Footbased Activity Recognition

Seminar: Interactive Analytics

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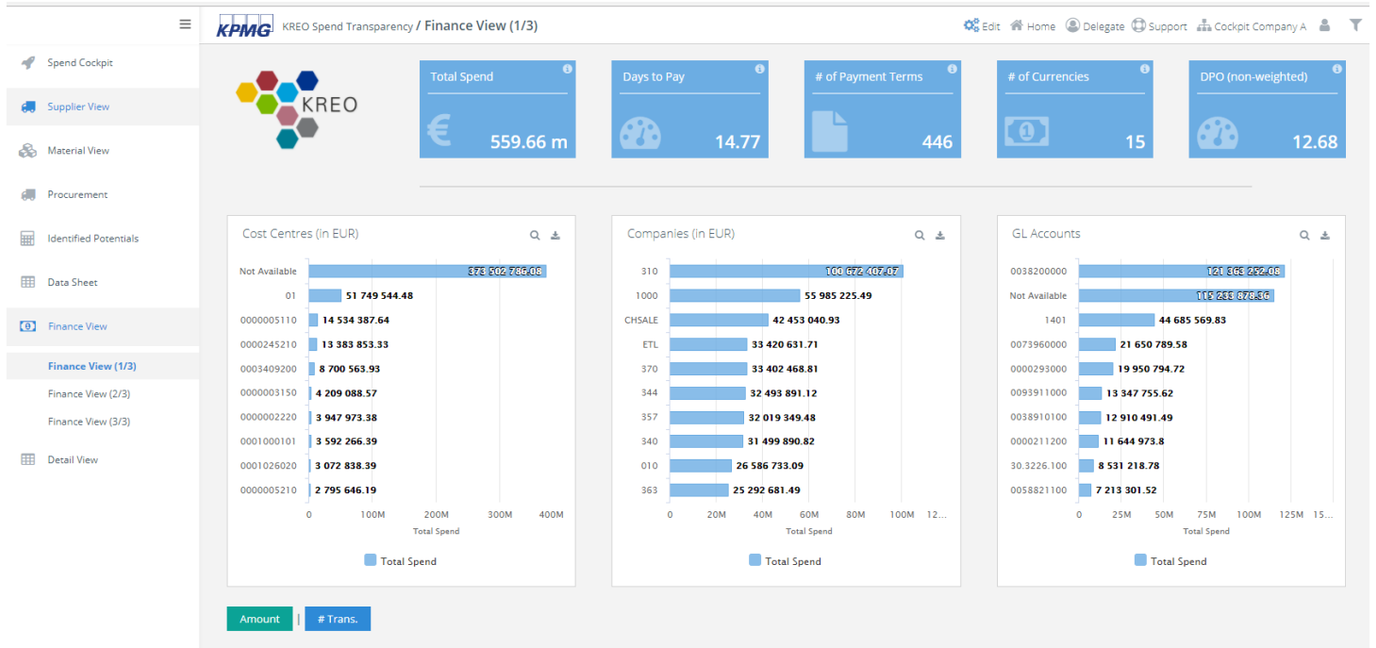
Goal

- Design a foot-based movement recognition system
- Controls can be mapped to interact with KPMG Dashboards and other applications (presentations, software development and others)
- We focus on usability and reliability in everyday use



Progress

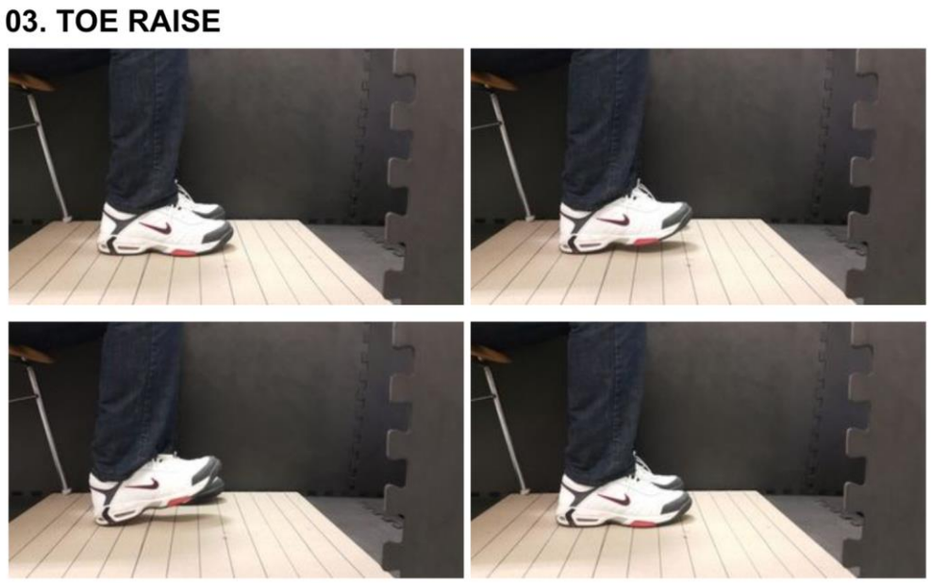
1. Brainstorm possible applications of our recognition system
2. Come up with user-friendly foot movements
3. Interface with provided sensors (Gyroscope, Accelerometer, Magnetometer)
4. Sample and visualize sensor data
5. Use machine learning on the data samples to differentiate between foot movements
6. Implement a graphical user interface (GUI)
7. Finish the documentation and create the final presentation

