USING SMART WEARABLE DEVICES FOR SEISMIC MEASUREMENTS AND POST-EARTHQUAKE RESCUE

SAN FRANCISCO STATE UNIVERSITY

J. Lok[1], B. Lopez[2], V. Samikeri[2], P. Amudala[2], Z. Jiang[3], X. Zhang[4]

Natural hazards such as earthquake can be catastrophic which causes destructive damages to structures and leads to loss of lives. With the advancement of technologies and internet-of-things (IoT), smart wearable devices equipped with advanced sensors can be utilized to capture the ground motions and assist in post-event rescue.

Embedded Sensors & IoT

Kinematic Sensors

Location Sensors

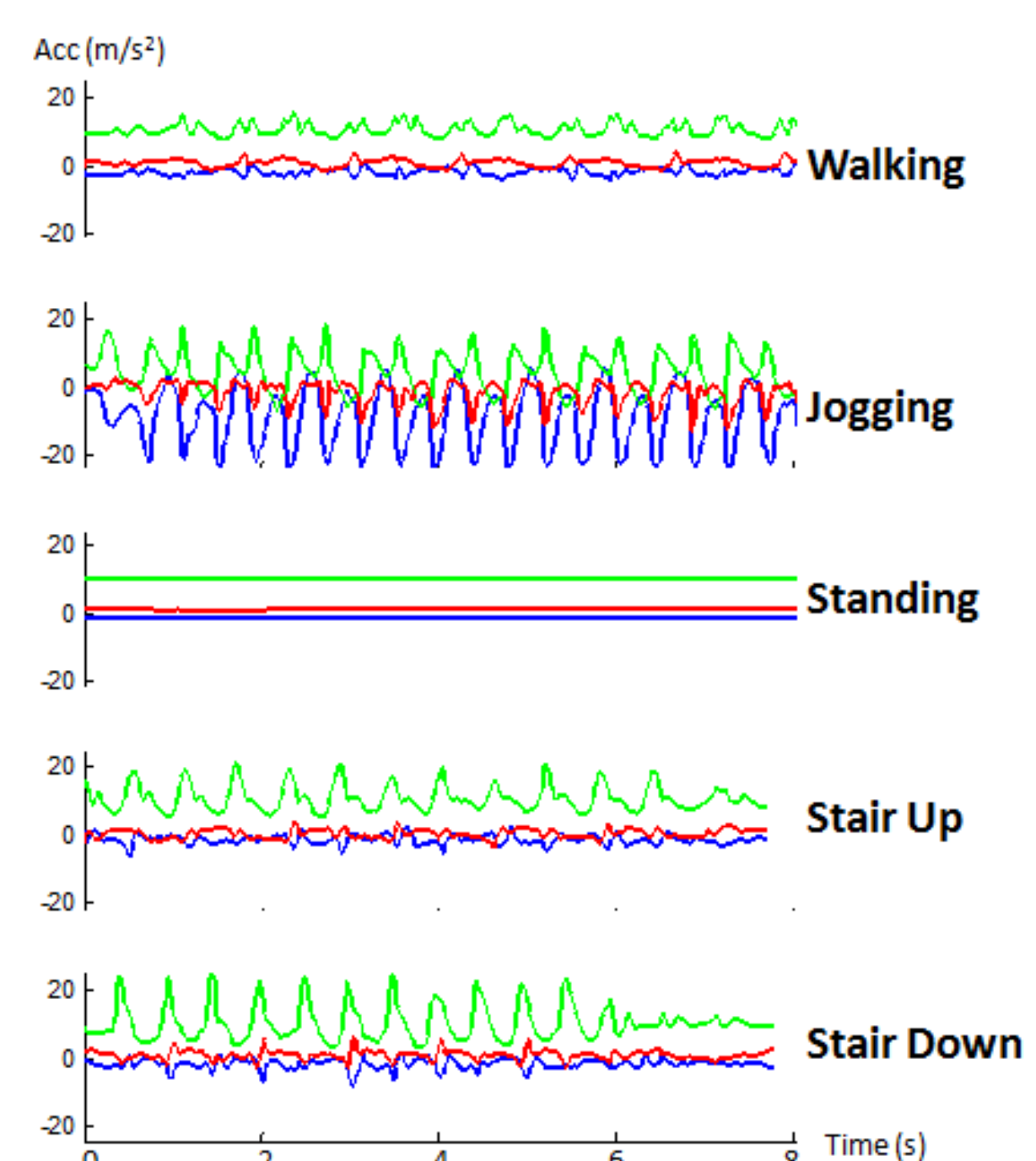Environmental Sensors

ON/OFF

Physiological Sensors

Cyber Life Straws – Post-Event Rescue

- Use information provided by physiological sensors and position sensors to trigger data collection and transmission, thus reducing the energy consumption

