

Challenge: Creating an *inclusive* environment for children with multiple *disabilities*



*"However difficult life may seem, there is
always something you can do and succeed at."*

— Stephen Hawking

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Challenge provider

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Problem Statement- Addressing Critical Challenges

*Current assistive technologies are often too **complex, unknown,** or **expensive,** creating significant **barriers** for families in need*



One-Size-Fits-All Limitation



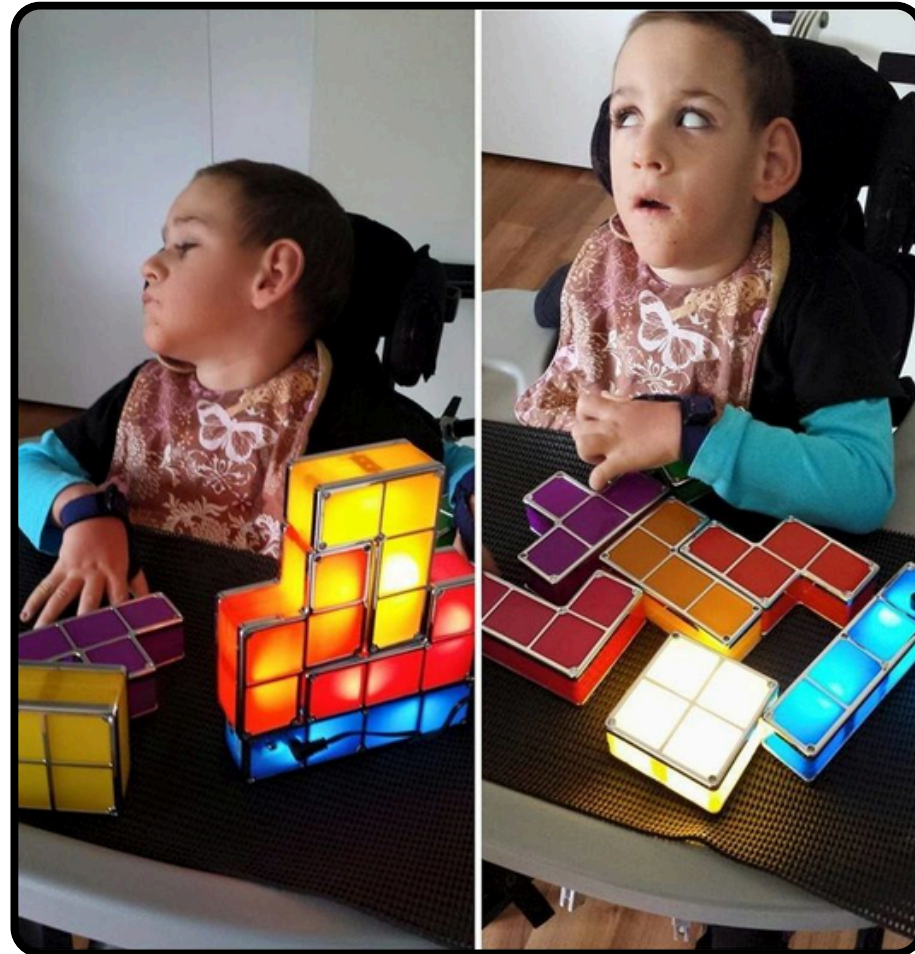
Lack of Personalization



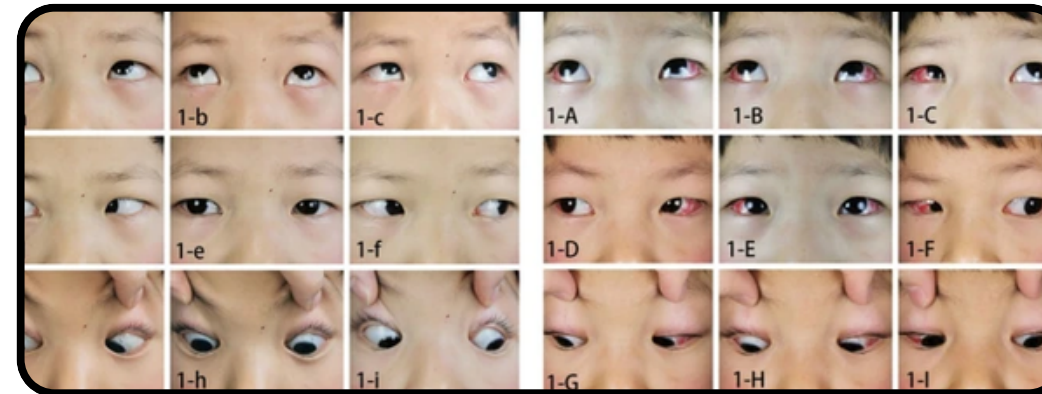
DIY Customization Rare

*Many children who remain unable to communicate or participate in daily activities lead to **isolation** and **frustration.***

