µLightDigit: TinyML-Empowered Contactless Digit Recognition with Light

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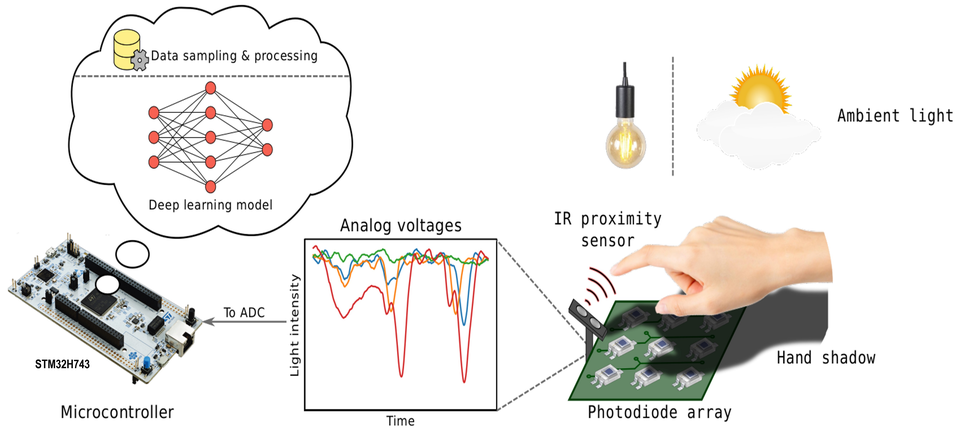
Motivation: Protections against COVID-19

ATM

Tissues

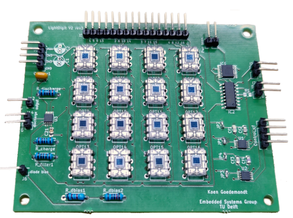
Use toothpicks to press the buttons

Proposed µLightDigit

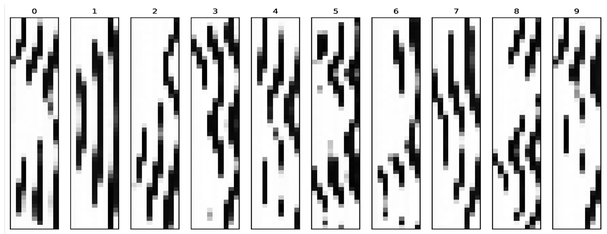


Goal: Create an embedded system running a **Tiny Deep Learning Model on a Microcontroller** which can correctly classify digits written in the air only using **ambient light** and **simple photodiodes**.

- Photodiodes will capture the shadow of the users' hand
- User interaction is touch free
- Increased privacy by not using a camera
- The model must be fast enough run in real-time

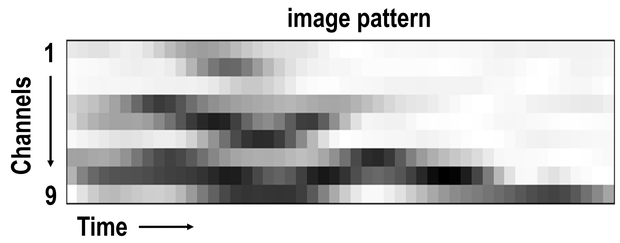


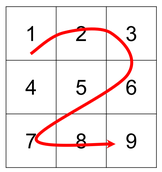
Built sensing board



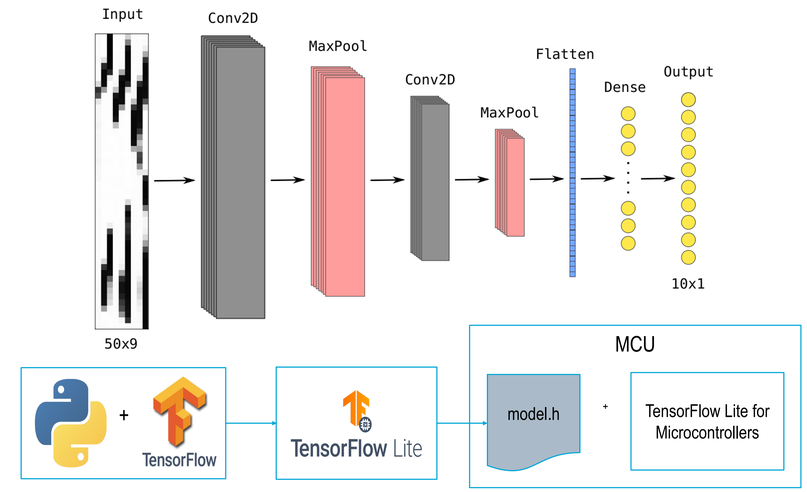
Each digit will create a different pattern

- Treat the resulting data as a 9 x 50 image
  - X-axis is time, y-axis are the channels 1-9
  - Different image sizes and channel orderings were also tested

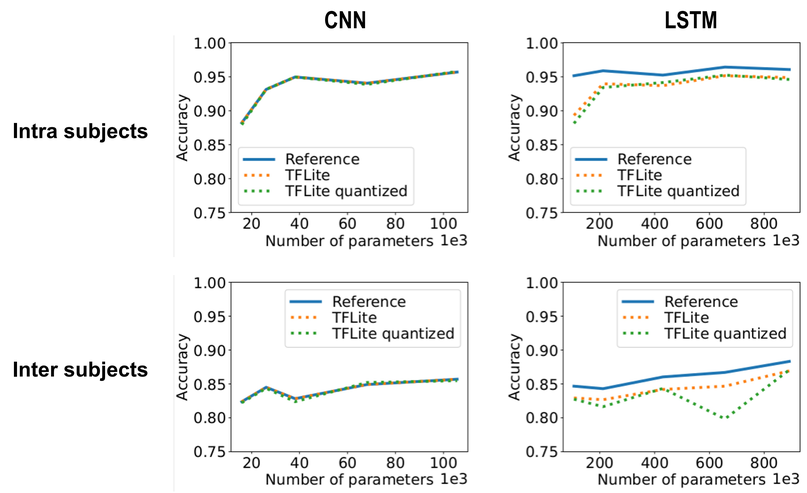




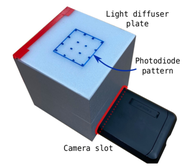
Tiny Deep Learning Architecture

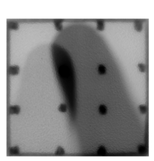


Performance Evaluation

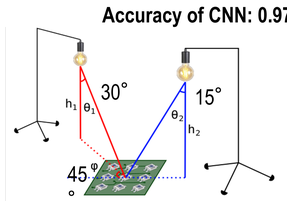


Two lights placed asymmetrically





Accuracy of CNN: 0.97



Scan the QR code to watch the demo