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Immersive Computing and Virtual Reality
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OpenARK

Mobile AR Digital Twin

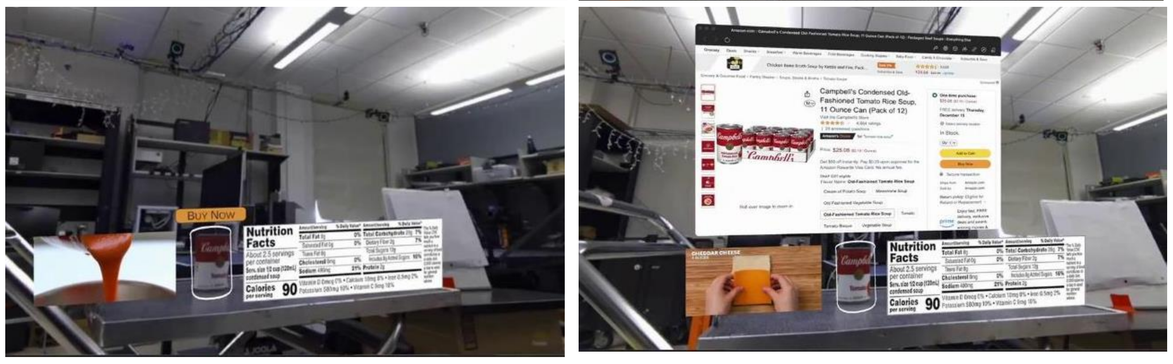
Target User Group and Problem Statement

This project seeks to create a virtual space which displays product information to inform real-world interactions with objects. The primary users of this project will be both retailers and consumers. It is envisioned to work in conjunction with a retailer to display information about a given product and other products in the store.

For example, when walking through a store, the application may display:

- Static content (nutritional information, pricing, shopping suggestions, etc)
- Interactive content (advertisements, instructions for use, games, etc)

As such, this application would work in conjunction with advertisers and retailers to create an immersive and compelling experience for users.



Sample User Interaction.

***Upper-left**: close to the object, it is circled but with no extra visual clues, attracting customers to concentrate; **upper-right**: gazing the object triggers an indication; **lower-left**: a physical touch pops up ads and nutrition facts; **lower-right**: hovering the "Buy" opens an Amazon page*

Implementation Details

The project was implemented in three parts:

Data collection:

- Calibrated using an Opitrack Prime 17w system
- Captured RGBD, segmentation, labels and ground truth rotation and translation (R&T) data.

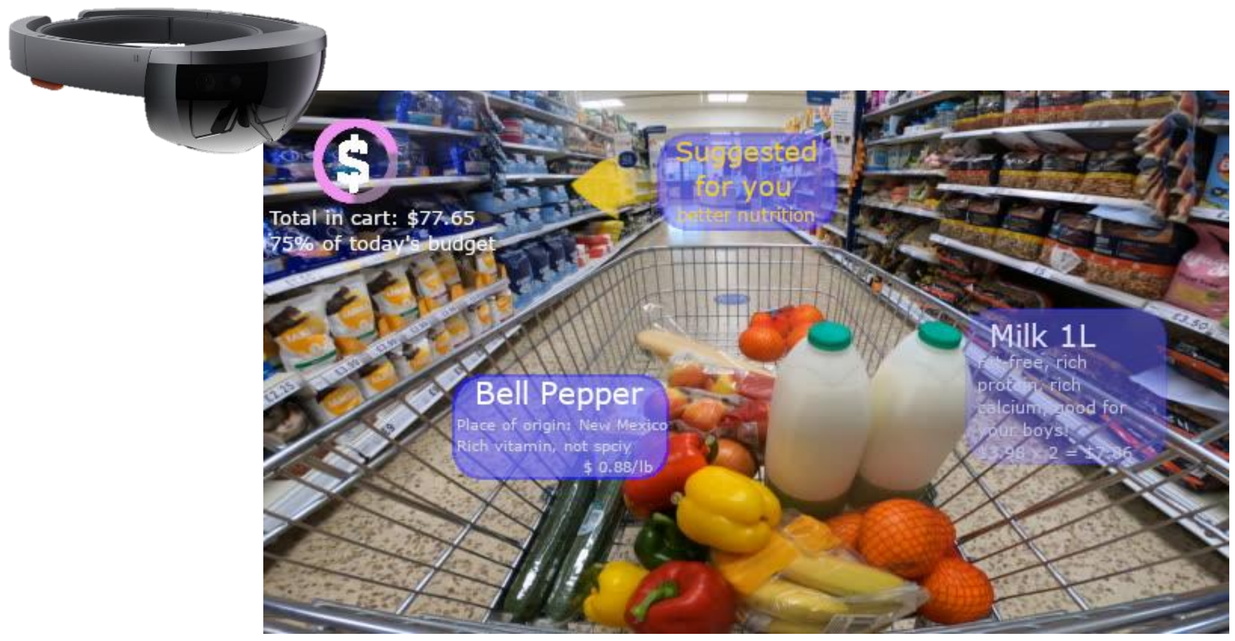
DL Algorithm Training:

- DenseFusion and FFB6D models were run in parallel
  - *Model input:* RGBD image
  - *Model output:* Predicted R&T

Unity Application

- Uses predicted R&T to obtain the awareness of interest objects' 6DoF poses
- Uses estimated poses to implement static and interactive display feature

This architecture is illustrated in the figure to the right.



