Low Power Embedded Gesture Recognition Using Novel Short-Range Radar Sensors

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Gestures Recognition Based on Short-Range Radar

This work proposes a low-power high-accuracy embedded hand-gesture recognition targeting battery-operated wearable devices using low power short-range radar sensors. A 2D Convolutional Neural Network (CNN) using range frequency Doppler features is combined with a Temporal Convolutional Neural Network (TCN) for time sequence prediction. The final algorithm has a model size of only 4572 parameters, yielding a memory footprint of only 91KB. Two datasets containing 11 challenging hand gestures performed by 26 different people have been recorded containing a total of 20210 gesture instances. On the 11 hands, gestures and an accuracy of 87% (26 users) and 92% (single user) have been achieved. Furthermore, reducing the gesture to 5 we achieved up to 98.9% in accuracy. Finally, the prediction algorithm has been implemented in the GAP8 Parallel Ultra-Low-Power processor by Greenwaves Technologies, showing that live-prediction is feasible with only 21mW of power consumption for the full gesture prediction neural network, without the sensor consumption.

Increasing research on radar for gesture recognition1,2,3

Google developed micro-radar for gesture recognition

Good results on difficult hand-gestures: 90% accuracy on 11 gestures and 10 people

Implement radar based hand-gesture recognition in embedded system

Create dataset with fine-grained hand-gestures

–at least 1000 samples per class and 20 users

Algorithm suitable for embedded systems

– less than 1MB, at least 700x smaller than I. w. Soi

Achieving similar accuracy as I. w. Soi

– 85% (single-user), 87% (10 people) on 11 Gestures

Algorithm implementation in GAP8 PULP processor and experimental evaluation on efficiency (power, run-...