- Use physiological sensors to evaluate real-time health status

- Use location sensors such as GPS to determine location

- Use environmental sensors such as proximity sensors, ambient light sensors and temperature and humidity sensors to detect surrounding information

- Combine real-time health information and surrounding information to decide urgency of rescue
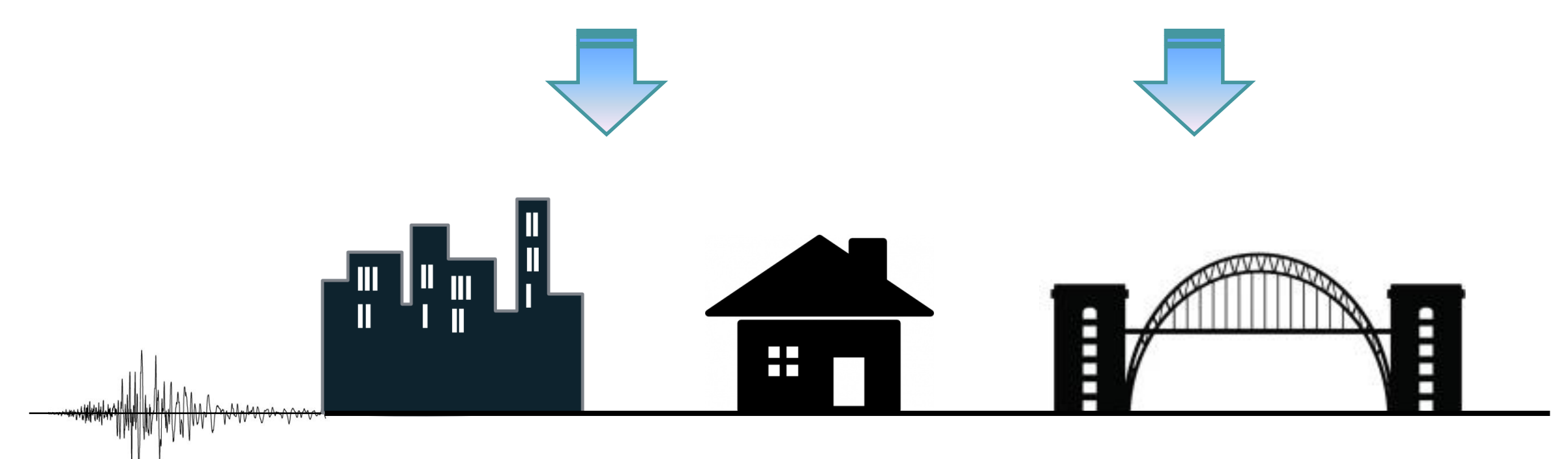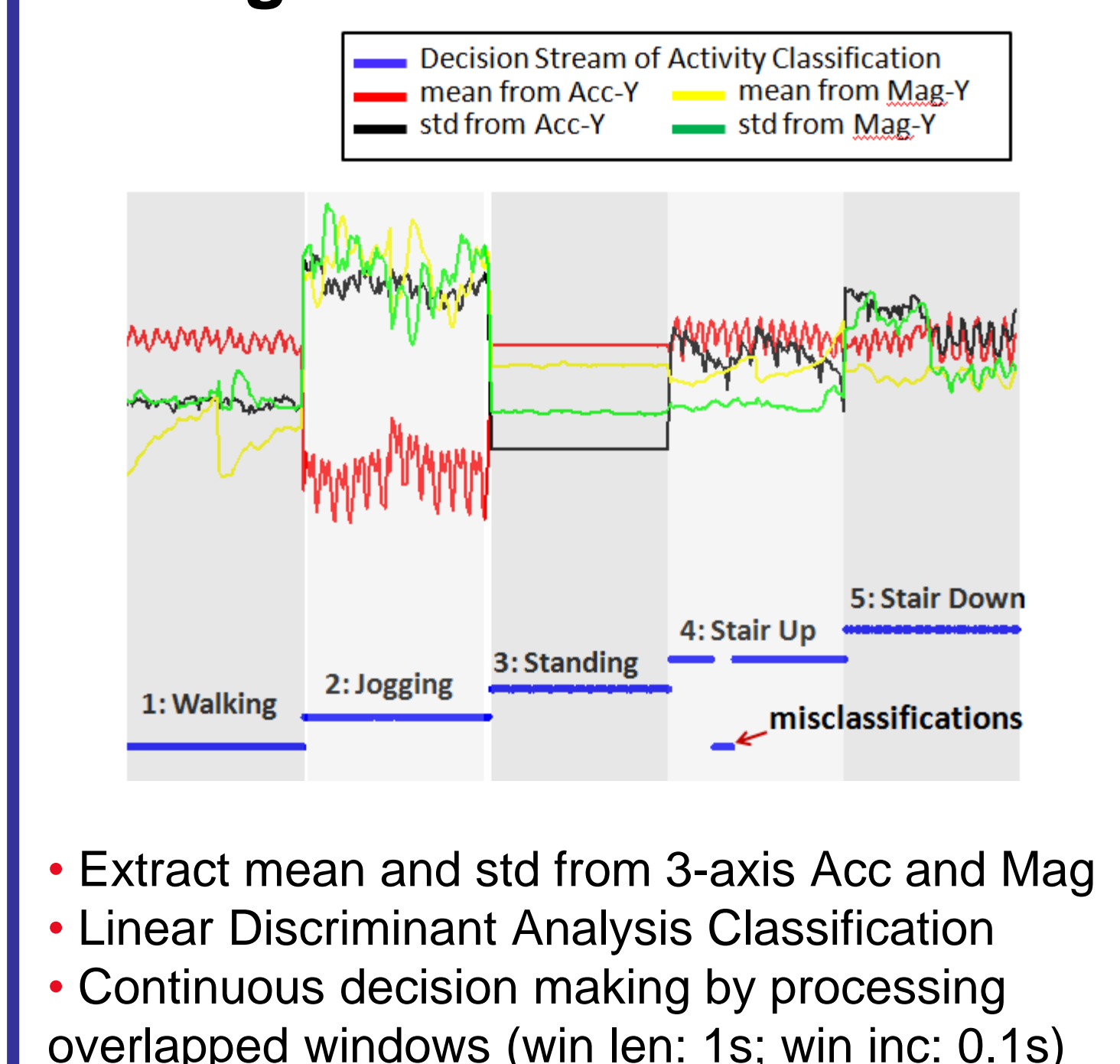
Activities Recognition