Target Users

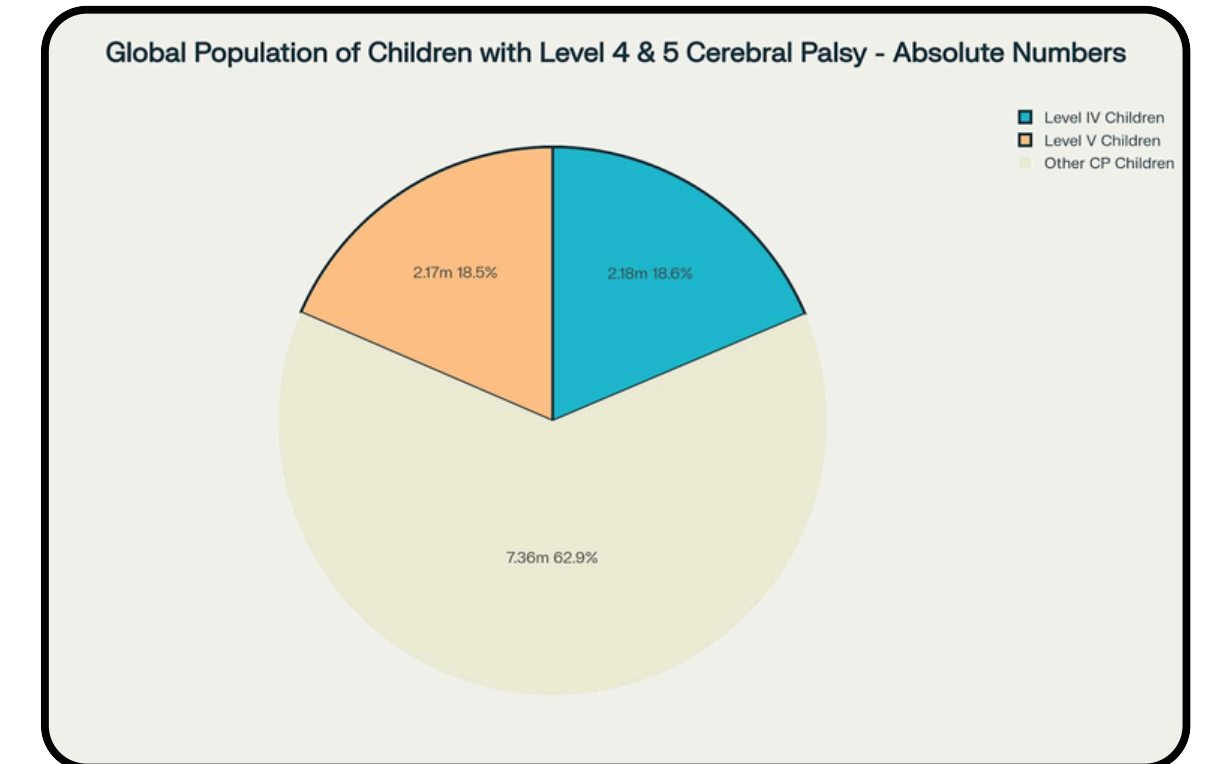


Who is Affected:
Children with severe motor/communication disabilities (CP Level 4 & 5)
Families, caregivers, therapists, and schools.



23%+ with CP report unmet needs for therapy/assistive tech

Reason - Lack of personalisation
Expensive / Limited access



- Total children with cerebral palsy worldwide: 11.7 million
- Children with Level IV cerebral palsy: 2.18 million
- Children with Level V cerebral palsy: 2.17 million

