



PEDIATRIC CLINIC
SABOL

SEND DD



TIS
MEETING OF MINDS



EuroHPC JU Information Day for AI on Supercomputers

26.09.2023



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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**

ORACLE

IBM

Microsoft

 **Namirial**
Information Technology

 **Red Hat**

 **AUTOMATION
ANYWHERE**
Go be great.

 **MIKROCOP**





SEND D

System for Early Neurological Deviation Detection

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



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



SEND D
US
FIDGETY MOVEMENTS

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

Coolaboration:

Pediatric Clinic Sabol & TIS Grupa

EU funding and cofinancing



Operativni program
KONKURENTNOST
I KOHEZIJA



EUROPSKI STRUKTURNI
I INVESTICIJSKI FONDovi



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. HADDERS-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.“

CONTRIBUTION!
OPEN TO THE PUBLIC
INTERESTED PARENTS OF
CHILDREN AGED 1.5-3.5M
FREE ASSESSMENT
MOBILE & WEB
ONBOARDING





EN

Search Clear filters

#NoP	#NoV	Classification date	AI assessment date	AI
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647	1	May 18, 2023	May 2, 2023	NC
743	4	May 18, 2023	May 15, 2023	NC
743	4	May 18, 2023	May 15, 2023	NO,NS (12)


GENERAL MOVEMENTS (GMs) ASSESSMENT

Name and surname: [REDACTED] Gestation age at childbirth: Term age
 Date of birth: 03. 02. 2023. Report date: 15. 05. 2023.
 Indication: SENDD Corrected age at time of recording: 2mo.

GMs age:	preterm	writhing	fidgety	x
Movement description: (complexity and variation)	Shows reduced spatial and temporal variation. Lack of movement fluency. Normal findings.			
GMs classification (Hadders Algra)	Significance in terms of early brain motor function			
Normal optimal GMs	Excellent			
Normal suboptimal GMs	x Typical (most of the population)			
Mildly abnormal GMs	Non-optimal function			
Definitely abnormal GMs	Dysfunction			
Impossible to estimate	Impossible to estimate			
Recommendation:	Monitor of development, examination by physiatrist and/or neuropsychiatrist if necessary.			
Prognostic value of general movements (GMs) assessment / interpretation of findings				
The quality of general movements is non-invasive and early available indicator of the motor development and expected outcome of infants with neurorisk, i.e. suspicion of brain damage or clinical deviation in early neurodevelopment. The brain in early development constantly explores different combinations of signals from the brain that result in random movements of the whole body (general movements). A healthy brain continuously produces new complex, diverse and fluid movements both spatially and temporally. Depending on the degree of brain damage, there is a reduction in complexity and variation of general movements that results in more stereotypical, repetitive or cramped synchronised movements. The quality of movements can be analyzed and standardized in classification system (SEND D) uses Hadders Algra classification system). A video sample according to the technical requirements is required for the analysis. The live assessment is not reliable. The quantity of movement (abundant, medium or poorly presented) is not prognostically significant in relation to quality.				
Normal GMs speak in favor of the expectation of a normal motor outcome in neurorisk children. Mild neuromotor dysfunctions are unlikely. The majority of the healthy population had normal suboptimal GMs in infancy. A smaller percentage of the healthy population shows normal optimal GMs and their long-term significance is still the subject of research.				
Mildly abnormal GMs speak in favor of the risk (single or multiple) of mild neurodevelopmental abnormalities, but also possibility of the normal outcome. It is the category when therapeutic work and brain plasticity of developing brain can have the greatest impact on outcome. Developmental monitoring and early intervention in case of deviation are required. Selection of diagnostic tests on clinical indication.				
Definitely abnormal GMs speak in favor of a high risk of multiple and severe neuromotor abnormalities or cerebral palsy (but not to what degree). Extensive diagnostic work-up, intensive and early multidisciplinary intervention and monitoring, specialized physicians and therapists are required.				
Doctor:	Goran Krakar			

