Collecting inertial signals from smartphones for the IGS database

M. Berenguer, M.J. Bouzid, D. Cibaud, H. Teyssier, F. Evennou, N. Noury. ***Collecting inertial signals from smartphones for the IGS database.*** *Gerontechnology 2014;13(2):167;* doi:10.4017/gt.2014.13.02. 125.00 **Purpose** The Inertial Global System (IGS) project was launched at Orange Labs to investigate into the use of inertial signals collected from smartphones. We identified 4 applicative domains: Health (monitoring of activity, assessment of autonomy, fall prediction); Professional (lonely worker); Consumers (sport, leisure, 'digital coach'); and Handicap (moving aids). We describe in this paper the elaboration of a database of inertial signals, which are collected on smartphones worn by elderly subjects during long periods (3 months). This database will be used for developing a toolbox of signal processing blocks, to detect postures, indoor and outdoor geo-location, and classify activities. **Method** The algorithms we have developed for the smartphone (Android Operating System) collect raw signals from 3 sensors (tri-axis accelerometer, magnetometer and gyroscope) at a 30 Hz sampling frequency, and transmit every hour to the server through a 3G path. The energy consumption of algorithms was optimized to reach 8 hours of duty every day, including communications. Since the walking signal is easily detected (a periodic signal within 0.5-2.5Hz), and performed vertically, the orientation of the smartphone is corrected using quaternions[1], and signals are recalibrated within the body reference (Z vertical, X and Y horizontal). Geolocalisation is based on trajectory reconstruction from the inertial signals (accelerations for horizontal displacements, and magnetometers for directions of displacements).The data processing algorithms, formerly developed under Matlab[2], were transposed under Python for better portability on the server. The experiments also included ergonomic aspects to assess the acceptability of the smartphone and investigate the need for future services. We recruited 8 subjects (3 male, 5 female), aged 64 to 90 years old (mean age 76 yr) living in either a flat or a detached house. Each of them agreed, after signing a consent form, to wear a smartphone all day long for a period of 3 months. **Results & Discussion** All subjects were compliant and wore the smartphone for a mean wearing period of 9h32mn each day and a mean of 95 days. All users understood the explanations about handling the smartphone (to wear and to charge it). Most users found the device easy to use (two considered it bulky and women would prefer to wear it on the wrist or in a handbag). After 1 month, three participants wore it in their pocket and three wore it on a shoulder strap. After 2 months, no usage modifications were noted. This experiment allowed us to collect an important database of real life signals (~20 GigaBytes). This large amount of data raised technical problems for storing large amount of data (Big Data Model), time of transfers, and relevance of the data over time (conservation). The implementation of the service is simple and easy, requiring no infrastructure at home, since everything is in the smartphone.

References

1. Fleury A, Noury N. 29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society 2007; pp 2311-2314; doi:10.1109/IEMBS.2007.4352788
2. Noury N, Quach KA, Berenguer M, Bouzid MJ. 2012 IEEE 14th International Conference on e-Health Networking Applications and Services (Healthcom) 2012; pp 423-426; doi:10.1109/HealthCom.2012.6379452

Keywords: housing & daily activities, inertial sensors, smartphone, real life database.
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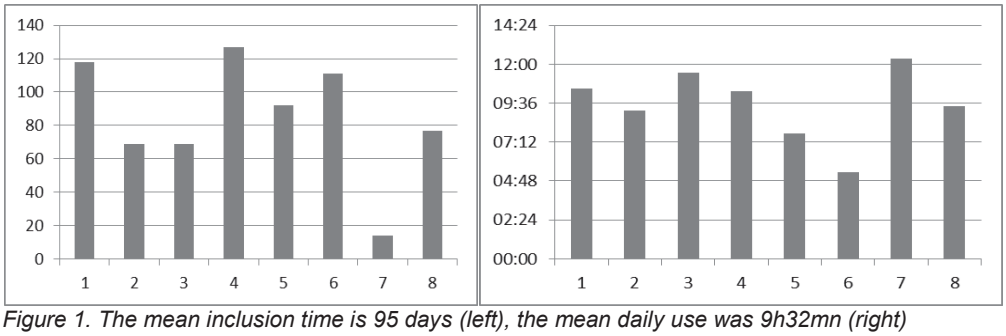

Figure 1. The mean inclusion time is 95 days (left), the mean daily use was 9h32mn (right)