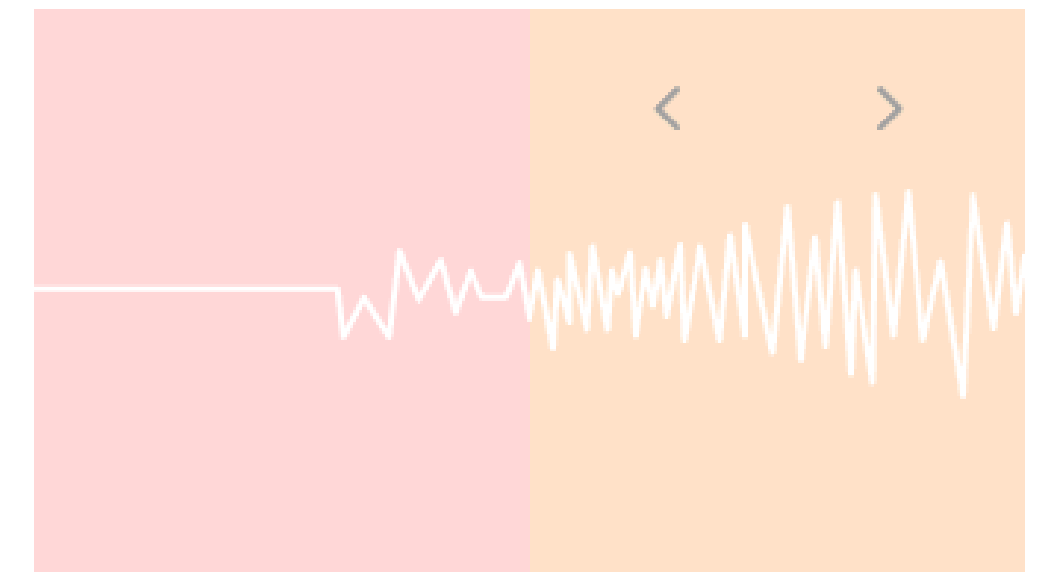
User Persona: Emma, 8 years old

- **Diagnosis:** Cerebral Palsy (GMFCS Level IV)
- **Mobility:** Powered wheelchair user
- **Communication:** Reliable facial expressions (smile, eyebrow raise, intentional blinking)
- **Personality:** Determined, expressive, curious, resilient
- **Support:** Requires extensive caregiver assistance

Emma's navigation needs range from full to none.

Fully Dependent

Independent



School Navigation

Caregiver fully assists with all navigation.

Leisure Navigation

Caregiver interprets needs for entertainment adjustments.