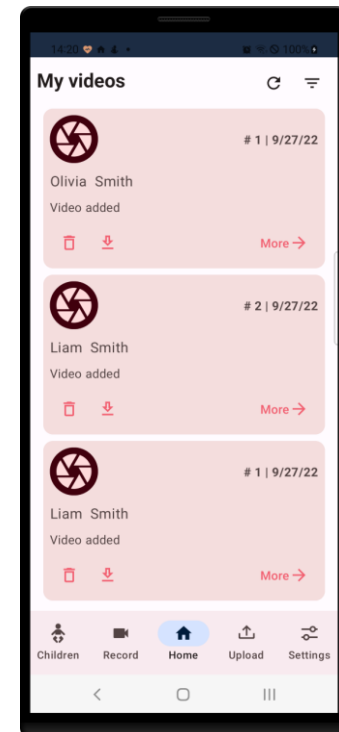
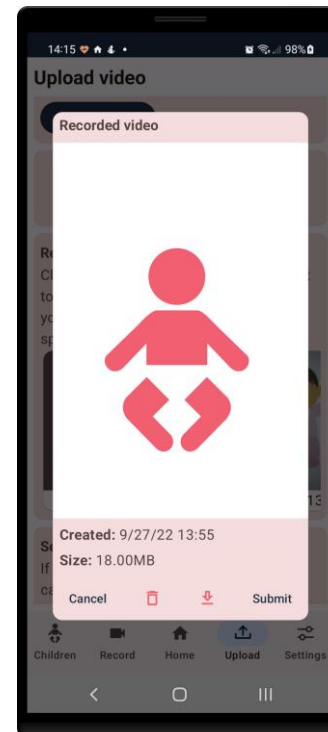
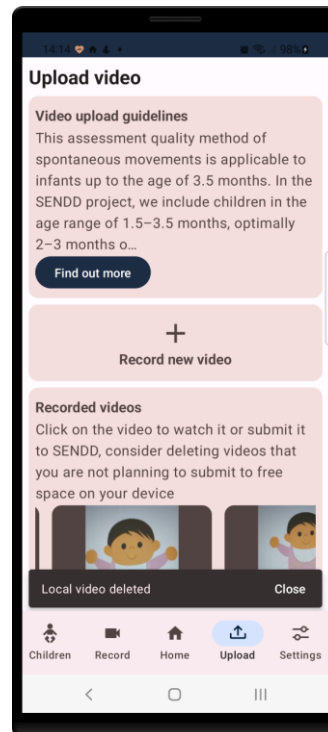
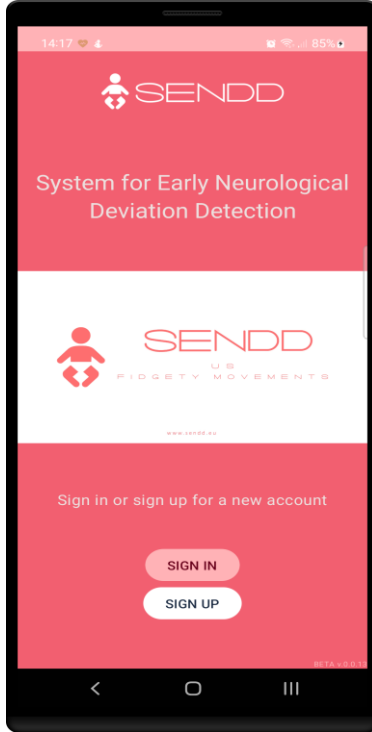
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WEB APP

for PARENTs, ASSISTENTs, DOCTORs, AI RESEARCHERS



Mobile Apps for PARENTS

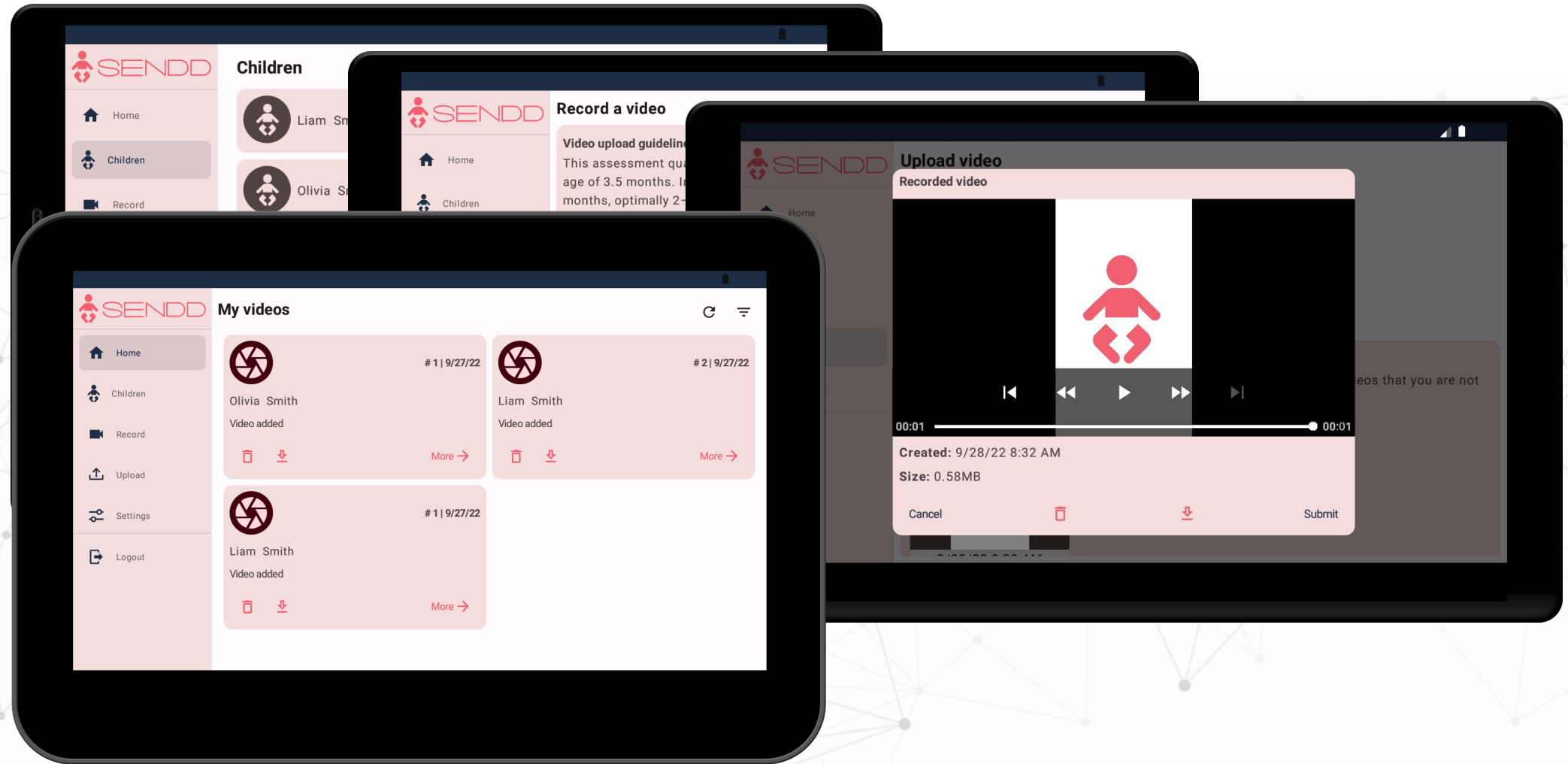




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Mobile Apps for PARENTS

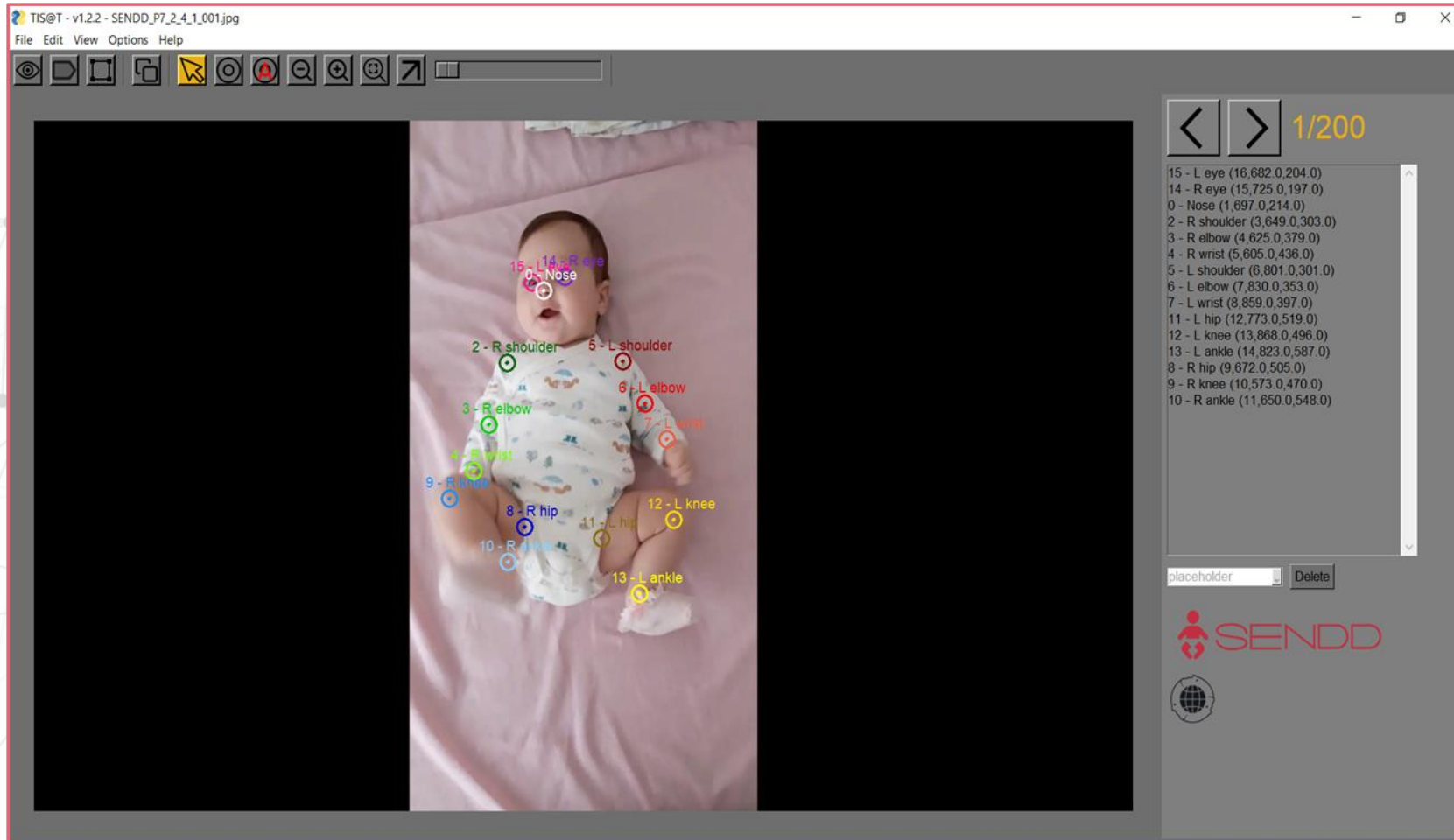




RESEARCH AND DEVELOPMENT CHALLENGES



SEND.D.AI: VIDEO POSE ESTIMATION



1.TIS@

2. KEY POINTS #15, #3 per extremity & eyes & nose



RESEARCH AND DEVELOPMENT CHALLENGES



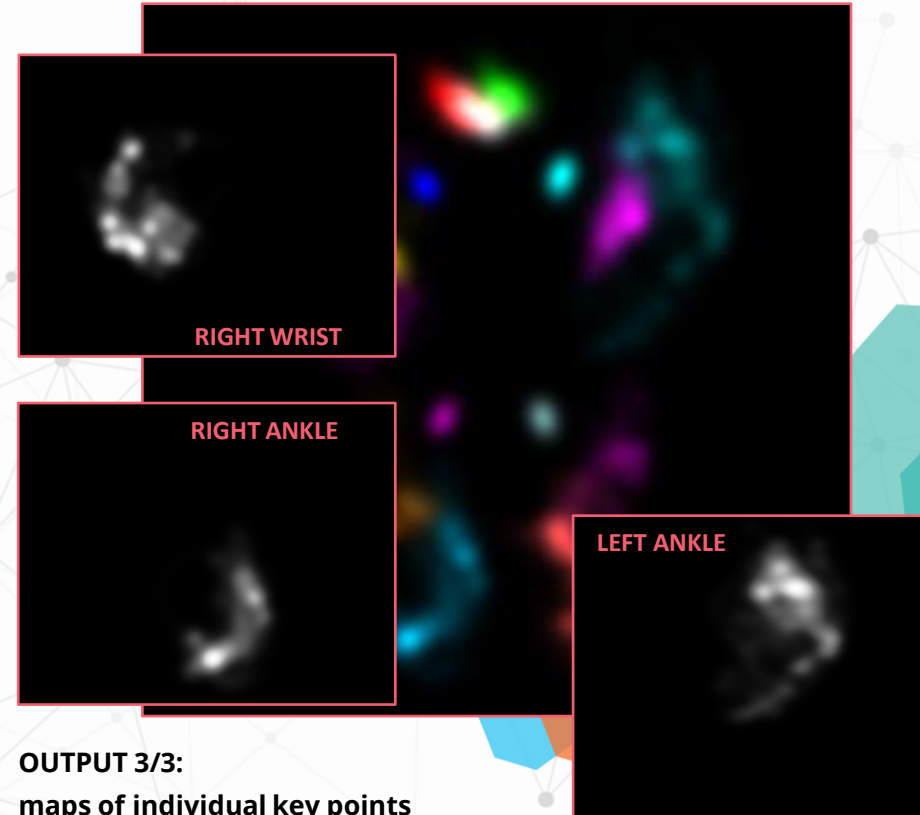
SEND.D.AI: VIDEO POSE ESTIMATION

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

1.TIS@

2.KEY POINTS

3.OUTPUT



RESEARCH AND DEVELOPMENT CHALLENGES



SENDD.AI ASSESSMENT

FIND THE BEST MACHINE LEARNING MODEL

25+

- **different models and algorithms vs different inputs**
- **ML models with best results:**
 - Convolutional Neural Network,
 - kNN, SVM, Logistic Regression...

max 21

- **days of training**

1400+

- **GMs videos from 15 countries (EU,USA,UAE..)**





CURRENT RESULTS



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

	TRAINING & VALIDATION SET	TESTING SET
Total No. of videos	492	151
No. of videos with normal movements	262	109
No. of videos with abnormal movements	230	42
Total No. of children	194	39
No. of children with normal movements	119	29
No. of children with abnormal movements	75	10





CURRENT RESULTS



(05.2023)	Logistic Regression	k-Nearest Neighbors (KNN)	Convolutional Neural Network (CNN)
Truly assessed abnormal movements	9	6	10
Truly assessed normal movements	21	19	13
Falsely assessed as abnormal movements	8	10	16
Falsely assessed as normal movements	1	4	0

PPV	53%	38%	38%
NPV	95%	83%	100%
Sensitivity	90%	60%	100%
Specificity	72%	66%	45%

Classification

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

Hadders Algra, 2004

High NPV
→ falsely assessing children with abnormal movements as normal movements is minimized.



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**





SENDD

TEAM:



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TIS
MEETING OF MINDS

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SENDD Mobile App
available on
Google Play Store
&
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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!