

Shoppers detection analysis in an intelligent retail environment

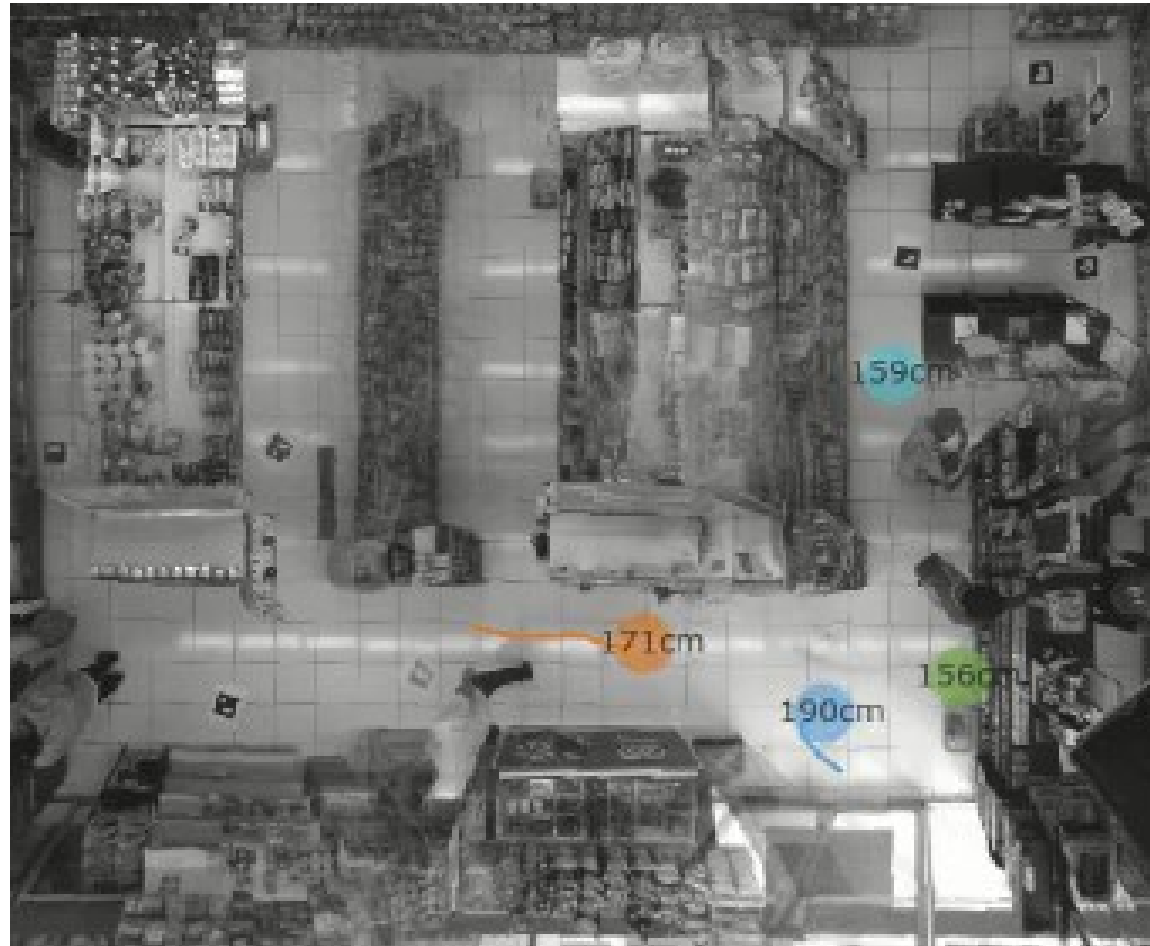
Rocco Pietrini, PhD

R&D Engineer @ Grottini Lab



11/01/2020

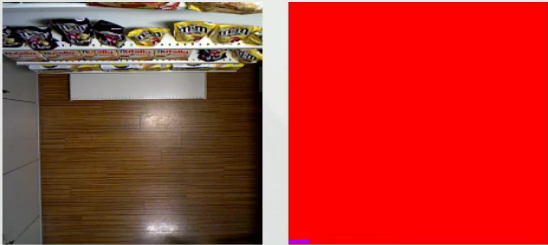
Shopper Analytics – State of the Art




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Shopper Science Lab