Possible applications

- The foot sensor can be used as an input device, similar to the use of a mouse or keyboard
  - Individual control binding enables a highly personalized use
  - Frees the hands
  - Use the sensor as a second mouse, which eliminates the need to take the hands from the keyboard

Movements

- Movements should be easy to use in an everyday office environment
- Planned movements (excerpt):
  - Toe and heel raise
  - One foot hover
  - Toe tap
  - Left and right side supination
  - Slides
  - Toe and heel rotation

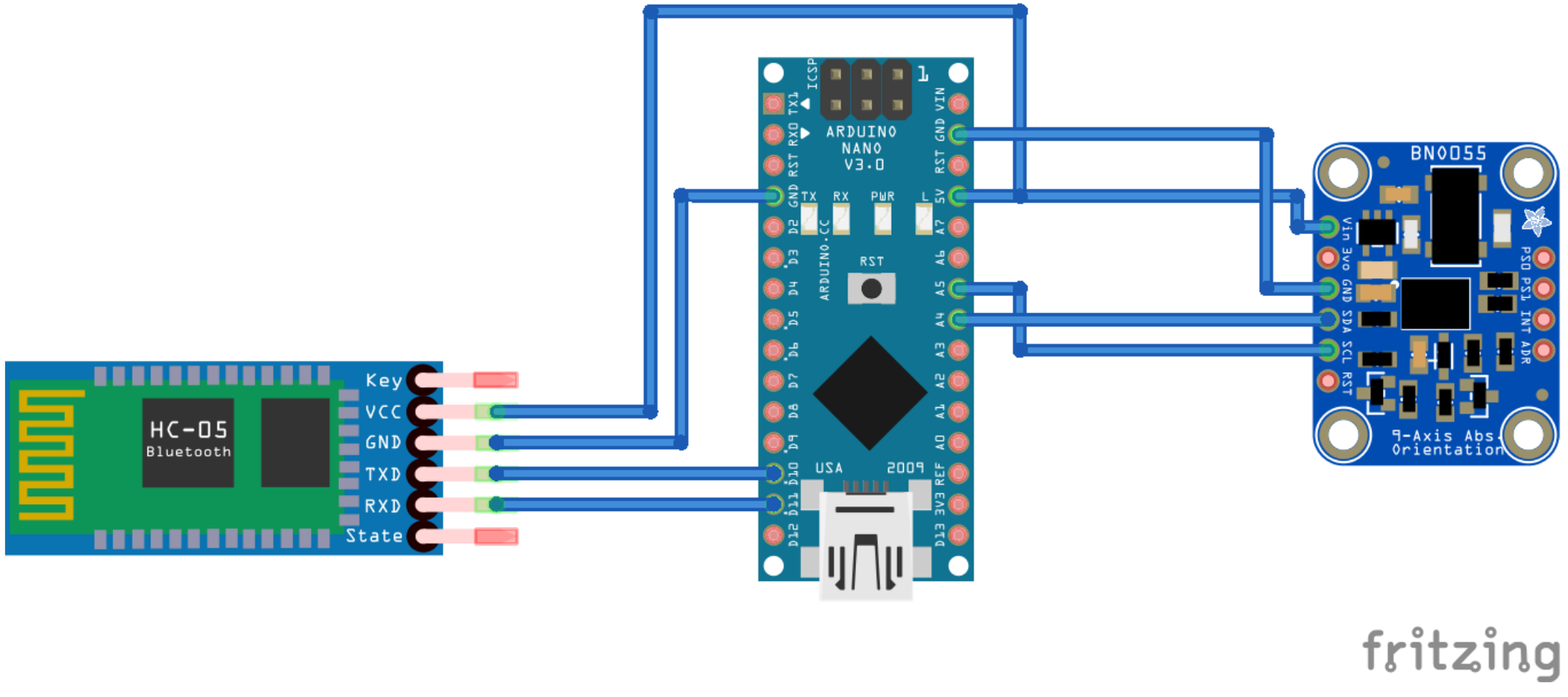


Movements