***A future shopping scenario:** A smart AR device identifies and estimates the pose of each item you put into your cart, attaching nutrition details, shopping suggestions, & budget analysis etc. for you.*

Solution

The OpenARK Digital Twin platform is a consumer-focused AR application that enables users to digitally interact with real-world objects. With this project, a user simply points the mobile camera at an object and will be prompted with an interaction mechanism, as detailed in the table below.

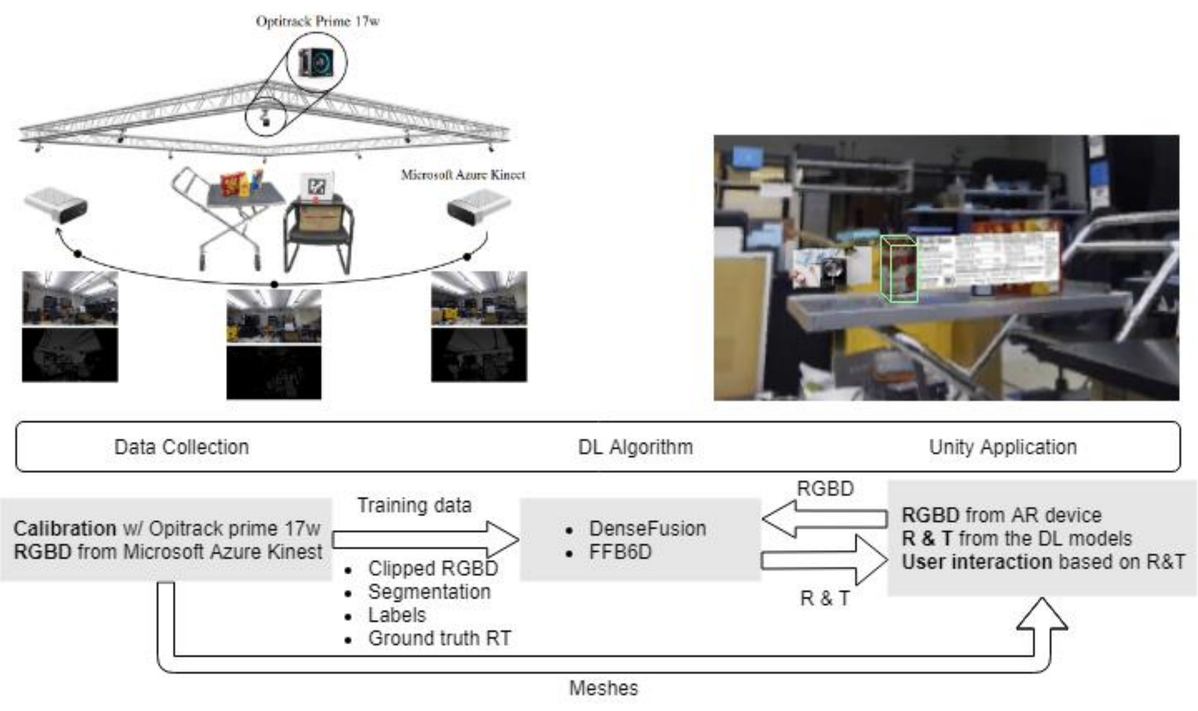
To achieve this, we aimed to solve the digital twin problem:

- Represent real-world objects in AR space
- Use digital camera to track and augment objects
- Generate 6DoF pose estimation

User Interaction	Triggered Event	Mocked UI in Demo
Walk close to the goods, gaze at it	Showing warnings (e.g. "HOT") or visual attractions	Put target at FOV center & close to object
Touch the target object	Pop-up ads, nutrition facts or other details	Click on the screen
Hover a virtual indication (e.g. "Buy Me!")	Trigger corresponding pages, like Amazon	Click on the button

User interaction.

This table contains a few example user interaction events, as well as how they are implemented in the demo application



Pipeline Architecture.

At the data collection, Opitrack Prime 17w calibrates the Azure Kinect while the latter collect RGBD data. This data is used for both training the DL models. The 6DoF inference is then used in the Unity Application.