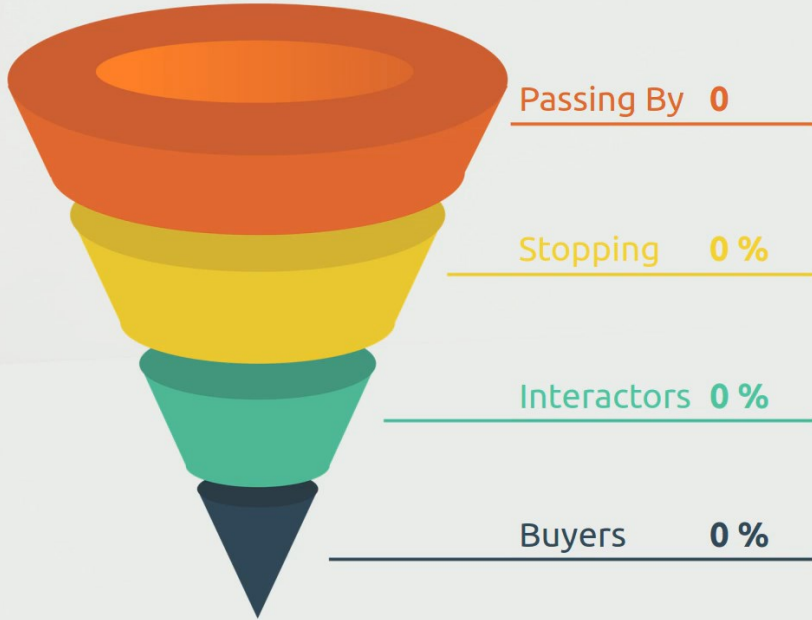
Sensor Views



Interaction Map



Conversion Funnel



Grottinilab
Communicating with the future

Pause Stop Exit

Shopper Analytics – State of the Art

HaDa (Hand Dataset)

- 13856 images (RGB+Depth)
- 3 months, 10 shelves in 4 categories
- Manual annotation
- Publicly available: <http://vrai.dii.univpm.it/hada-dataset>