Carry-on Sensors – EQ Data Collection

- Humans are all around the world: bountiful sensors and large data sample

- Specific sensor measurements passed through the activates recognition are used to extract the earthquake ground motions

- The extracted earthquake information together with information obtained from traditional seismic station can be used by seismologists and structural design authorities

Accelerometer Data for Different Motion Activities

Acc (m/s²)

Walking

Jogging

Standing

Stair Up

Stair Down

Time (s)

Results of Activity Recognition Using Pattern Classification

Decision Stream of Activity Classification
mean from Acc-Y
std from Acc-Y
mean from Mag-Y
std from Mag-Y

1: Walking 2: Jogging 3: Standing 4: Stair Up 5: Stair Down

misclassifications

- Extract mean and std from 3-axis Acc and Mag
- Linear Discriminant Analysis Classification
- Continuous decision making by processing overlapped windows (win len: 1s; win inc: 0.1s)

[1] Student, Civil Engineering, School of Engineering, San Francisco State University.
[2] Students, Electrical and Computer Engineering, School of Engineering, San Francisco State University.
[3] Assistant Professor, Civil Engineering, School of Engineering, San Francisco State University; Corresponding author: zsjiang@sfsu.edu.
[4] Assistant Professor, Computer Engineering, School of Engineering, San Francisco State University.