



2019 Embedded Human Activity Recognition Design Contest

15 October 2019

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Release Date: 5/1/2019

Motivation and Background

Human Activity Recognition (HAR) has been a very active research field since it is the first step to monitor, diagnose, and cope with movement disorders [1]. Rise of smartphones and wearable devices enabled many new embedded system solutions on these platforms. However, access to common set of experimental data has been a major obstacle that prevents breakthrough in this area. According to the International Technology Work Force on Parkinson's Disease, two major technology barriers are lack of compatible platforms and isolated research efforts [2]. We are organizing the First Embedded Human Activity Recognition (HAR) Design Contest to stimulate research and innovative solutions towards practical IoMT for health monitoring.

What is Provided to the Participants?

One of the major barriers to HAR research is access to labeled data sets. To this end, we developed an open source wearable IoT platform for health and activity monitoring [3]. Using our prototype, we performed user studies with 22 users while they performed the following daily activities: *Go down stairs, Go upstairs, Jump, Lay down, Sit, Stand, Walk*. The following dataset from these experiments will be provided to the participants:

1. Raw 3-axis accelerometer data
2. Raw stretch sensor data
3. Activity labels for the raw data
4. Example features for each labeled activity window
5. A baseline reference HAR classifier [4] implemented in Matlab using this data

We provide precise time stamps and activity windows in contrast to coarse data sets collected by non-real-time platforms, such as smartphones. This is the only data set that has stretch sensors data. It is also one of the largest publicly available data sets.

What Will Be Submitted?

The goal of the contest is to design energy-efficient HAR classifiers. The participants can start either with the raw data (items 1-3 above) or use the example features provided to them (item 4 above), which will lower the barrier to entry. The designs can be submitted in one of the following categories:

Category-1: An embedded implementation on TI CC2650 MCU or a compatible IoT device



- Designs in this category will be evaluated based on classification accuracy, execution time per activity, and energy consumption per activity

Category-2: An FPGA implementation

- Designs in this category will be evaluated based on classification accuracy, execution time, and area

All submissions must include

1. One slide executive summary
2. Two-page description of the design
3. Their project source files (C, Verilog, or VHDL)

Presentation at the Conference:

The proposed contest will feature both presentations and demonstrations of the top designs in each category. The tentative outline is provided below:

1. Introduction of the Contest (*10 min*)
2. Background on Human Activity Recognition (*10 min*)
3. Announcements of the winners in each category (*5 min*)
4. Presentations of the selected entries (*45 min*)
5. Demonstrations of selected designs (*20 min*)

Tentative Dates:

Registration to the Contest: May 22, 2019 – July 1st, 2019 (*this step is required to receive the datasets*)

Design Submission Deadline: July 21st, 2019

Notifications: August 17th, 2019

References:

- [1] J.-F. Daneault, "Could Wearable and Mobile Technology Improve the Management of Essential Tremor?" *Frontiers in Neurology*, vol. 9, pp. 257:1–257:8, 2018.
- [2] A. J. Espay, et al., "Technology in Parkinson's Disease: Challenges and Opportunities," *Movement Disorders*, vol. 31, no. 9, pp. 1272–1282, 2016.
- [3] G. Bhat, R. Deb and U. Y. Ogras, "OpenHealth: Open Source Platform for Wearable Health Monitoring," in *IEEE Design & Test*, March 2019, doi: 10.1109/MDAT.2019.2906110
- [4] G. Bhat, R. Deb, V. V. Chaurasia, H. Shill, and U. Y. Ogras. "Online Human Activity Recognition using Low-Power Wearable Devices", in *Proc. of Intl. Conf. on Computer-Aided Design (ICCAD)*, Nov. 2018.