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Motion spy- vibration energy harvesting sensor can track train passengers using machine learning techniques

Today's mobile devices are equipped with a range of embedded sensors. These sensors can be used to infer contextual information such as location, activity, health, etc. and thus enable a range of applications. Recent research has demonstrated that applications with access to data collected from GPS, accelerometer and even device battery profile can accurately track the location of users as they move about in urban spaces. In recent years, vibration energy harvesting (VEH) has emerged as a viable option for mobile devices to address the inadequacy of current battery technology. VEH harnesses power from human motions and ambient sources and it could be used as a motion sensor. This is due to the fact that different ambient vibrations and human motions produce a unique pattern of energy in the VEH circuit. In this paper, we reveal that VEH signal contains rich information and it is possible to precisely identify the trip using machine learning techniques. A typical train ride consists of episodes of continuous motion interspersed with brief stoppages at train stations. Our key hypothesis is that the train tracks between any two consecutive stations create a unique vibration characteristic that is reflected in the VEH data and we model it using machine learning techniques. Then, we leverage the sequential nature of a trip to correct the occasional segment misclassifications and ultimately infer the entire trip. To demonstrate our hypothesis, we collected real-world motion data from 4 distinct train routes in the Sydney metropolitan area. Our data set includes motion data from 36 trips. To exploit a thresholding-based segmentation algorithm and extract the individual segments, we employ different machine learning classifiers and ensemble classifier achieves accuracy of 60.9% for identifying individual segments. Finally, we use the sequential properties of a train trip and achieve a trip inference accuracy of 97.2% for a journey of 7 stations.

Biography

Marzieh Jalal Abadi has completed her PhD at University of New South Wales (UNSW) in 2016 and joined data61-CSIRO as Research Associate in 2017. Her research is in machine learning, sensory data, IoT and cybersecurity.

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