Positive



Negative

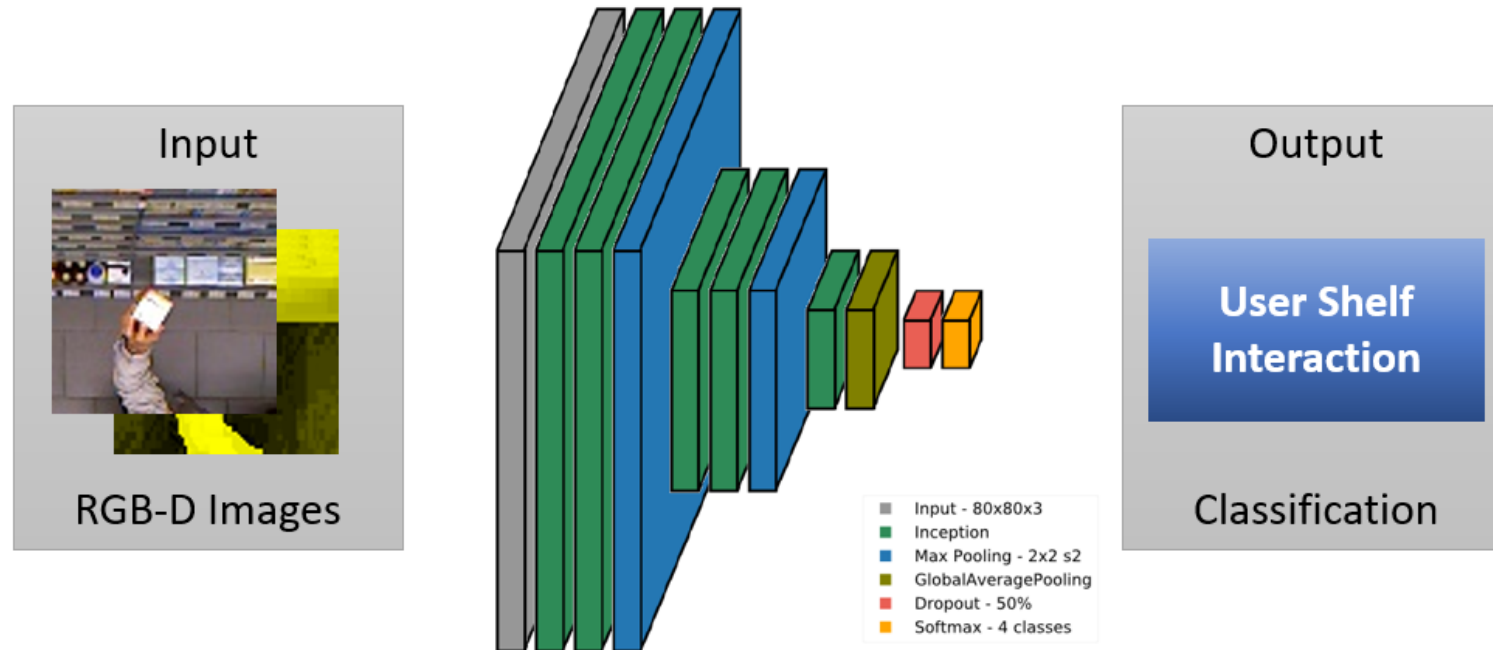


Neutral



Refill

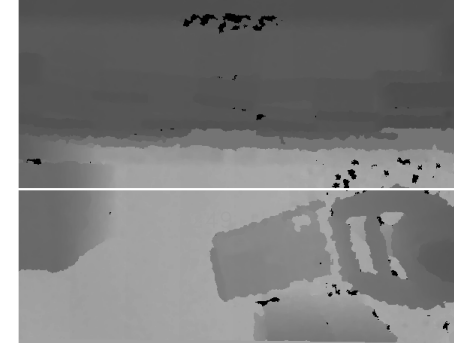
Shopper Analytics – State of the Art



Paolanti M., Pietrini R., Mancini A., Frontoni E., Zingaretti P.: “Deep understanding of shopper behaviours and interactions using RGB-D vision”, In: Machine Vision and Applications, 2020/11

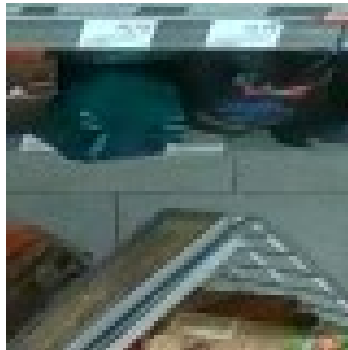
Shopper Analytics – State of the Art

- Accuracy on classification 93%
- Unintentional interaction exclusion (22% of the test set)
- Refill detection

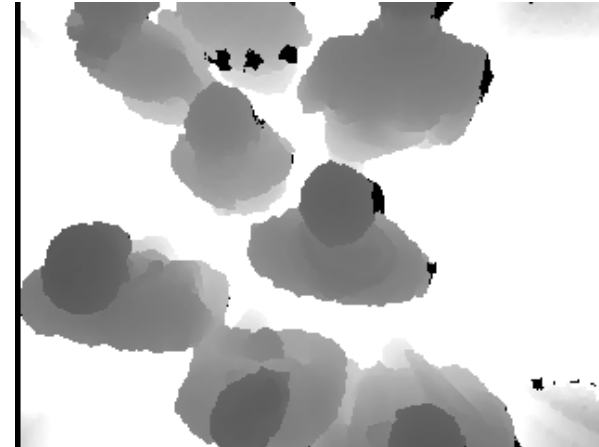


Approach	Loss	Accuracy	Precision	Recall	F1-Score
CNN	0.3775	0.9186	0.8395	0.8340	0.8367
CNN2	0.7773	0.8611	0.8620	0.8611	0.8616
AlexNet [86]	0.6115	0.7993	0.8164	0.7711	0.7928
CaffeNet [87]	0.7608	0.8731	0.8768	0.8720	0.8743
NASNet [88]	0.3316	0.9089	0.9124	0.9078	0.9300
Xception [89]	0.3362	0.9002	0.9066	0.8959	0.9011
VRAI-Net 2	0.2251	0.9260	0.9347	0.9254	0.9300

