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center za prenos tehnologij in inovacij
na Institutu "Jožef Stefan"

Licensing opportunity

Context-based human activity recognition using a single wearable sensor

Field of use
01003003 Artificial Intelligence (AI)
01004001 Applications for Health

Current state of technology
Stage of Development: Prototype available for demonstration

Patent status
TBA

Publication
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Jožef Stefan Institute

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Background

Slovenian researchers are offering a software solution that uses a single wearable sensor to recognize user's activity by exploiting the context of the current activity. The technology is useful in mobile computing, sport, elderly, medical rehabilitation and other human activity related applications. Companies interested in licencing in the technology and research partners interested in further joint development of the technology through research or technical cooperation agreements are sought.

Description of the Invention

The presented approach recognizes the user's activity by exploiting its context provided by sensor data. In order to accurately recognize the current activity, the approach uses not only the data segment for that particular activity, but also the context of the current activity, i.e., the data segments before and after the current activity.

Accurate activity recognition may have many technical effects. For example, if an intelligent system installed at a subject's home (i.e., smart home) is aware of the subject's activity, it may adapt to his/her needs. For example, if the subject is sitting and watching TV in the living room and the lights are on in the kitchen, the system may first adjust the temperature in the living room and then turn the lights off in the kitchen. Furthermore, detection of a fall activity can automatically trigger an emergency phone call. Regarding the sensor's battery life, which is limited, a detection of static activity, i.e. sitting or lying posture, may put the sensor in an idle state, and, consequently, contributes to a longer battery life.

A typical application of the offered approach would be activity-recognition system that uses a single accelerometer placed on the torso. Related approaches that recognize the activities by analysing only a single data segment (the current one) are failing in distinguishing two of the most common activities - standing and sitting. The approach overcomes this issue by additionally analysing the context of the current data segment. That is, it includes the segments before and after the activities. Using all these segments, it extracts multiple features (variables) that represent the context information. In the next step, each of these features is used as a context individually, for which multiple classification models are learned. Therefore, when a new activity is recognized, it is evaluated by multiple classification models, each model corresponding to the context of the user.

In order to illustrate the main idea of the approach, suppose there is an activity sequence consisting of: walking, transition down, sitting. The current activity of the user that needs to be recognized is sitting. The

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data segments for the sitting and the standing are similar; therefore a method that analyses only the sitting segment would have problems distinguishing them. However, because the method analyses the transitions and activities before the sitting, it would successfully recognize the sitting.

The researchers are looking for companies interested in licencing in the technology for implementation of the technology in their products and services. The companies should have the focus on, and capacity for, industrial-scale production in the area of mobile applications, security, smart home, sport/elderly/medical applications, sensor hardware development and/or sensor software development and other areas where context based human activity recognition might be implemented.

Research partners from universities / research institutions, interested in further joint development of the technology and implementation of the technology in the above mentioned areas through research or technical cooperation agreements are also sought. Their focus should be on research in the field of ambient intelligence, elderly support, eHealth and other areas where context based human activity recognition might be implemented.

The authors of the system are members of the largest research institute in Slovenia. They are internationally recognized experts in the fields of ambient intelligence, machine learning and data mining, language and speech technologies, computational intelligence and agent and multiagent systems. Their activity-recognition technology, which uses wearable accelerometers, has won the international EvAAL competition (Evaluating AAL Systems through Competitive Benchmarking).

Main Advantages

While using accelerometers to measure human activity has been attempted before, the invention presents a method that improves upon related work by a unique characteristic to operate using the context of the subject's activity.

Recent research and activity recognition applications (AR) show that wearable accelerometers are the most suitable for unobtrusive recognition of basic activities (sitting, standing, walking, running and similar). Furthermore, one of the best accelerometer placements for AR – and even more so for the applications built on top of AR, such as fall detection and human energy-expenditure estimation – is on the torso (chest or abdomen). However, two very common activities – sitting and standing – are difficult to recognize with such a placement and are usually mutually misrecognized and almost impossible to distinguish using standard AR approaches. The reason is that they do not differ in the torso orientation, so distinguishing them with a single accelerometer placed there is challenging.

The context-based approach overcomes this problem by including the context of the current activity, i.e., it analyses the data segments before and after the current activity. Current methods are more obtrusive by including more than one accelerometer and do not take the context into account. The approach is innovative and less obtrusive because it can accurately recognize the user's activities by using a single accelerometer placed on the torso.

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