- Movements should be easy to use in an everyday office environment
- Planned movements and mapped actions (excerpt):
  - Toe and heel raise → zoom in or out on the dasboard
  - One foot hover → end current application (Alt + F4)
  - Toe tap → scrolling
  - Left and right side supination → scrolling
  - Slides → scrolling up or down
  - Toe and heel rotation → swipe to next or previous dashboard

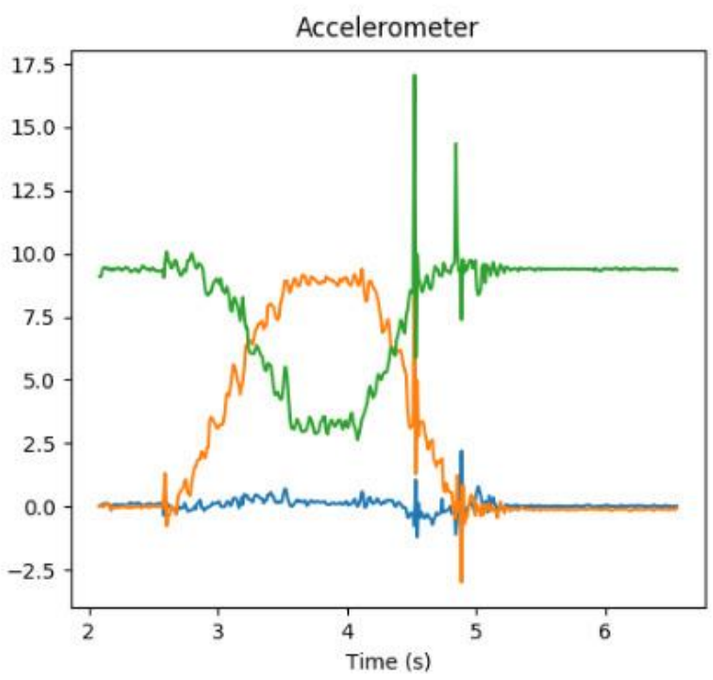
Hardware scheme

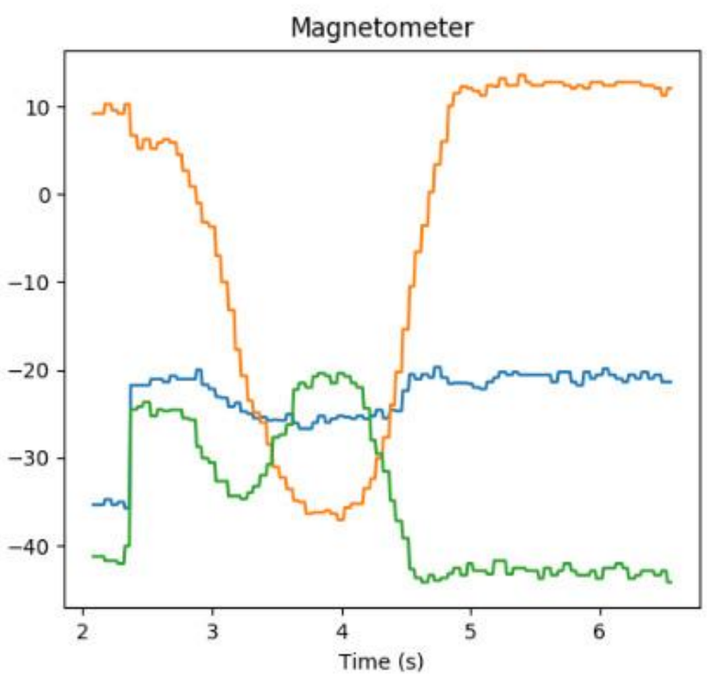
- Our Hardware consist of three components (left to right):
  - Bluetooth module, Arduino and the sensor module