Problems



Unclassifiable interactions



Overcrowding

Desiderata

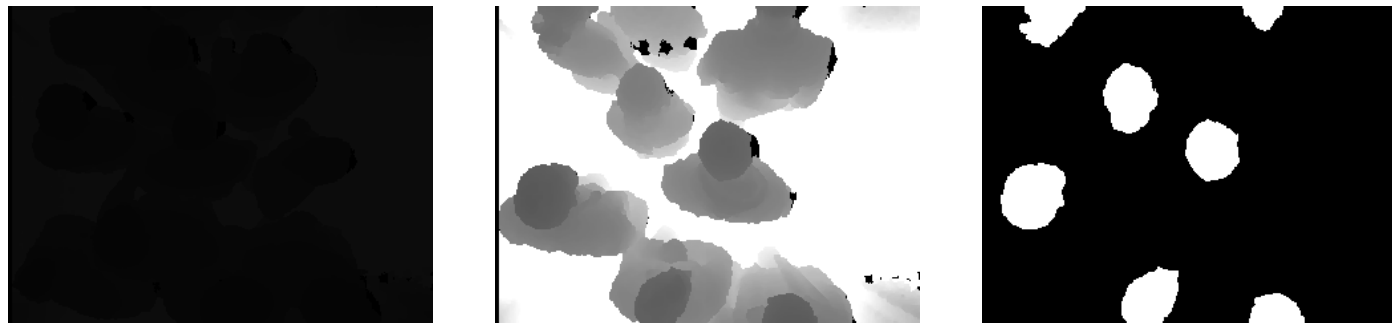
- Run on Edge -> Real time performances
 - Preserve privacy
 - Reduce network traffic
 - Low cost hardware scalability
- Non intrusive installation in existing stores



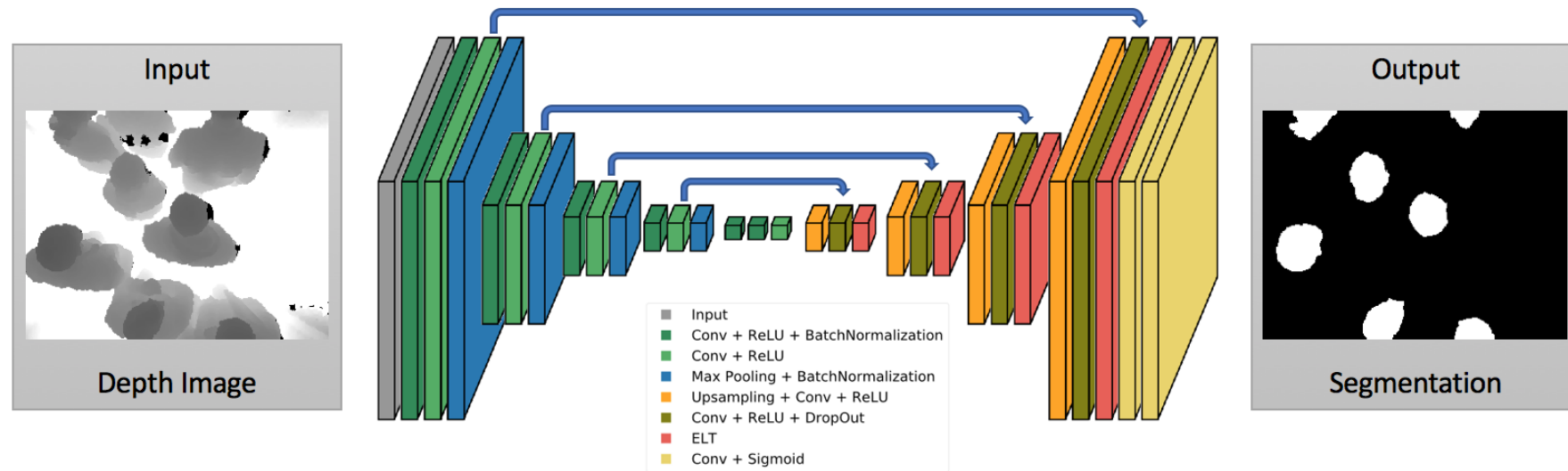
TVHeads Dataset

TVHeads (Top-View Heads Dataset)

- 1815 depth images (16+8bit)
- 320x240 px
- Manual annotation (segmentation)
- Publicly available: <http://vrai.dii.univpm.it/tvheads-dataset>



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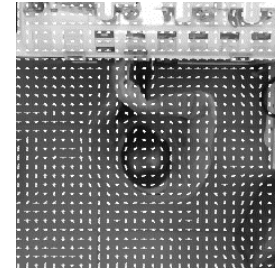
New Dataset



Negative examples

Positive examples

SVM Classifier on HOG Features



Input Image



Preprocessing



HOG Features



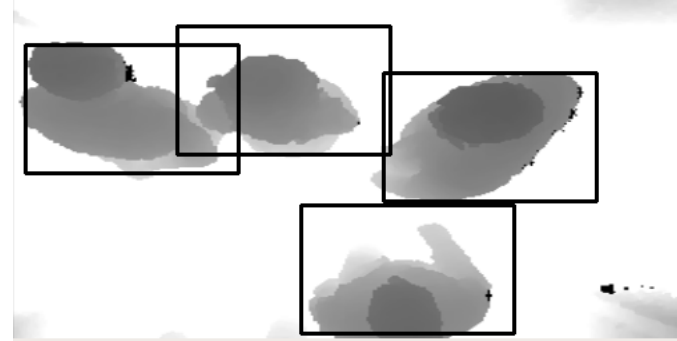
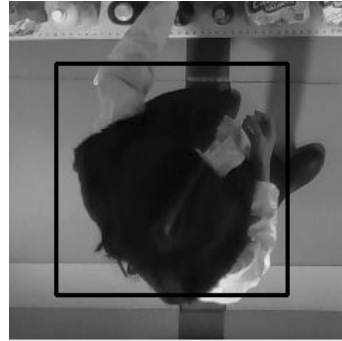
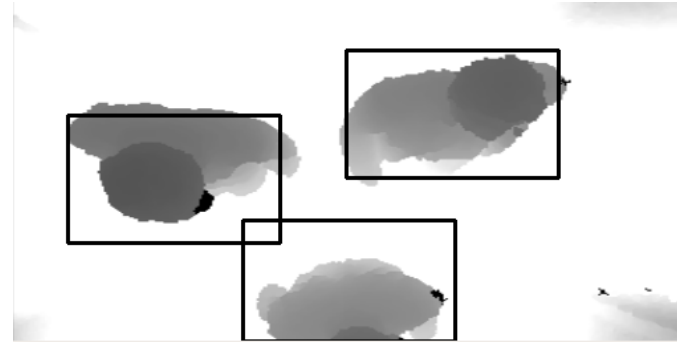
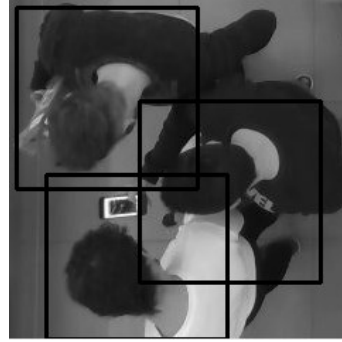
SVM Classifier



