Greeting

- Good morning, dear members of the examination committee (and dear audience).
- My name is Martin Beneš.
- Welcome to my bachelor thesis defense.

Assignment

- Study the PIR sensors and recognition/classification.
- On basis of this knowledge design a theoretical system
  - Predefined fuzzy logic / artificial learning system
- With PIR sensor data scan the situation
  - Possibly the count of people.
- Implement the described algorithm.
  - Verify its functionality on real situation.

Design

- Client-server structure
- Client = sensor device
  - Responsibilities sensing and homogenous segmentation
  - Implemented with PIR STD (B+B Sensors) + NodeMCU
    - Advantage of ESP8266 on the board = WiFi embedded
    - Programmed using C++/Arduino
    - Configuration via HTTP API
  - Writes data to multicast channel
- Server = classification server (Monitor)
  - Responsibilities classification, presentation (and fusion)
  - Implemented in Python3 (easy prototyping)
    - Due to a number of libraries (NumPy, SciPy, MatPlotLib)

Feature extraction

- Let's continue to method description.
- Signal undergoes processing pipeline consisting of
  - Feature extraction + classification itself
- Signal is segmented into parts (artefacts) with similar character
  - The features are statistical attributes of each artefact
    - Mean, variance, interpolated line scale, length
  - To get those artefact
    - The edges were detected using CWT
    - Areas between edges formed primary segments
    - Neighboring segments merged with fuzzy logic

Classifier

- Based on linear regression
  - Multiple classifiers, each determining one attribute
    - Distance
    - Orientation
    - Side
- Spacial model of sensed area = matrix with fuzzy values
  - Formula for the index value is a polynome
    - Classifier outputs being variables
    - Coefficients characteristical for the index
  - Indices do not separate the space homogenously

Training

- Manual labelling
  - Reference of synchronized video frame
- Rather inaccurate
- Definitely a room for improvement

Postprocessing

- **Localization** = cluster analysis
  - K-means **vs.** Partitioning around medoids
- **Counting the people** = minimal within-cluster sum of squares

Results

- Posterior probability (percentage) of partial classifiers
- Evaluation:
  - How many positive samples were classified positive?
- Possible improvements to the future
  - Change the labelling method
  - Usage of multiple sensors
    - Fusion described theoretically, but not implemented