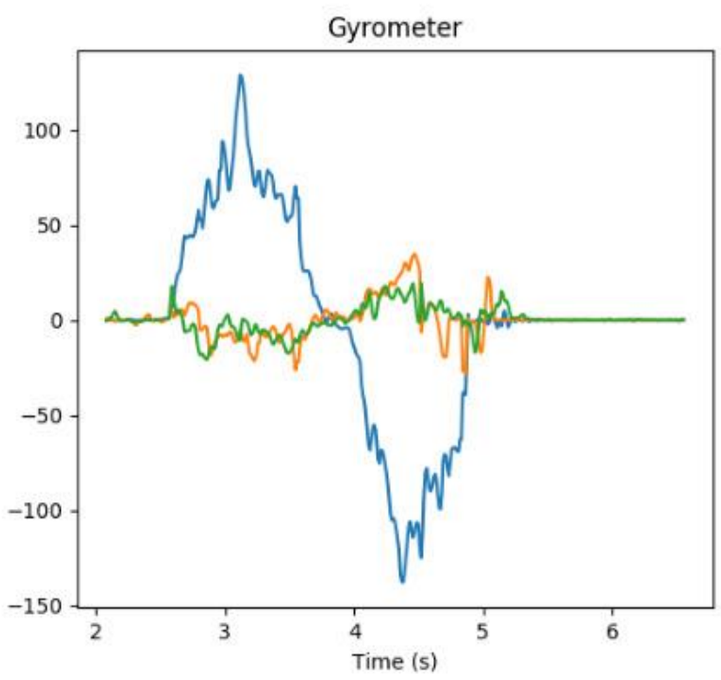


Sensor data output

- This is the data we receive from out sensor for the movement „suspination“
  - In the future the system can differentiate between the movements based on the data alone







Next Steps

- Finish implementing the (machine learning) pipeline

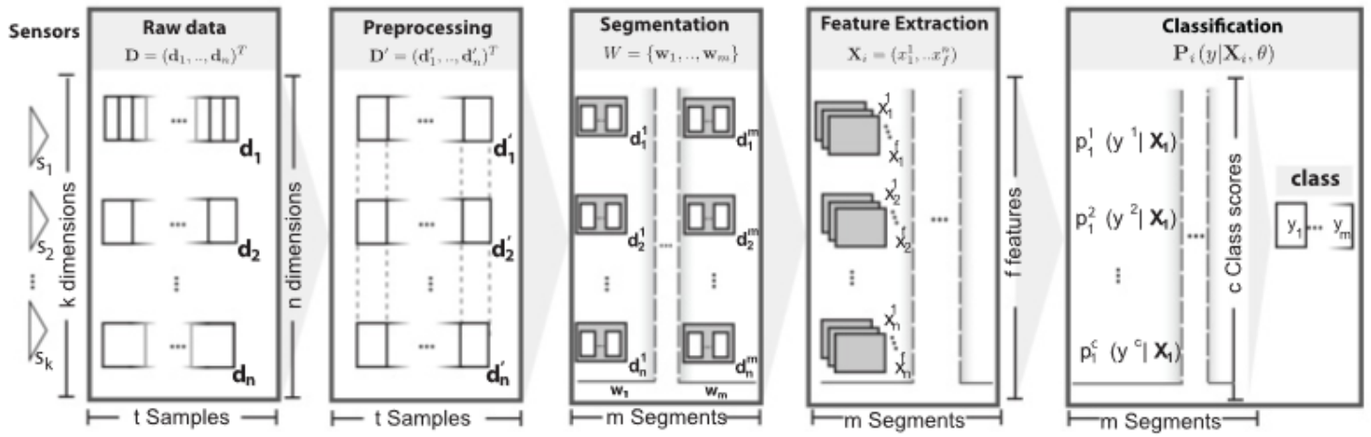


Fig. 1. Typical Activity Recognition Chain (ARC) to recognize activities from wearable sensors. An ARC comprises stages for data acquisition, signal preprocessing and segmentation, feature extraction and selection, training, and classification. Raw signals ($\mathbf{D}$) are first processed ($\mathbf{D}'$) and split into m segments ($\mathbf{W_i}$) from which feature vectors ($\mathbf{X_i}$) are extracted. Given features ($\mathbf{X_i}$), a model with parameters θ scores c activity classes $\mathbf{Y_i} = \{y^1, \ldots, y^c\}$ with a confidence vector $\mathbf{p}_i$.

- Implement a user interface
- Finish the documentation and create the final presentation