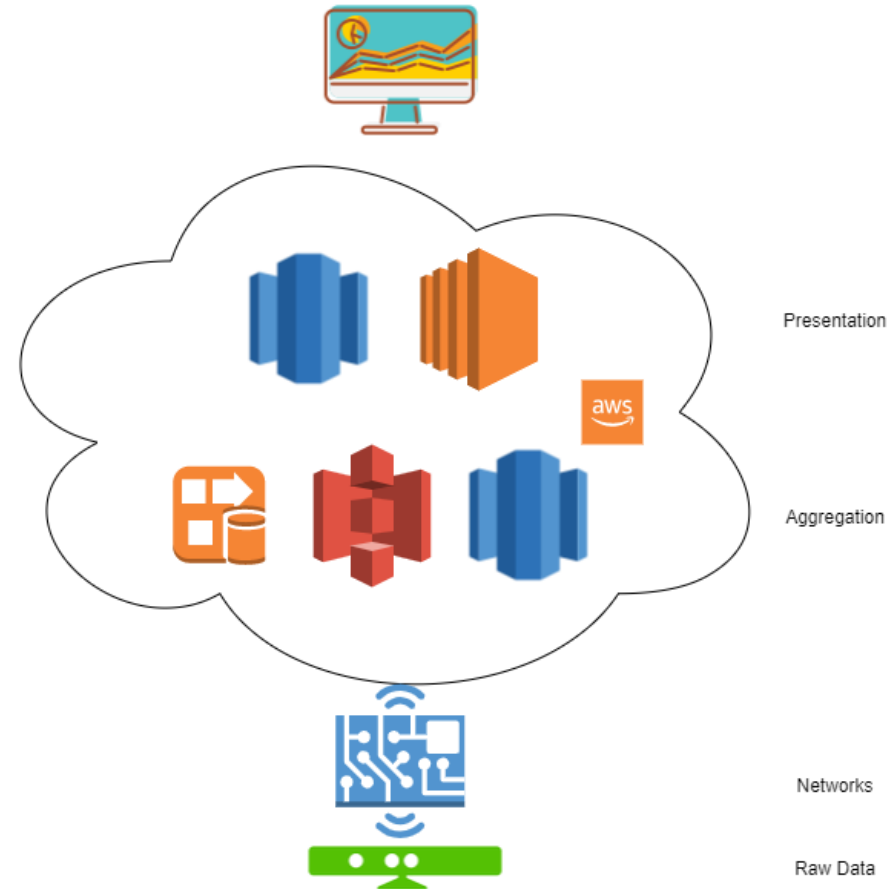
People/Not People

- Linear Kernel
- ϵ -SVR

SVM Classifier on HOG Features



Deployment



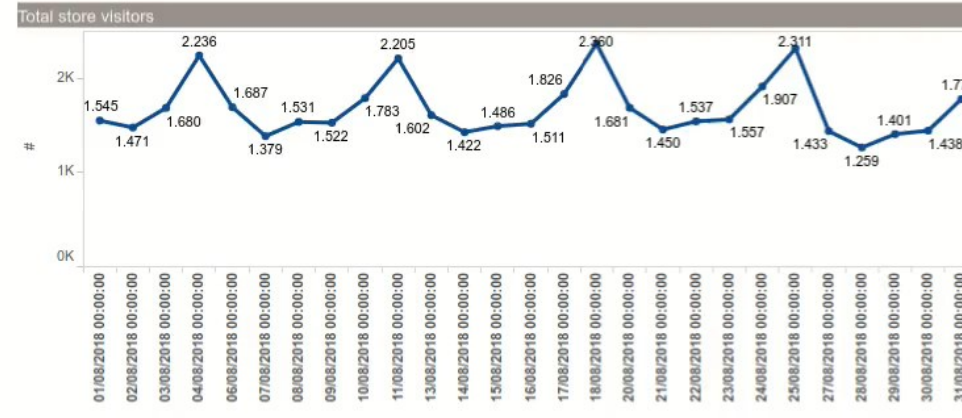
Deployment

COCKPIT STORE VISITS FUNNEL + HORIZONTAL HEATMAP VERTICAL HEATMAP +

Cockpit

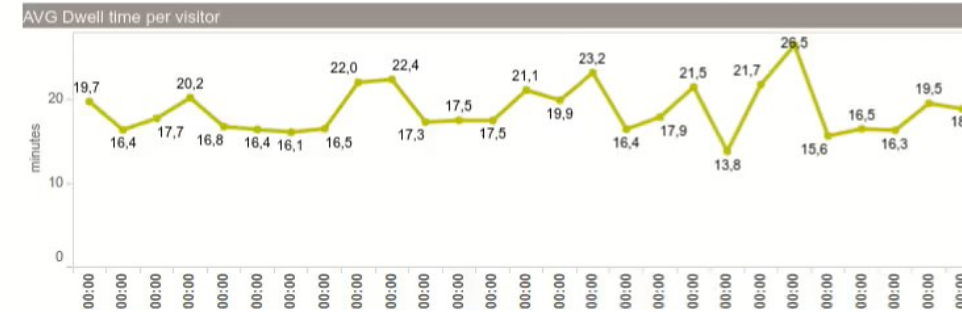
Selected period: 01/08/2018 07:00:00 - 31/08/2018 21:00:00
 Aggregation level: days