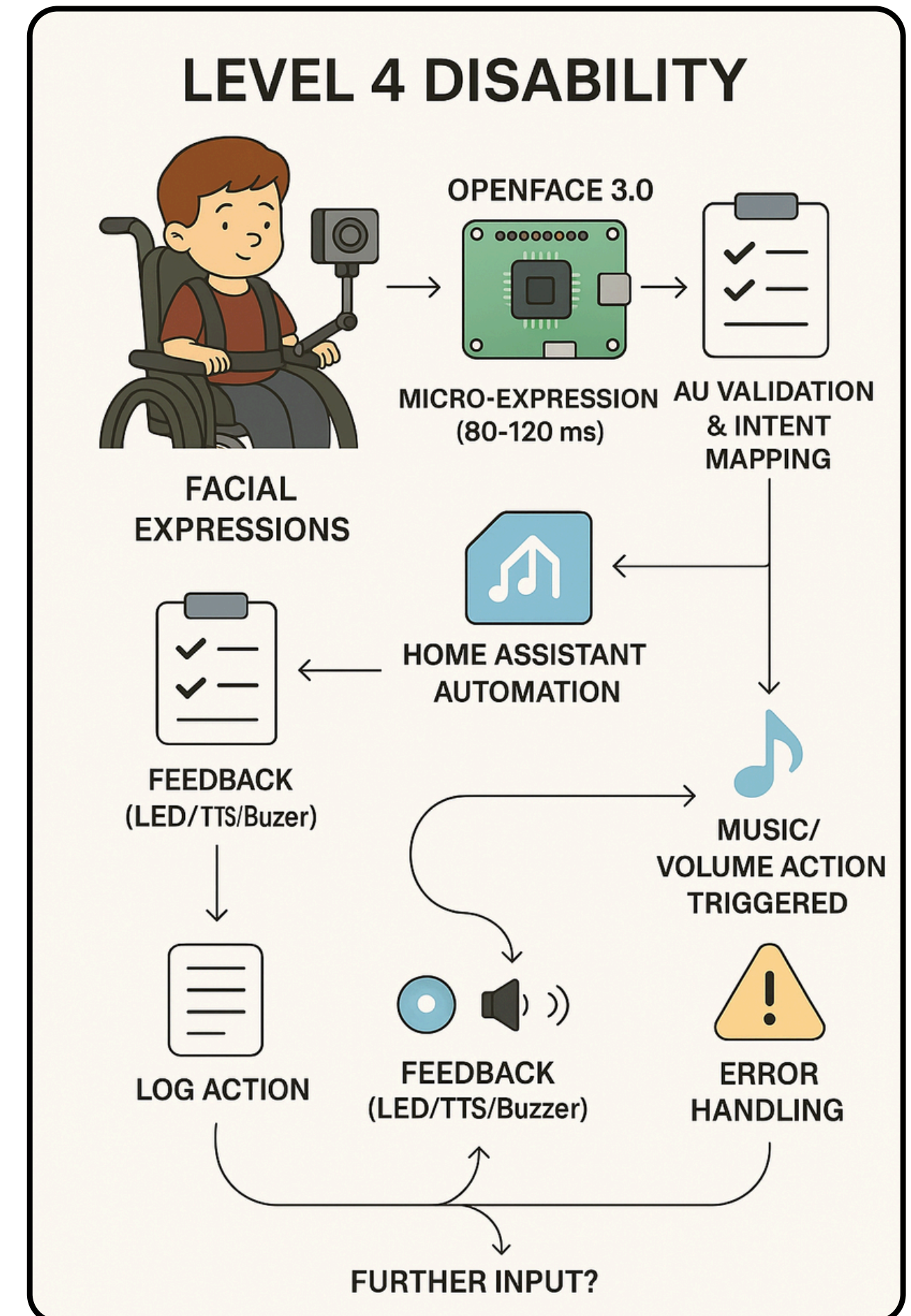
Scope of the Project

“Introducing Facial Expression AAC”

Our brief idea centers on a low-cost, effective expression recognition system using open-source tools like OpenFace or OpenCV, interfaced with a Raspberry Pi and a camera. This system empowers children to engage socially through pre-defined sentences and audio output displayed on a screen.

Key Features & Innovations:

- Personalization
- Accessible Technology
- Seamless Smart Home Integration
- Open-Source Ecosystem
- Feedback Loops



