ➢ **collect a larger number** of videos **including extremes**
FIDGETY IS IMPORTANT!

There are no two babies with the identical general movement pattern, even at identical twins who share the same genes.

Check the quality of the general movements in early infancy to detect infants at high risk of neurodevelopmental abnormalities!

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