Using Multiple Wearable Sensors Dynamically to Facilitate Activity Recognition

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Abstract

Multiple wearable sensors can be used to detect user activities, movements, and status through machine learning techniques. Sensors utilizing accelerometers are worn on the wrist, ankle, arm, lower back, and as a lanyard; in addition, a hand-held or holstered device with sensing capabilities is used as a master device. Sensors can be selectively used, and the system dynamically adapts to the sensors available to give the best possible activity classification for the user. Also, sensors can be dynamically disabled for power savings. The system can be used in package delivery, retail, healthcare, and exercise domains, and data can be synchronized with a computer or server.

Experimentation Setup

Training

- 11 Activities: Sitting, Standing, Lifting, Sweeping, Walking, Running, Carrying Boxes, Mopping, Stairs, Ladder, Pushing/Pulling Cart
- About 2 minutes of each activity per user
- 12 users for initial data collection

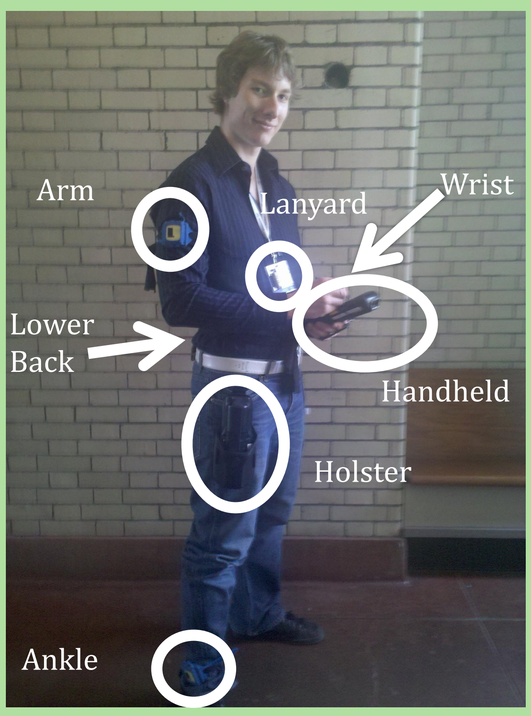
Testing

- Package delivery field test with 4 users

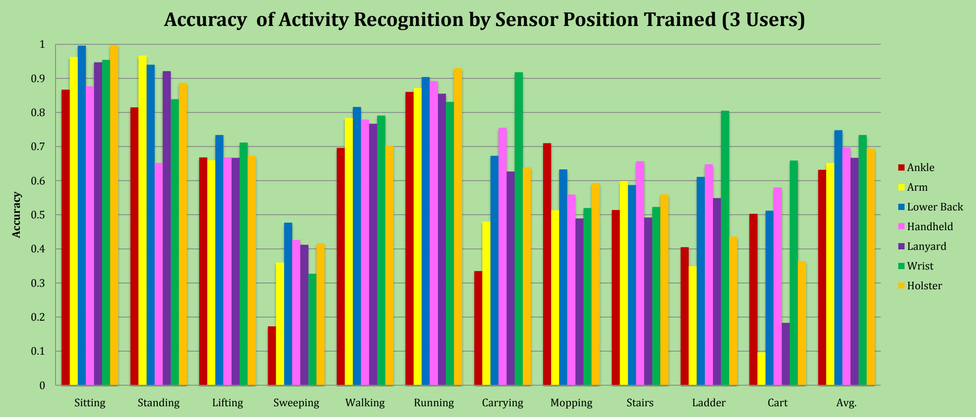
Sensor Positions

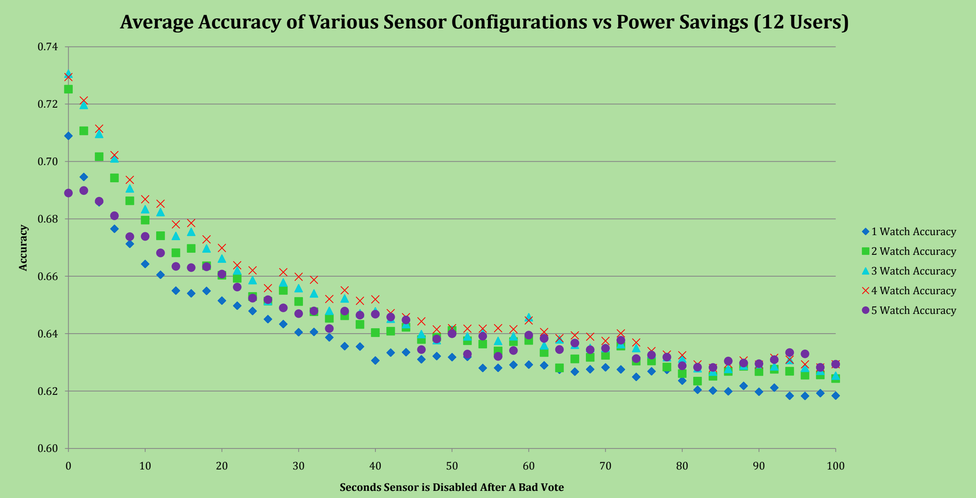
5 Wearable eWatch Sensors
- Arm
- Wrist
- Ankle
- Lanyard
- Lower Back

2 Motorola MC9500 Mobile Computers
- Handheld
- Holster

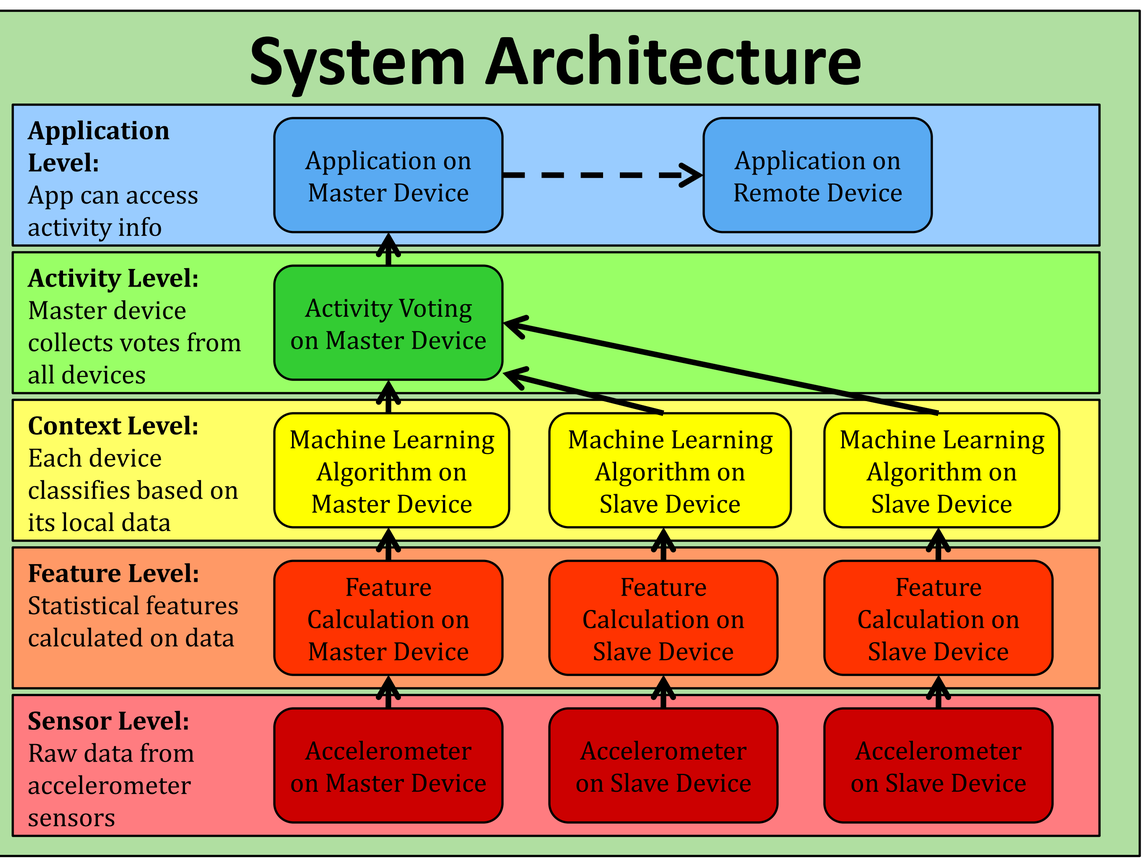


Results





System Architecture



Conclusions and Future Work

Sensor Location

- Depending on the activity, various locations have increased accuracy relative to other sensors, so the aggregate voting scheme should be tailored to give sensors with greater confidence more weight for a given decision.

Activity Recognition

- More complex activities with multiple components like sweeping are harder to discern than purer activities like sitting.

Future Work

- Compare various machine learning algorithms
- Variable sampling frequencies
- Lower system power usage

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