Smart Cart Proposal

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# 1. BACKGROUND

In the 1930s, a supermarket owner named Sylvan Goldman recognized a critical problem to his business: shoppers only purchased as much as they could carry. To overcome this, Goldman designed and implemented a cart to enable people to carry more products through his stores. While consumers were initially reluctant to use the cart in Goldman’s Humpty Dumpty supermarket chain, the shopping cart now pervades across most stores and is intrinsically tied to our modern shopping experience (Dunne, 2014).

Between 1937 and today, there have been modest updates to the shopping cart to optimize the design and reflect improvements in materials and manufacturing techniques. For example, modern cart cages are largely made of plastic rather than the spot-welded steel, rear walls are hinged to enable efficient stacking and storage, and product storage capacity has increased to 15,000 cubic inches to ensure that volume availability does not limit quantity of purchases (Crockett, 2016). To date, these improvements have been largely focused on mechanical design modifications, unreflective of current technology trends.

Today’s growing sensor solutions, rising storage and data capacities, and increased accessibility of powerful controllers have propelled growth in “intelligent” and connected devices like smart home systems, autonomous vehicles, and health-monitoring wearables (Ahmed, n.d.). These technologies can be applied to the shopping cart to further refine the in-store consumer journey.

To that end, modern retailers are actively working on deploying these technologies to drive consumer retention and growth. For instance, FiveElements Robotics developed a robotic shopping cart called Dash in 2016 to follow users around a store, carry products, and handle the payment process. However, after partnering with Walmart and scheduling production for early 2017, the product has not yet demonstrated the reliability to justify implementation at scale (Ackerman, 2016). Part of the reason is that there are still open areas of research like indoor localization that need refinement before commercialization (Zafari et. al., 2018).

That said, there is tremendous opportunity in working on this technology. The smart cart is a progression of the shopping cart to further address consumer’s latent needs. Consumers should no longer fret about strolling their cart or scanning their groceries, liberating the shopping experience. Beyond the grocery store, the smart cart’s underlying technologies have the potential to affect human-robot interactions in several other environments including warehouses, homes, and hotels.

# 2. PROJECT STATEMENT

I envision a fully fleshed-out smart cart to be a motorized vehicle that offers storage volume, navigates around store obstacles (obstacle avoidance and path planning), follows the user around the store (indoor localization and target tracking), seamlessly scans items placed into the cart, and provides a payment terminal on the cart itself.

For the scope of this course, I plan to build a system with primary emphasis on the design and prototyping of the motorized system, secondary emphasis on obstacle avoidance and navigation control, and tertiary emphasis on indoor localization and target tracking. At this stage, I do not plan to work on the item scanner and payment terminal tasks of the cart. Further, industrial design and aesthetic will not be a priority in this functional prototype.

I propose that the minimum deliverable at the end of this course is a mobile robot that can carry a specified payload and reasonably sense and avoid obstacles in its path. Further the robot should demonstrate design intent and robustness that will allow it to serve as a platform for subsequent research on tasks involving indoor localization, item scanning, and payment handling.

# 3. DESIGN METHODOLOGY

## 3.1. Concept Generation and Selection

## 3.2. Engineering Analysis

## 3.3. Prototyping

### 3.3.1. Electrical Prototyping

### 3.3.2. Mechanical Prototyping

### 3.3.3. Software Prototyping

# 4. BILL OF MATERIALS

# 5. CONCLUSIONS AND FUTURE WORK

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