Openface Opensource facial Recognition Model

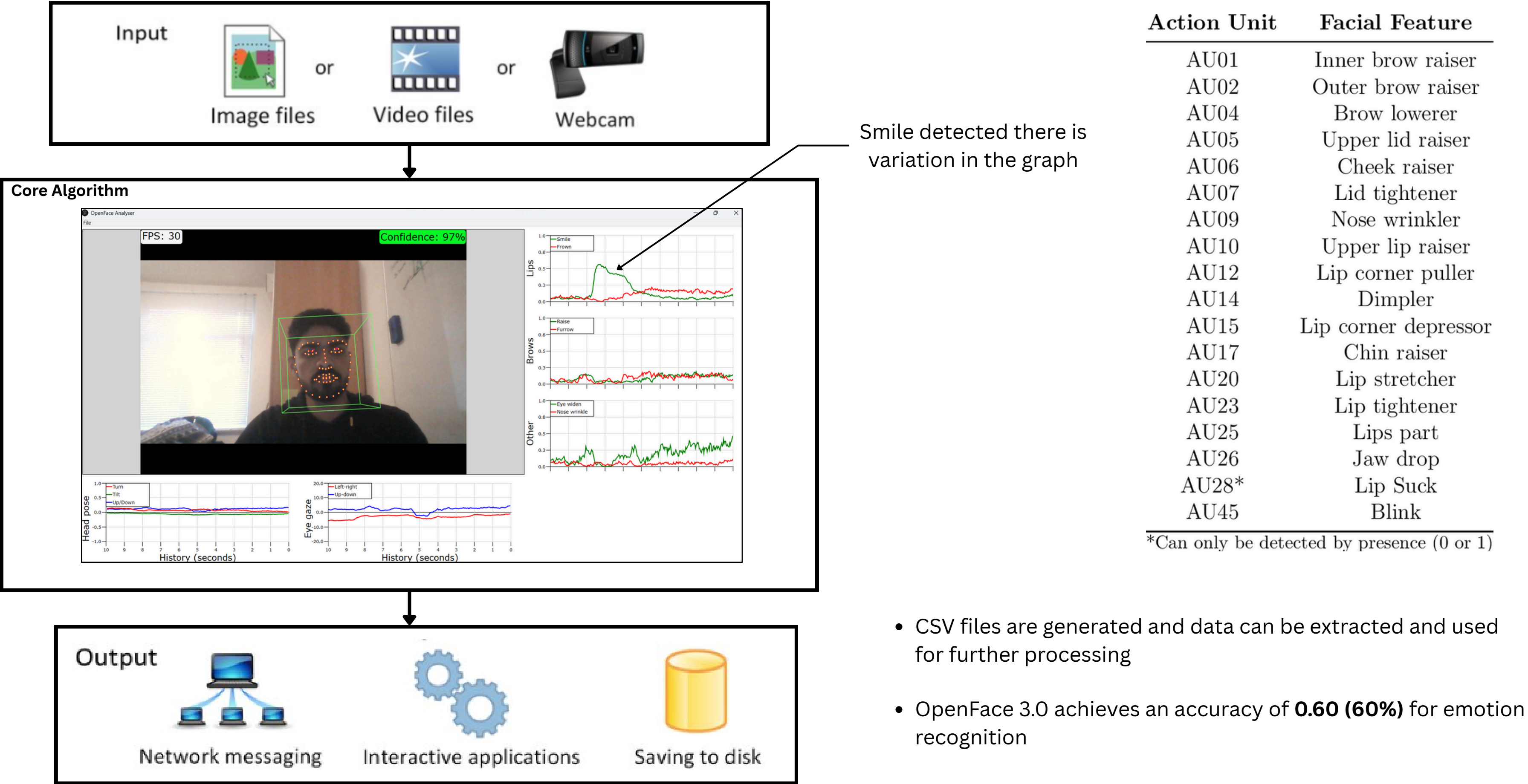
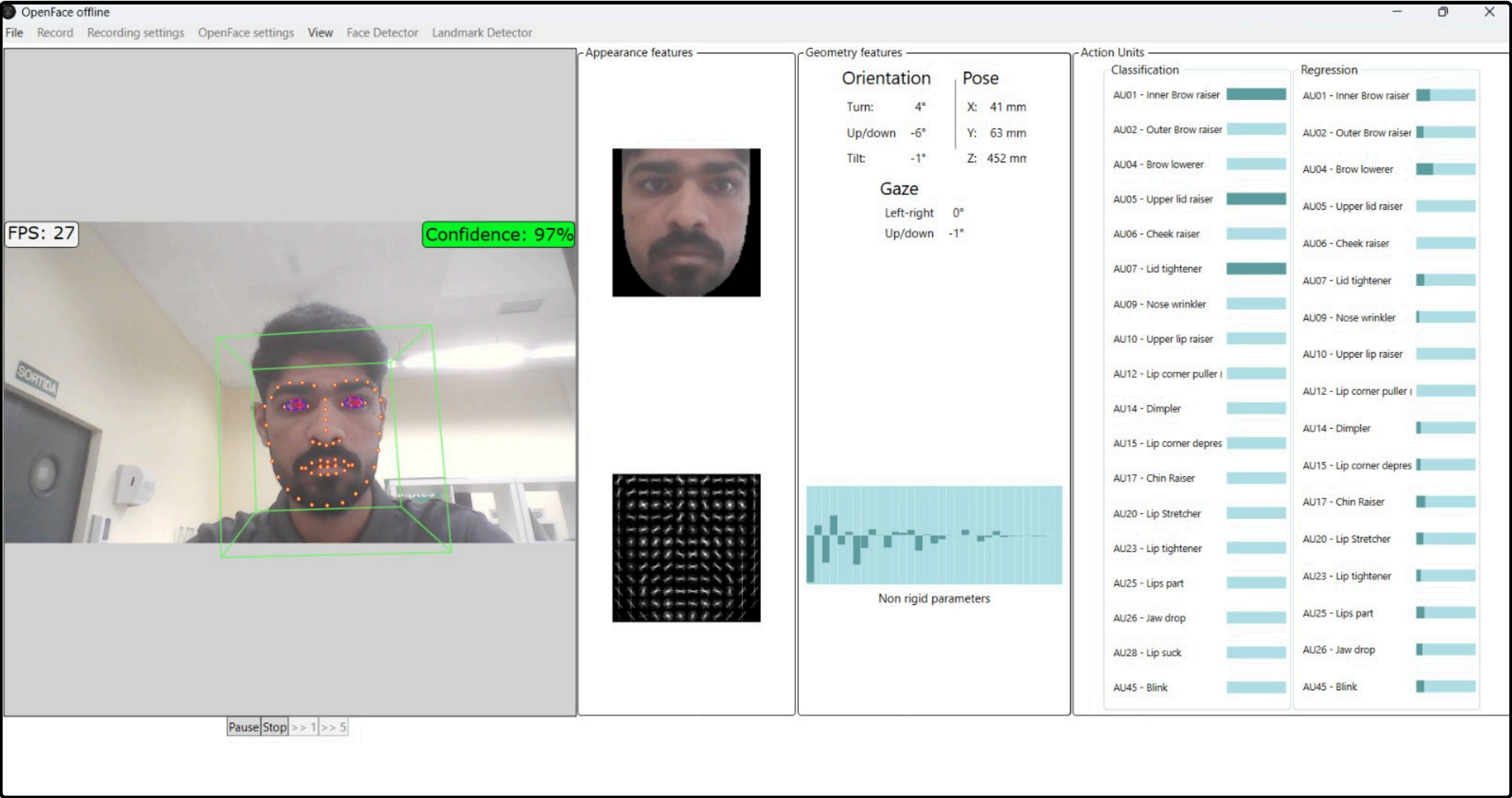


