INTRODUCTION

What is Embedded Real-Time Emotion Classification?
- Distinguishing one human emotion from another.
- Making the distinctions at the same time as they occur.
- Mounted on a device which collects physical data.

Why is it Important?
- Recognition of stress levels in drivers [2].
- Occupational therapy for Autism and ADHD [3], etc.

The two dimensional valence-arousal classification model is used to classify four classes of emotions: Joy, Anger, Sadness and Pleasure.

DESIGN METHODOLOGY AND FEATURE SELECTION

Energy-Aware Operating Modes Design
- What is the Goal? To maximize the classification accuracy and to minimize the energy consumption in doing so.
- The Smartcardia INYU [4] wearable bio-signal processor is employed to derive all the features (like heartrate, etc.) from the signals.
- An algorithm has been developed to extract features smartly based on a given energy budget.

The proposed algorithm description:

\[ \phi = \alpha A + (1 - \alpha) E \]

\[ \star \]
- A = Classification accuracy,
- \( \alpha \) = Adaptive weight,
- E = Available energy fraction

EXPERIMENTAL DETAILS AND RESULTS

The targeted embedded platform is the INYU device. It has a 3.3V, 32 MHz STM32 ultra-low power microcontroller, capable of operating in sleep mode and low power sleep mode. The battery is of 710 mAh rating at 3.7V.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Average Current (mA)</th>
<th>Lifetime (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.86</td>
<td>146.1</td>
</tr>
<tr>
<td>2</td>
<td>1.69</td>
<td>420.1</td>
</tr>
<tr>
<td>3</td>
<td>1.09</td>
<td>651.3</td>
</tr>
<tr>
<td>4</td>
<td>0.63</td>
<td>1126.9</td>
</tr>
</tbody>
</table>

The accuracy trade-offs range between 95% - 75% and 89% - 70% for arousal and valence classification accuracy respectively.

The battery lifetimes for the different modes range from 146.1 hours in Mode 1 to 1126.9 hours in Mode 4.

REFERENCES: