Umass mHealthLab: Campus-scale Testbed for Real-time Wearable Sensing and Analytics

**Deployment**: Ongoing deployment of campus-scale testbed with 500-1000 subjects with continuous data from wearables and mobile devices.

**Platform**: Scalable platform for streaming data collection from wearable sensors, massively parallel logging, real-time analytics and visualization.

**Scalability**: Support for thousands of users and devices, diverse machine learning analytics, real-time feedback and interventions.

**Analytic**: Ingested data immediately available to Machine Learning libraries, live sensor visualizations and dashboards.

**MOSAIC: Research Interests and Capabilities**

- Large-scale testbed for data collection, algorithm development, and field validation of MOSAIC.
- Scalable open-source platform and real-time machine learning analytics on multi-modal sensor streams; real-time interventions.

**Research Areas**

**Machine Learning for Mobile Health**

- **Sensor data analysis**: Wireless ECG morphology extraction using Conditional Random Fields (CRF) and CRF + Context Free Grammar (CRF-CFG) models
- **Multi-modal inference**: Leveraging diverse sensors on wearables and phones using Dynamic Bayesian Networks and CRFs to improve detection accuracy.
- **Ground truth label availability**: Training event detectors using multiple-instance (MI) learning and Active Learning methods.
- **Lab-to-Field generalizability**: Domain adaptation techniques to handle covariate shift, prior probability shift and label granularity shift.

**Wearable Sensing & Health Applications**

- **Drug usage detection**: Real-time detection of cocaine use in the natural environment using chest worn ECG sensors.
- **Smoking and eating behaviors**: Detection of smoking/eating/drinking behaviors via wrist-worn sensors and hand-to-mouth actions.
- **Group dynamics sensing**: Understanding group dynamics via context sensing, bluetooth interactions and WiFi logs.
- **Fatigue detection**: Fatigue detection using custom-designed low-power computational eyeglasses.
- **Context sensing**: Combining location, time-of-day, physiology (pulse, GSR, ECG, eye movements), behaviors (via hand-to-mouth gestures) for continuous assessment.
- **Neurological, Neuromuscular, and Muscular skeleton disorders**: Novel sensors and remote monitoring systems for stroke, Parkinsons and Osteoarthritis.

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