Fig 1. Openface working

Openface Action Units



Block Diagram

- Raspberry Pi 5 integration with Aeotec sensors and switches
- Alexa support for home automation services
- Facial recognition using openface open source model
- Predefined outputs which are input to Alexa based on the emotions detection.
- Further actions were taken for home automation devices.

Hardware Used:

- 2 Raspberry Pi 5 with 8 GB RAM
- Raspberry cameras
- Sensor: Smart Home MultiSensor 7 - Aeotec
- Sensor: Home Energy Meter - Aeotec
- sensor: Door/Window Sensor 7 - Aeotec
- Actuators: Aeotec Pico SmartThings integrated Switch - Aeotec (or similar from Aeotec).

Building a Smart Home System



The Benefits – What Sets Our Solution Apart

Tangible Benefits



Clear Communication



Enhanced Independence



Accessible & Affordable



Time & Cost Savings

Intangible Benefits



Dignity & Inclusion

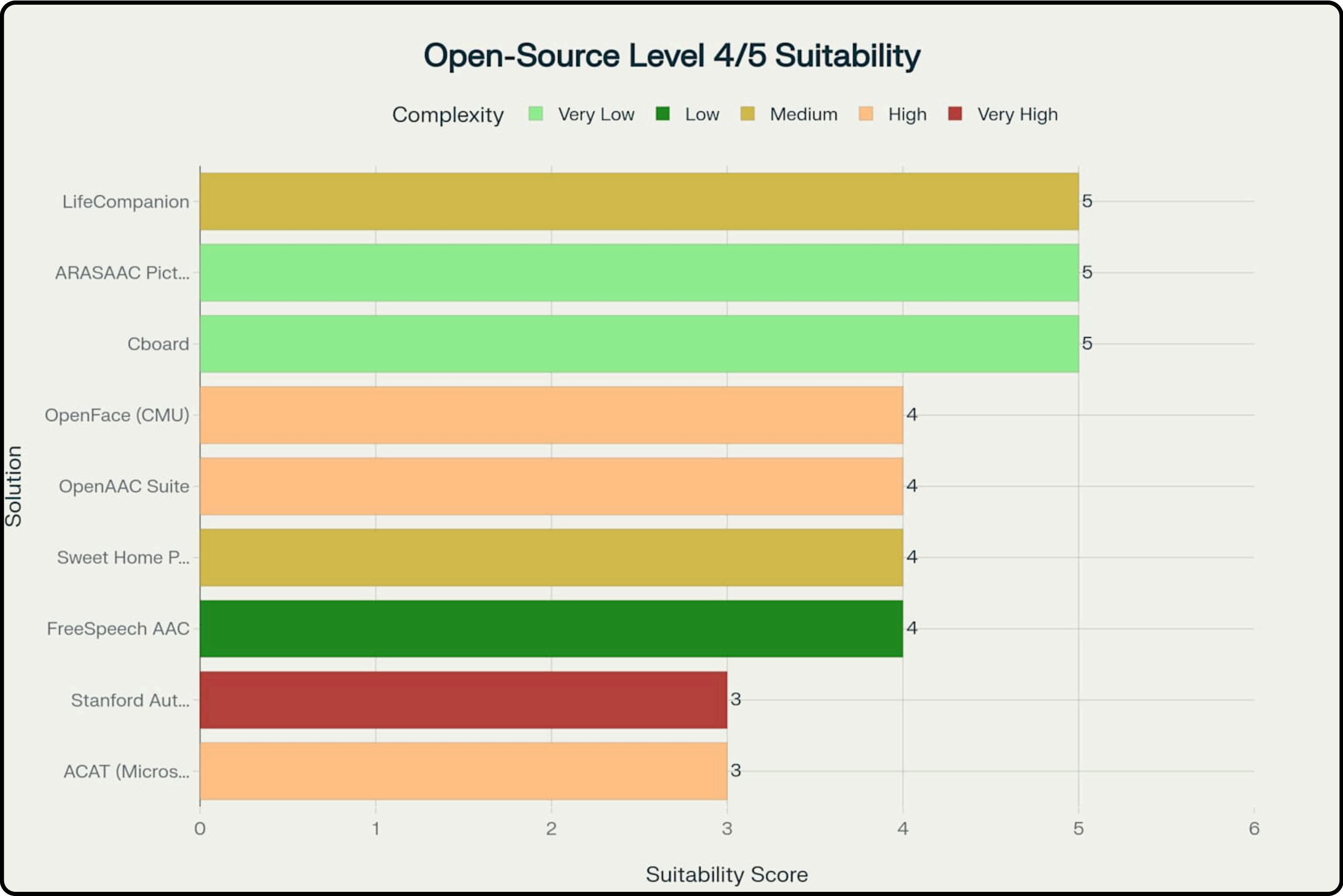


Confidence & Self-Esteem



New Opportunities

Existing Technology: Challenges of Complexity and Reliability



Thank your time and attention!

Open for Discussion & Questions



List of references

Cerebral Palsy Prevalence and Epidemiology

- Rosenbaum, P., et al. (2007). "A report: the definition and classification of cerebral palsy." *Developmental Medicine & Child Neurology*, 49(s109), 8-14.
- Oskoui, M., et al. (2013). "An update on the prevalence of cerebral palsy." *Developmental Medicine & Child Neurology*, 55(6), 509-516.
4. ResearchNester. "Global Cerebral Palsy Market Analysis & Forecast (2024-2037)."
 5. SkyQuest. "Cerebral Palsy Treatment Market Report (2024-2032)."
 6. Verified Market Reports. "Cerebral Palsy Market Size & Forecast (2024-2033)."
 7. IMARC Group. "Assistive Technologies Market Report (2024-2034)."
 8. Data Bridge Market Research. "Assistive Devices Market Analysis (2023-2031)."
 9. Zion Market Research. "Assistive Technology Market Outlook (2024-2034)."
 10. Market.us. "Assistive Technology Market Forecast (2023-2033)." Children with Severe CP & GMFCS Distribution
 11. Palmer, M. A., et al. (2008). "The distribution of gross motor function levels in children with cerebral palsy." *Developmental Medicine & Child Neurology*.
 12. Gorter, J. W., et al. (2010). "The GMFCS in children with cerebral palsy: a systematic review." *Developmental Medicine & Child Neurology*.
 13. Brazilian Cerebral Palsy Registry (2024). Regional data on severity levels.
 14. Bangladesh CP Study (2023). Regional prevalence and severity data.
 15. CDC (2010). "Prevalence of Cerebral Palsy in the United States." *Morbidity and Mortality Weekly Report (MMWR)*. Technical & Research Sources
 16. Carnegie Mellon University. "OpenFace: Facial Behaviour Analysis Toolkit." <https://cmusatyalab.github.io/openface/>
 17. Baltrušaitis, T., et al. (2018). "OpenFace 2.0: Facial Behaviour Analysis Toolkit." *IEEE Transactions on Pattern Analysis and Machine Intelligence*.
 18. Stanford Autism Glass Project. <https://autism.stanford.edu/>
 19. Microsoft ACAT (Assistive Context-Aware Toolkit). <https://github.com/Microsoft/ACAT>
 20. ARASAAC Pictogram Library. <https://arasaac.org/>
 21. Open-source AAC platforms: Cboard, FreeSpeech AAC, OpenAAC repositories. Additional Sources
 22. World Bank. "Disability and Development." <https://www.worldbank.org/>
 23. UNICEF. "Inclusive Education and Assistive Technologies." <https://www.unicef.org>