Kitchen Occupation

People counting using depth sensors.

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Objectives

1. Create a system to monitor room usage intensity, primarily focusing on student kitchens.
2. The system needs to be cheap and easy to install and maintain.
3. The system should provide real-time information about room usage intensity.

Introduction ??

- The Linköping University IT department wants to be able to measure room usage intensity, primarily the student kitchens, but also other spaces. In order enable informed decisions to be made on where to invest in e.g. a new kitchen

The system

- Hardware setup.
  - Stuff about the setup.
- Portability.
  - Stuff about supported sensors and platforms.
- Performance requirements.
  - Herpa derpa derpa.
  - derp herrrp derp.
  - Walla.

Placeholder

Image

Figure 1: Figure caption

Software

- The software pipeline
  - Suspendisse potenti. Fusce a est eget turpis rhoncus varius sed sed dui. Cras justo nibh, bibendum a cursus eget, consequat et dui. Maecenas vel nisl elit, sed dignissim dolor.
  - In hac habitasse platea dictumst.
- The GUIs
  - Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.
  - Proin in nisi diam.
  - Nam ultricies pellentesque nunc, ultrices volutpat nisl ultrices a.
- Configuration
  - Duis semper lorem eget dui dignissim porttitor.
  - Nulla facilisi. In ullamcorper lorem quis dolor.

Image Processing

- The depth images.
  - Duis ante erat, bibendum nec tempus nec, interdum quis est. Nulla at mollis tortor. Phasellus quis leo dolor, aliquam laoreet orci $\boldsymbol{X}$ Donec dapibus sagittis neque eu nec, interdum quis est. $\boldsymbol{Y}_n, \boldsymbol{n} = \boldsymbol{1}, \cdots, \boldsymbol{N}$ ndum nec tempus nec, interd

$$\boldsymbol{X} \rightarrow \boldsymbol{r}(\boldsymbol{X}) = \arg\max_{\boldsymbol{c}} \left\{ \max_{\boldsymbol{n}} \left\{ \sum_{\boldsymbol{x}_i \in \boldsymbol{X}} \boldsymbol{\delta}(\boldsymbol{x}_i, \boldsymbol{Y}_{n,c}) \right\} \right\}$$

  - Cras faucibus scelerisque cursus. Proin ut vestibulum augue. $\boldsymbol{\delta}(\boldsymbol{x}_i, \boldsymbol{Y}_{n,c})$
- Tracking and counting.
  - The tracker pairs objects with each other from previous frame to the next. Pairs closest matching objects. Handles occlution, outliers and noise.
  - Counting is done using user specified checkpoint lines and a door area.
- Queue detection.
  - detecting queues

Results: Table

- Final system performance

$$\boldsymbol{A}_{in} = \boldsymbol{1} - \left| \frac{\sum_{frames} \boldsymbol{in}_{Est} - \sum_{frames} \boldsymbol{in}_{GT}}{\sum_{frames} \boldsymbol{in}_{GT}} \right| \quad (1)$$

$$\boldsymbol{A}_{out} = \boldsymbol{1} - \left| \frac{\sum_{frames} \boldsymbol{out}_{Est} - \sum_{frames} \boldsymbol{out}_{GT}}{\sum_{frames} \boldsymbol{out}_{GT}} \right| \quad (2)$$

Sequence Name	Total entered (GT)	$\boldsymbol{A}_{in}$	Total exited (GT)	$\boldsymbol{A}_{out}$
Data seq. 1	108 (108) people	99 %	101 (104) people	97 %
Data seq. 2	122 (141) people	87 %	77 (91) people	85 %

Table 1: System performance in the two evaluation sequences

- Data seq. 1 & Data seq. 2 are two data sequences of 30 minutes each.

Results: Figure

Placeholder

Image

Figure 2: Resulting accuracy

Conclusion

- The system provides high-precision people counting using the Microsoft Kinect sensors.
- The software architecture enables fast implementing and testing of different algorithms.
- SOMETHING MORE

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