

Konark: A RFID based system for enhancing in-store shopping experience

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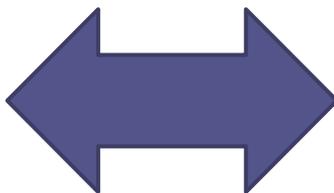
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Motivation

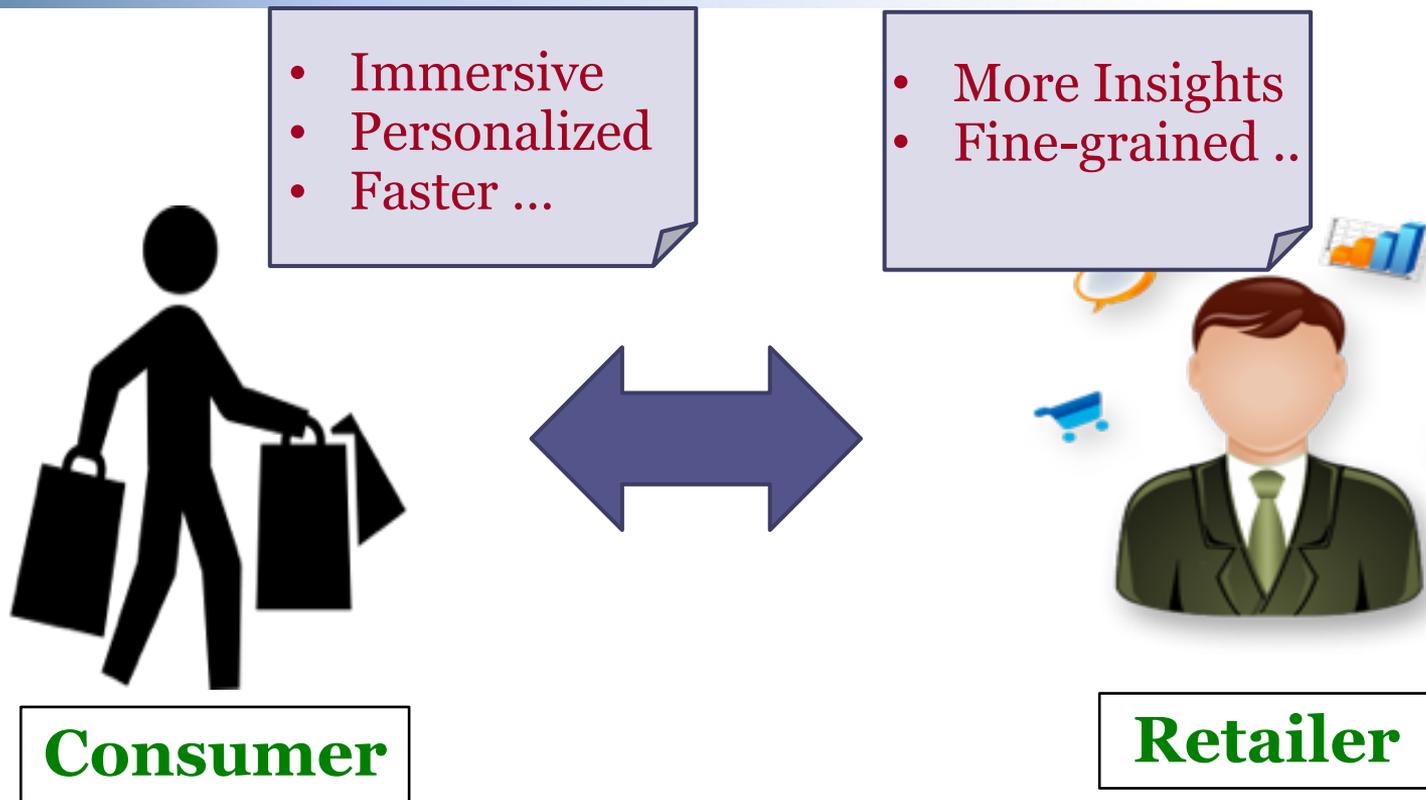


Consumer



Retailer

Motivation



Overview

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- Creating a RFID based system to provide
 - ***Better consumer shopping experience***
 - ***Richer retail analytics***

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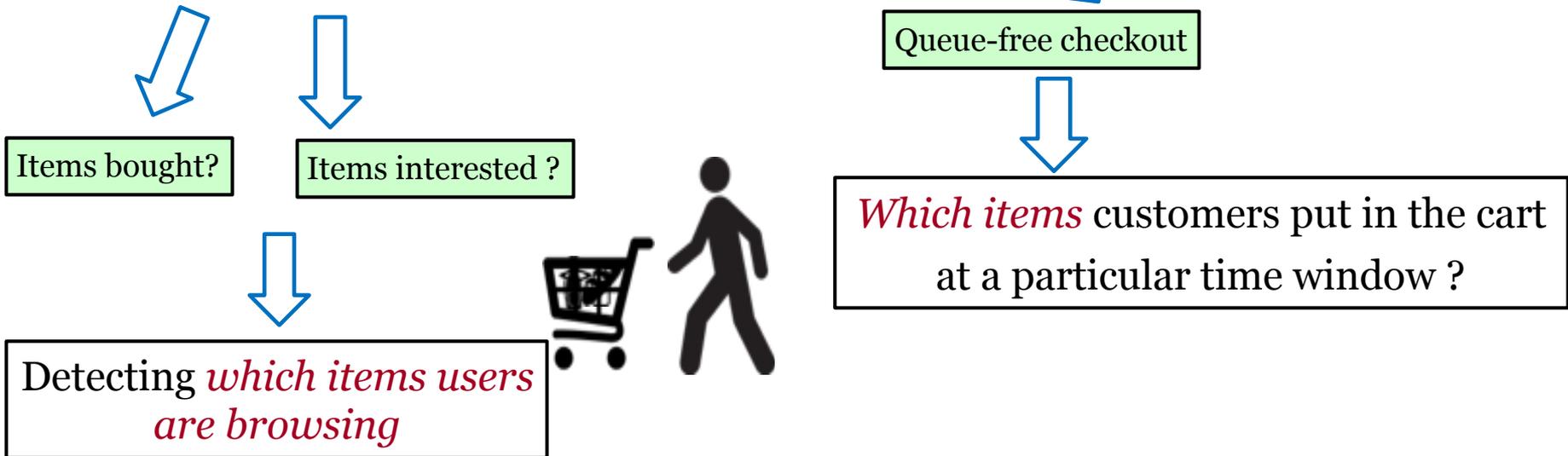


Queue-free checkout

Which items customers put in the cart
at a particular time window ?

Overview

- Creating a RFID based system to provide
 - *Better consumer shopping experience*
 - *Richer retail analytics*

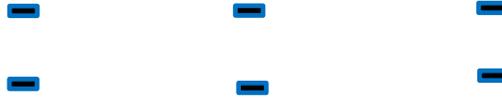


Our Work

Our Work

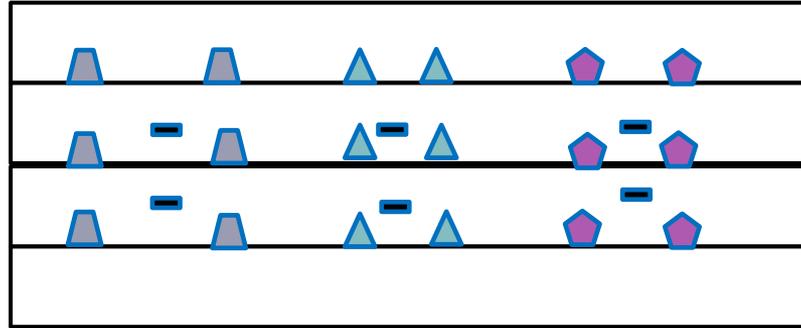
Building a RFID reader and antenna equipped
shopping cart and
developing **algorithms** to *detect items inside the cart*,
and to **detect users'**
browsing interests *on-the-go*.

Detecting Items Inside the Cart



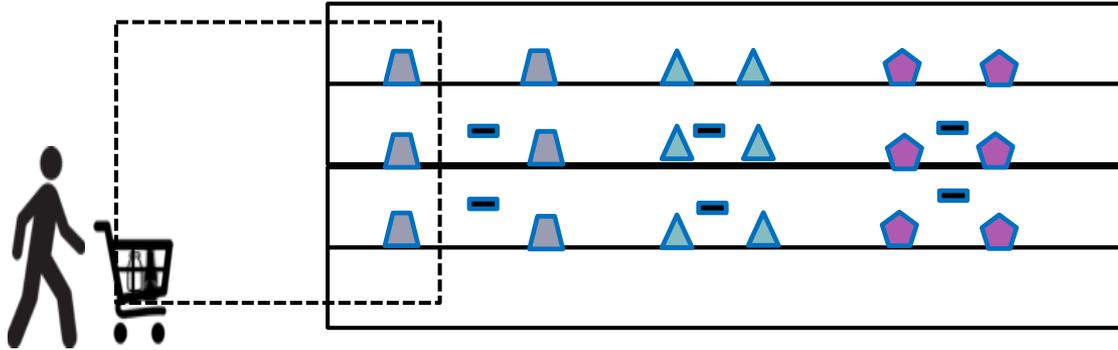
Detecting Items Inside the Cart

Key idea



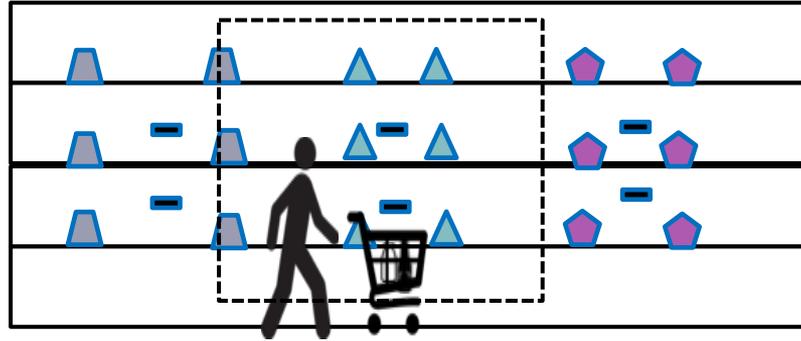
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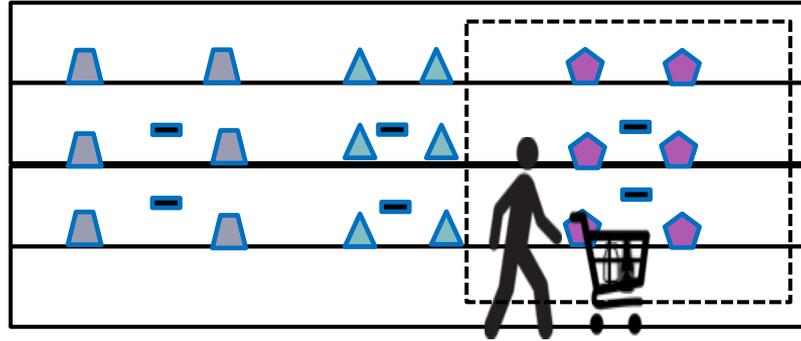
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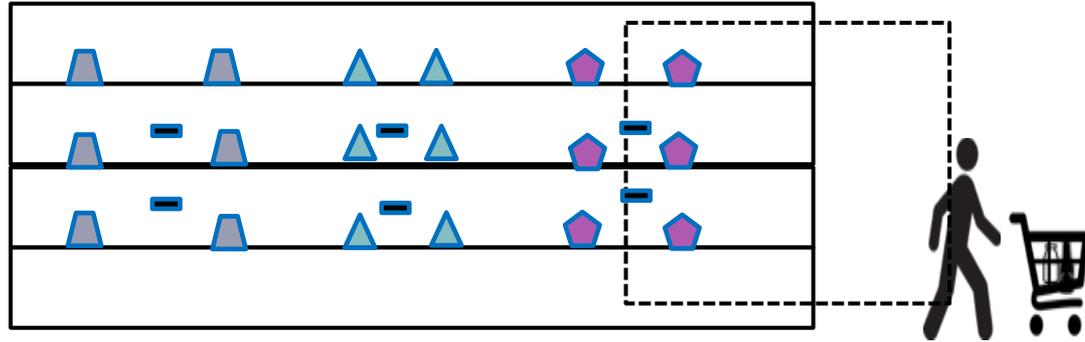
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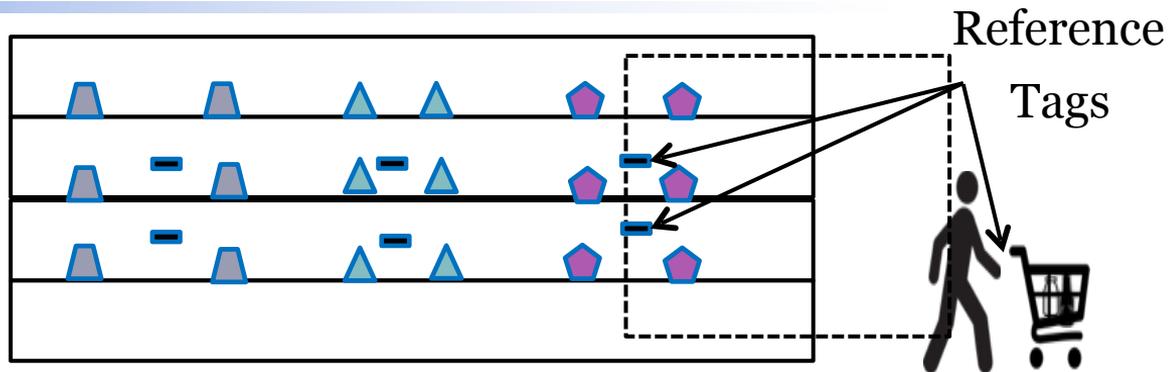
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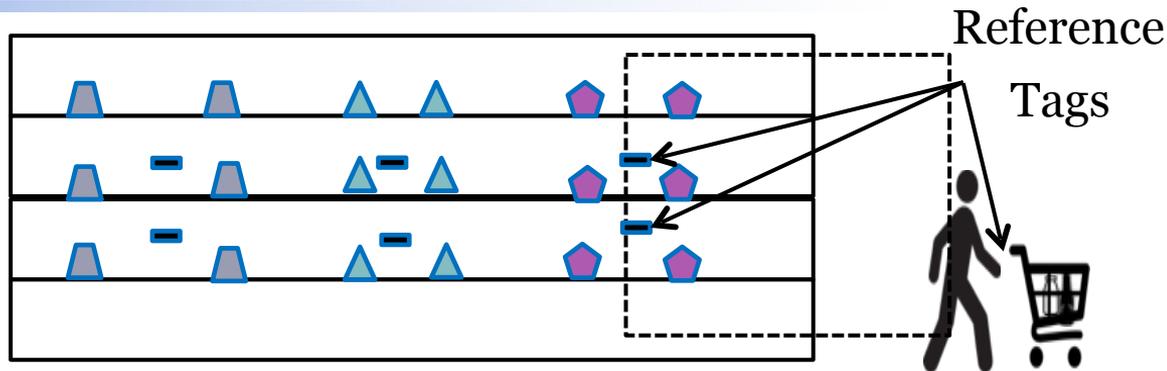
Detecting Items Inside the Cart

Key idea



Detecting Items Inside the Cart

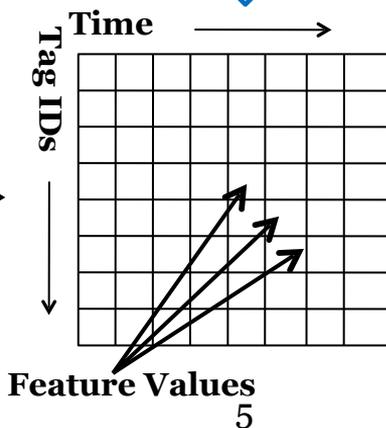
Key idea



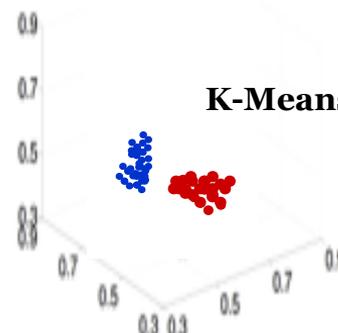
Algorithm sketch:

Cart is Mobile ?

Yes



Hi-dimensional Feature Space



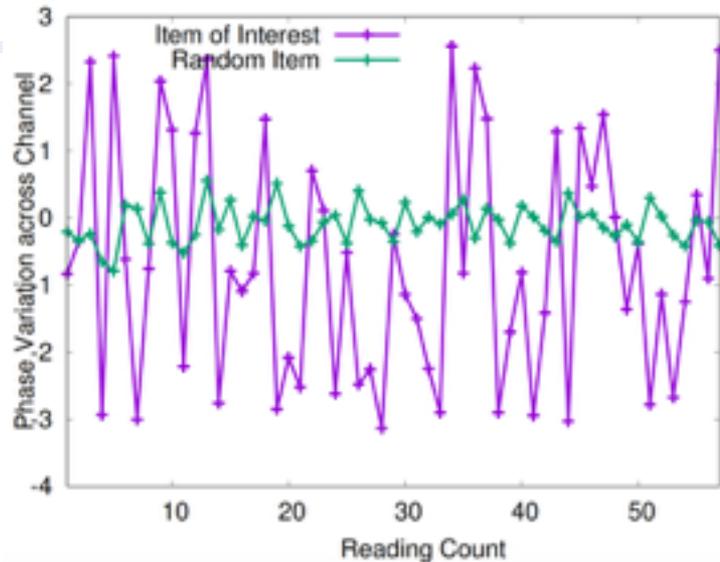
User's Item Browsing Detection

- Key idea :

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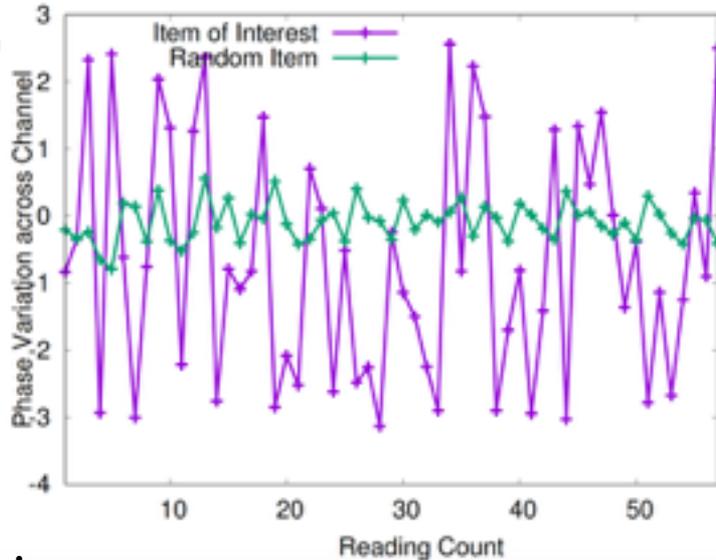
The *phase variation* of the tags of interacted items is **higher**.



User's Item Browsing Detection

- Key idea :

The *phase variation* of the tags of interacted items is **higher**.



Algorithm sketch:

Cart is Mobile ?

↓ **No**

Filter tags according to nearest reference tags

Track phase variation
across tags

Find the tags with *highest*
phase variation



Setup

- Impinj Speedway Revolution RFID Reader
 - Reads phase, RSSI, doppler of RFID tags
 - **300 tags/second**
 - **50 channels, 902.75-927.75** (25 MHz bandwidth)
- **6 dBi** gain circular polarized Antennas
- Dogbone Monza 6 RFID tags
(Suited for **866-928 MHz** reading)



Experimental Setup



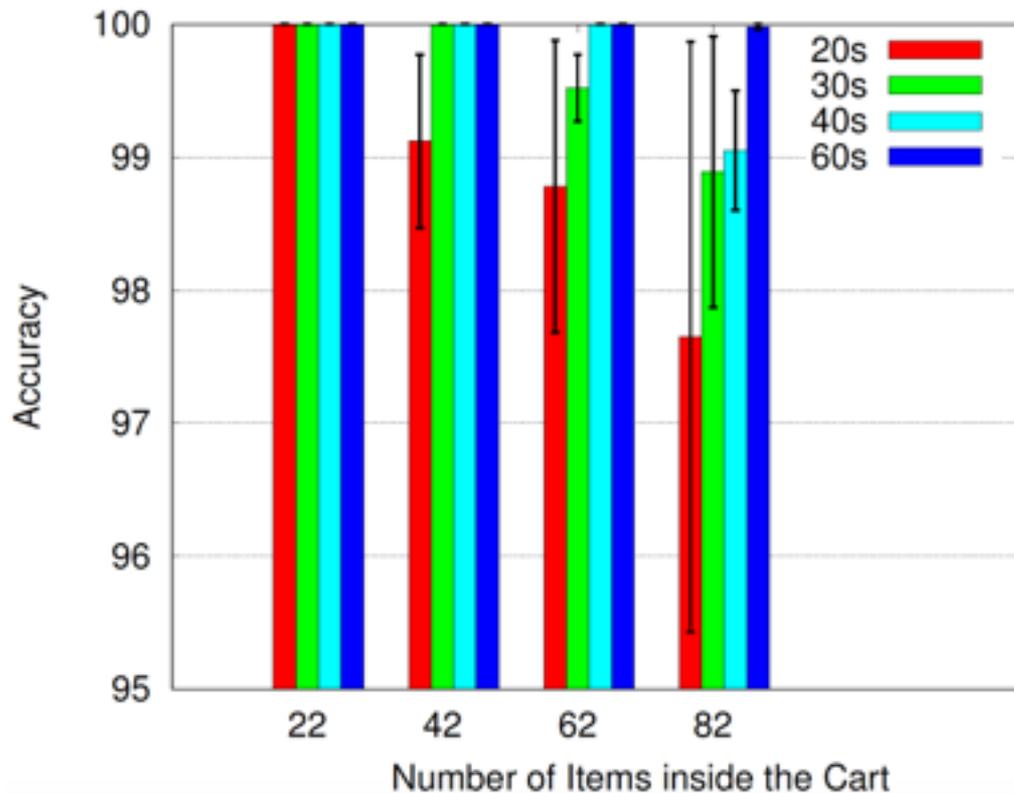
Evaluation metrics

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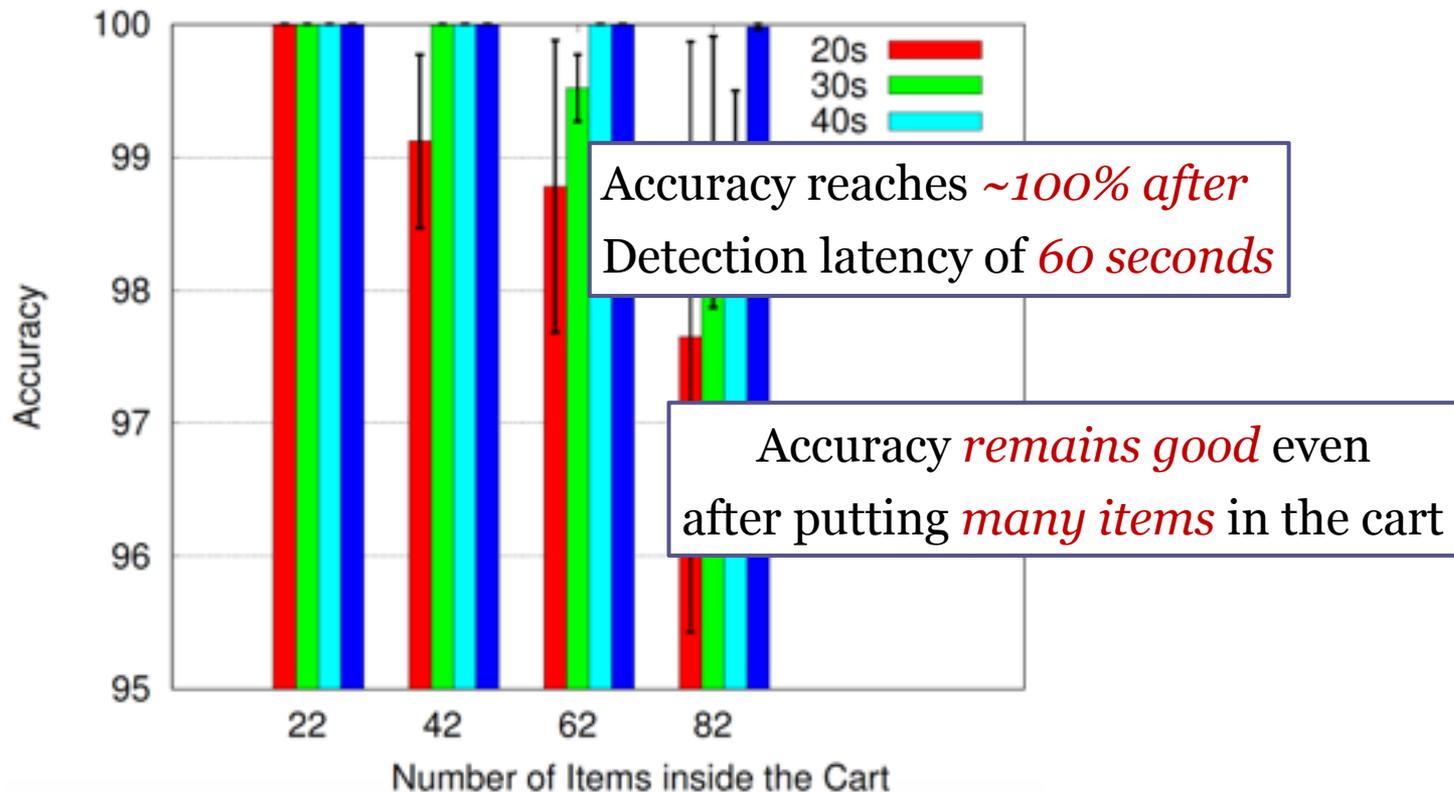
- Modules :
 - Detecting items inside the cart.
 - Detecting user interest in a particular item.
- Metrics :
 - **Accuracy** (What percentage of items predicted correctly ?)
 - **False Positive %** (What percentage of items are outside but tagged inside ?)
 - **False Negative %** (What percentage of items are inside but tagged outside ?)
 - **Detection Latency** (How much time it takes to detect ?)

In-cart item Detection Accuracy

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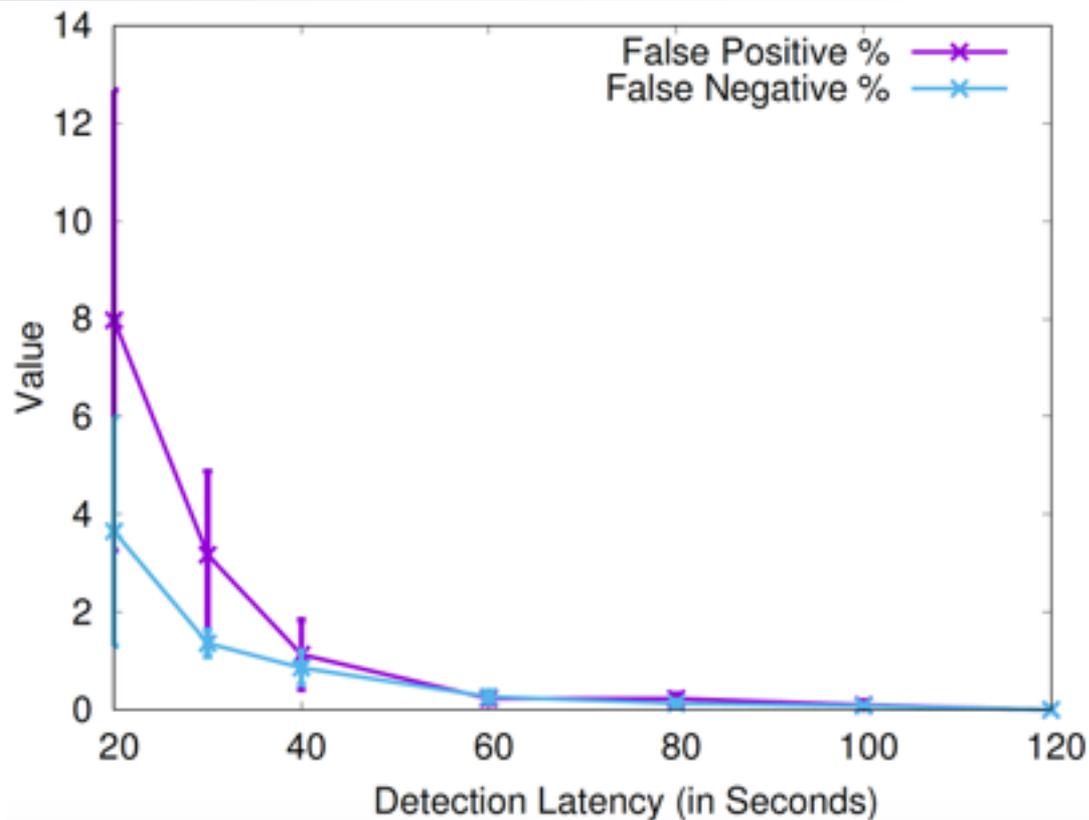


In-cart item Detection Accuracy

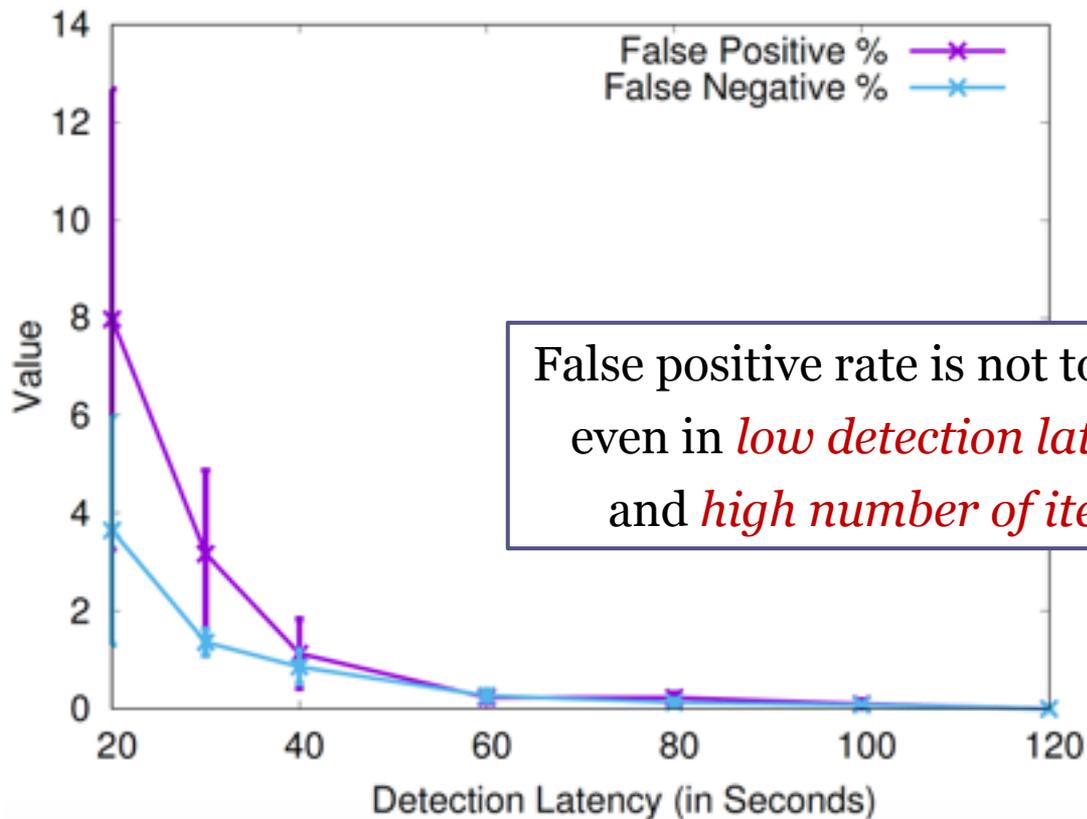


Detection Latency vs Accuracy

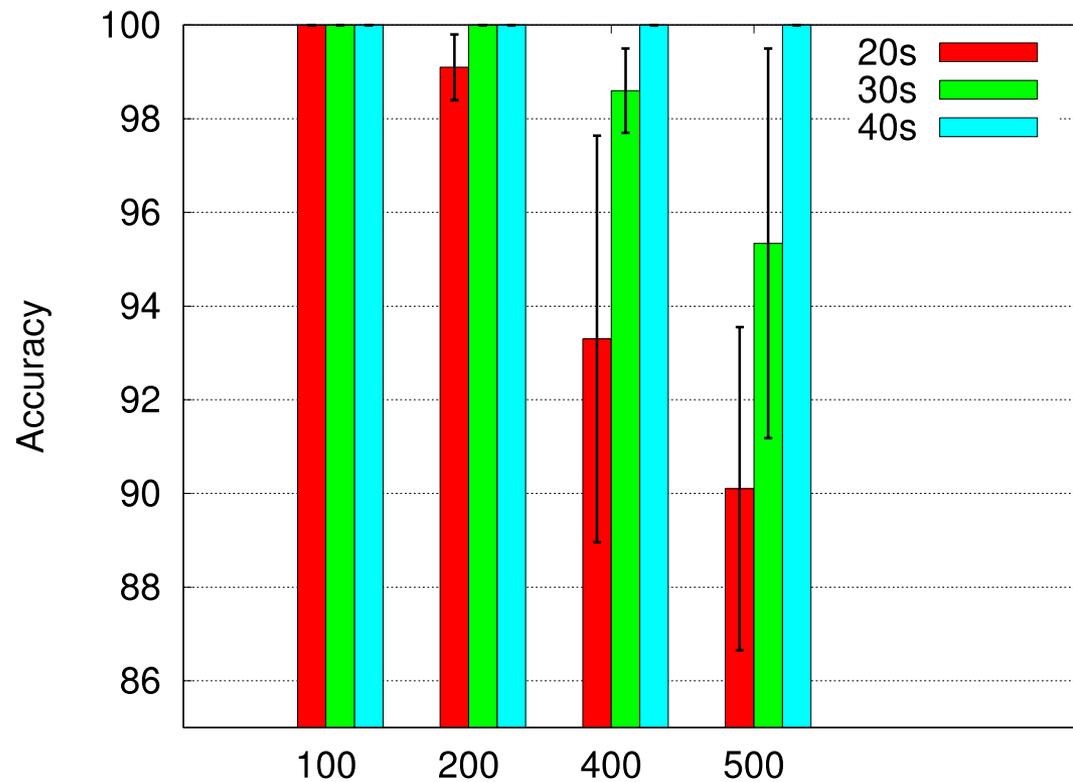
Detection Latency vs Accuracy



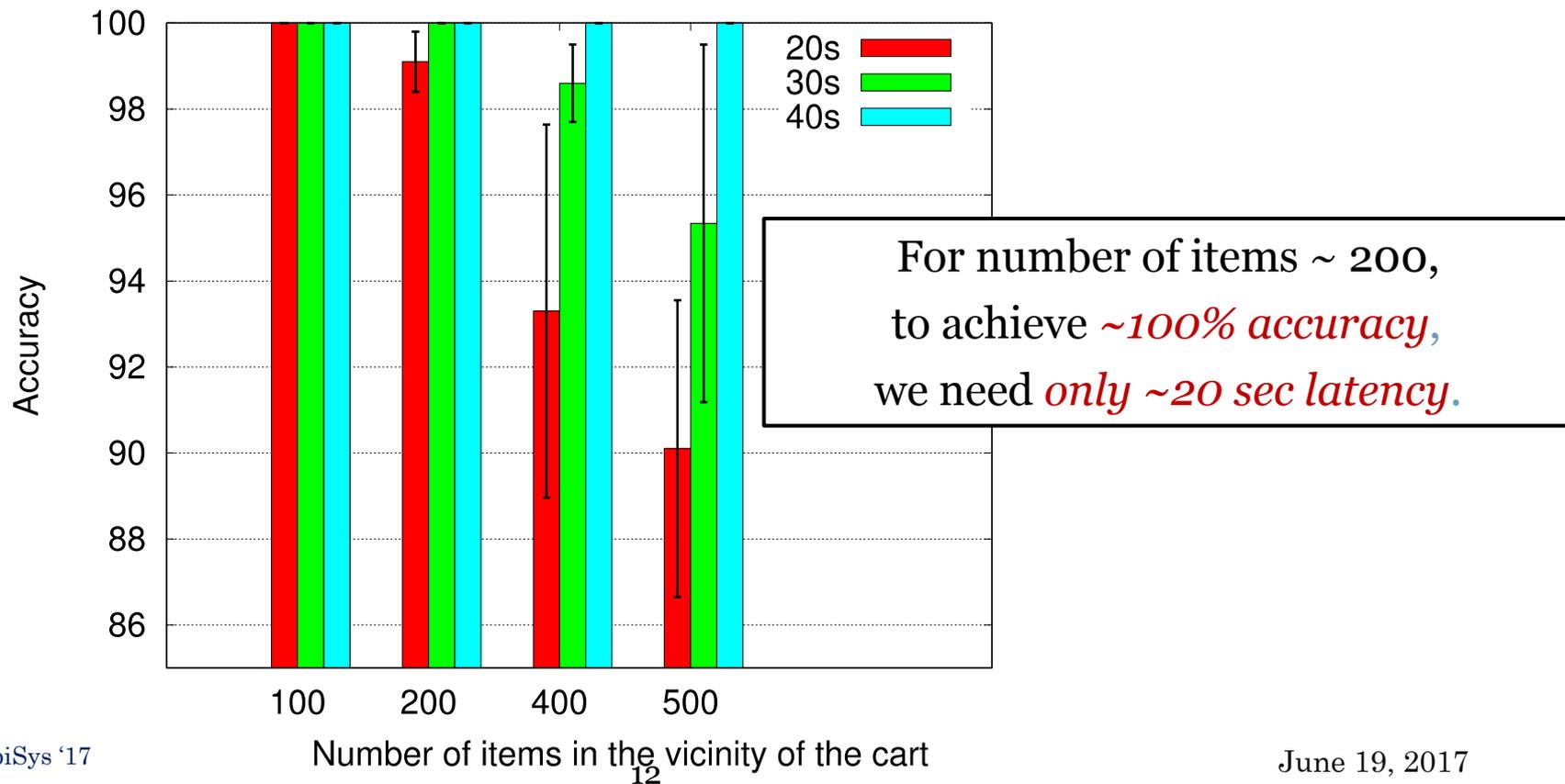
Detection Latency vs Accuracy



Item Browsing Detection



Item Browsing Detection



Key takeaways

- Trade-off between **detection latency and accuracy**.
- **Speed and benefits** compared to traditional self-checkout system or **vision based system (Amazon Go)**. (**NLOS/Occlusion**).
- *Infrastructure RFID* solutions (***ShopMiner*** [SenSys '15] or ***CBID*** [Infocom '14]) which *work with smaller number of tags*, and *lacks user level information*.

Future Works

- Making the *retail analytics richer*.
- *Testing with multiple carts* at different mobility.
- Collaboration among shopping carts etc.
- *Field-testing* the system in real shopping malls.

Q & A