tinyML Summit
Enabling Ultra-low Power Machine Learning at the Edge

Products and applications enabled by tinyML

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www.tinyML.org
Killer App: Human Health Analysis

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Diabetes around the world in 2021

537 million adults (20-79 years) are living with diabetes - 1 in 10. This number is predicted to rise to 643 million by 2030 and 783 million by 2045.

Diabetes is responsible for 6.7 million deaths in 2021 - 1 every 5 seconds.

541 million adults have Impaired Glucose Tolerance (IGT), which places them at high risk of type 2 diabetes.
# Available devices (2021)

## Hybrid closed-loop systems

<table>
<thead>
<tr>
<th>Integrated pump</th>
<th>670G, 780G (coming soon)</th>
<th>Tandem t:slimX2</th>
<th>Dana RS pump</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensor</strong></td>
<td>Guardian 3</td>
<td>Dexcom G6</td>
<td>Dexcom G6</td>
</tr>
<tr>
<td><strong>Sensor duration</strong></td>
<td>7 days</td>
<td>10 days</td>
<td>10 days</td>
</tr>
<tr>
<td><strong>Number of fingersticks</strong></td>
<td>4 to 6 per day, may be less for 780G</td>
<td>Rarely (factory calibrated)</td>
<td>Rarely (factory calibrated)</td>
</tr>
<tr>
<td><strong>Approximate yearly cost in UK NHS</strong></td>
<td>Pump = £612.50 Consumables = £1400 Medtronic sensor = £3186 SMBG = £500 App = £0</td>
<td>Pump = £838 Consumables = £1588 Dexcom G6 sensor = £2645 SMBG = £100 App = £0</td>
<td>Pump = £575 Consumables = £1400 Dexcom G6 sensor = £2645 SMBG = £100 App = £840</td>
</tr>
</tbody>
</table>

Achieving non-invasive glucose
A wide variety of use cases

Drive valuable health insights with diagnostic and predictive algorithms

- ECG/PPG
- EEG
- Skin
- Motion
- Temperature

Life Quality  |  Performance  |  Safety  |  Health

NOWATCH  |  poly  |  OURAR  |  SLATESAFETY  |  Hyfe  |  KNOWLABS
How are they doing it?
Data validation

**Catch errors early**

Checklists are already very powerful.

Multiple devices involved? Find correlation between similar data channels.

Correlation can also be used to time-sync files.

Spot trends in the data between your device and the gold standard tests.
Feature engineering

Example: Cognitive fatigue detection algorithms

Common sensor modalities available on COTs hardware
- Photoplethysmogram (PPG)
- Motion (IMUs)
- Temperature

Possible derived features for correlation to gold standard tests
- Heart Rate Variability (HRV)
- Heart Rate (HR)
- Exertion levels
- Respiratory Rate
- Sleep Quality

Output
ML-Powered Cognitive Fatigue Estimator
Large scale clinical trials

Automated pipeline

Dataset creation
- Aggregate data
- Validate data
- Prepare data

Model development
- Feature extraction
- Develop and train
- Test and tune

Deploy

Device

Edge Impulse

Researcher

Health device

Reference clinical data

New data

Active learning

Performance Monitoring

Large scale clinical study
(1000s of subjects)
HEALTH REFERENCE DESIGN

Accelerating human health

- Infrastructure to scale clinical studies
- Reference datasets
- Nordic nRF5340 BLE SoC
- Syntiant NDP-101 ML Processors
- PPG, Vibration, Temp, Audio

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What we know
Where are we today?

64 investments (2019-2022) for health monitoring related to blood glucose, blood oxygen, brain activity detection and real-time energy monitoring

Gartner®, “Emerging Tech: Venture Capital Growth Insights for Biosensor Technology”, 1 November 2022, Stacey Yin
To improving more lives together!

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