Full store metrics



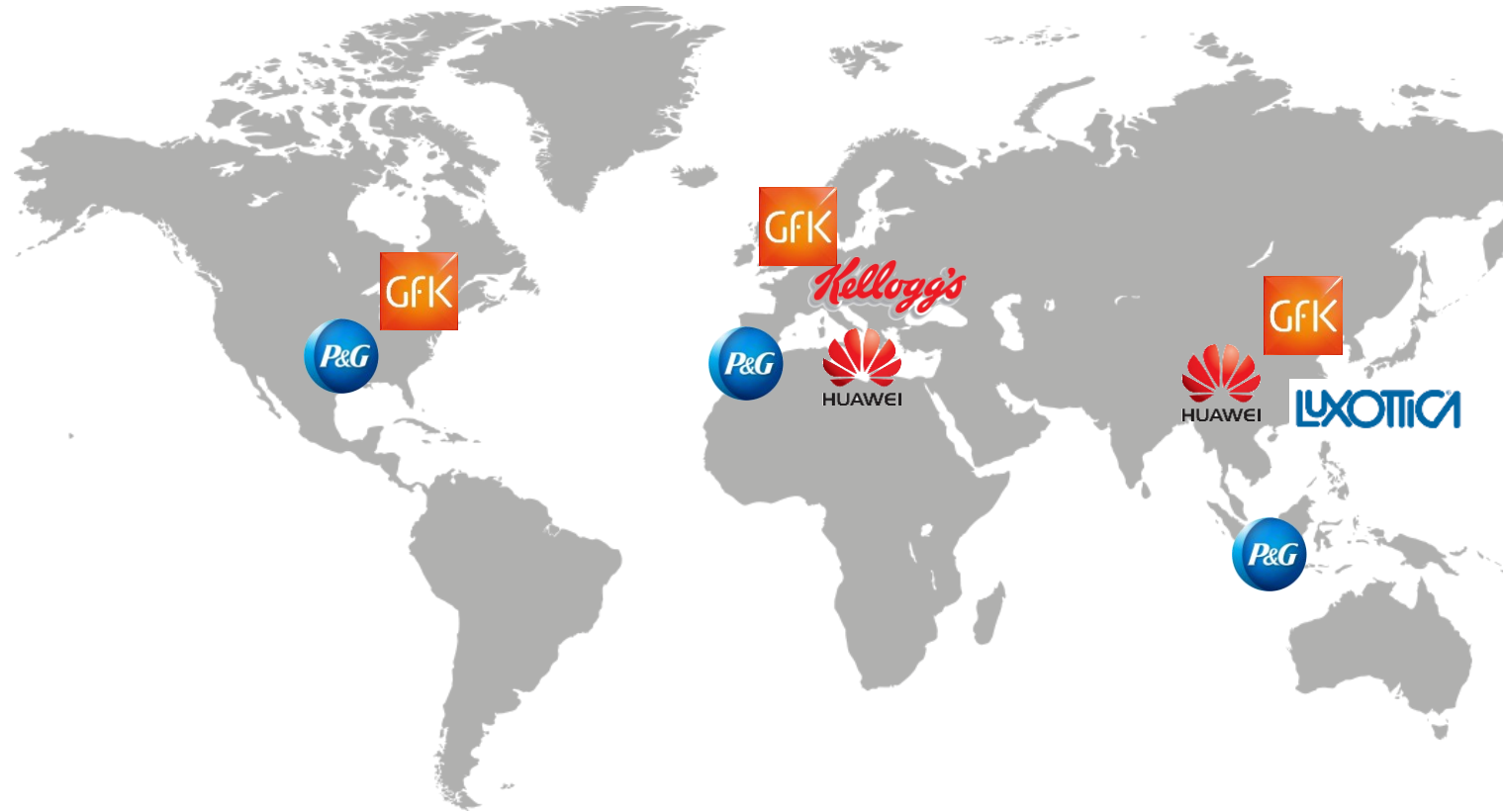
Total store visitors

44.993



Overall AVG d.t.

Deployment



Collected Data
2016-2020

People
20.327.710

Interactions
2.404.788

Conclusion and Future Work

Understanding shopper behaviors is challenging! The high variability in data and the lacks of datasets together with privacy concernings asks for real time accurate on-edge systems.

- Move frame based methods to action detection
- Extend datasets and algorithms for better generalization

Thank you!

Rocco Pietrini
rocco.pietrini@grottinilab.com