



LiteSpeed Gate

A **pleasant**, **fast** and **light** shopping experience

April 2015

Agenda



Our Team



Motivation

- Market
- Competition



System Overview

- Main Features
- Project Modules



Logistics Overview

- Budget and Timeline
- Challenges and Major Changes



Future Implementations and Future Plans



Learnings

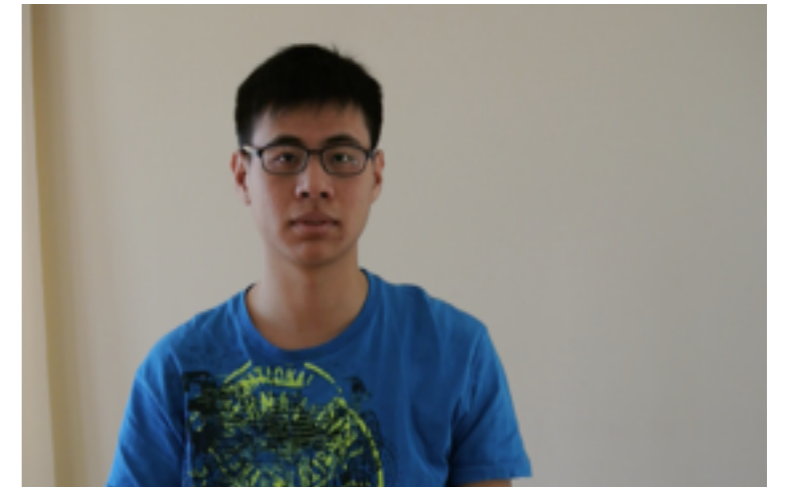
Our Team



Noah Balzer
Chief Executive Officer



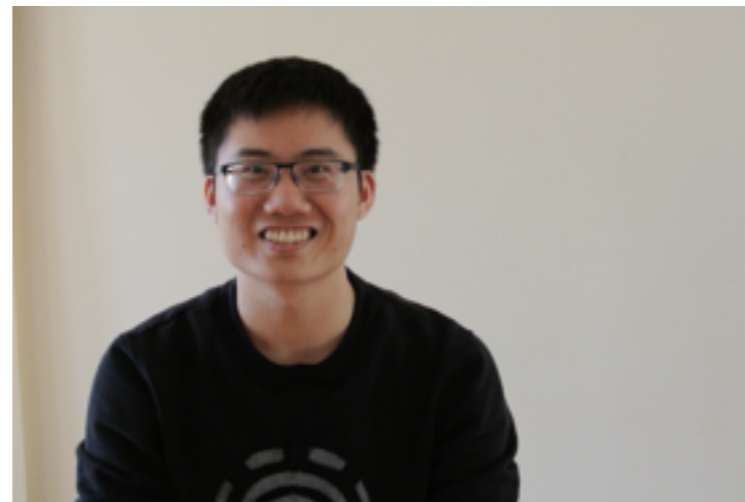
Joyce Zhang
VP Marketing



Kelvin Chu
Chief Information Officer



Brian Lew
Chief Technology Officer



Tim Chupeng Lei
Chief Finance Officer



Alex Yang
VP Strategies



When we were brainstorming...

Motivation | Market



Motivation | Market

Current solution

- Express checkout lane
- Self checkout
- Not solving the root cause

High demand for good solution

- 761 Costco warehouses
- Over 1300 Safeway stores
- Over 3500 H&M stores



Motivation | Proposed Solution



Motivation | Competition

IER 960 Self-payment Kiosk

- Only works with small items, doesn't solve the real issue



System Overview | Main Features

Fast Checkout process

- Eliminate the process of unloading and loading items from the shopping carts
- Fast Scan in less than 10 seconds

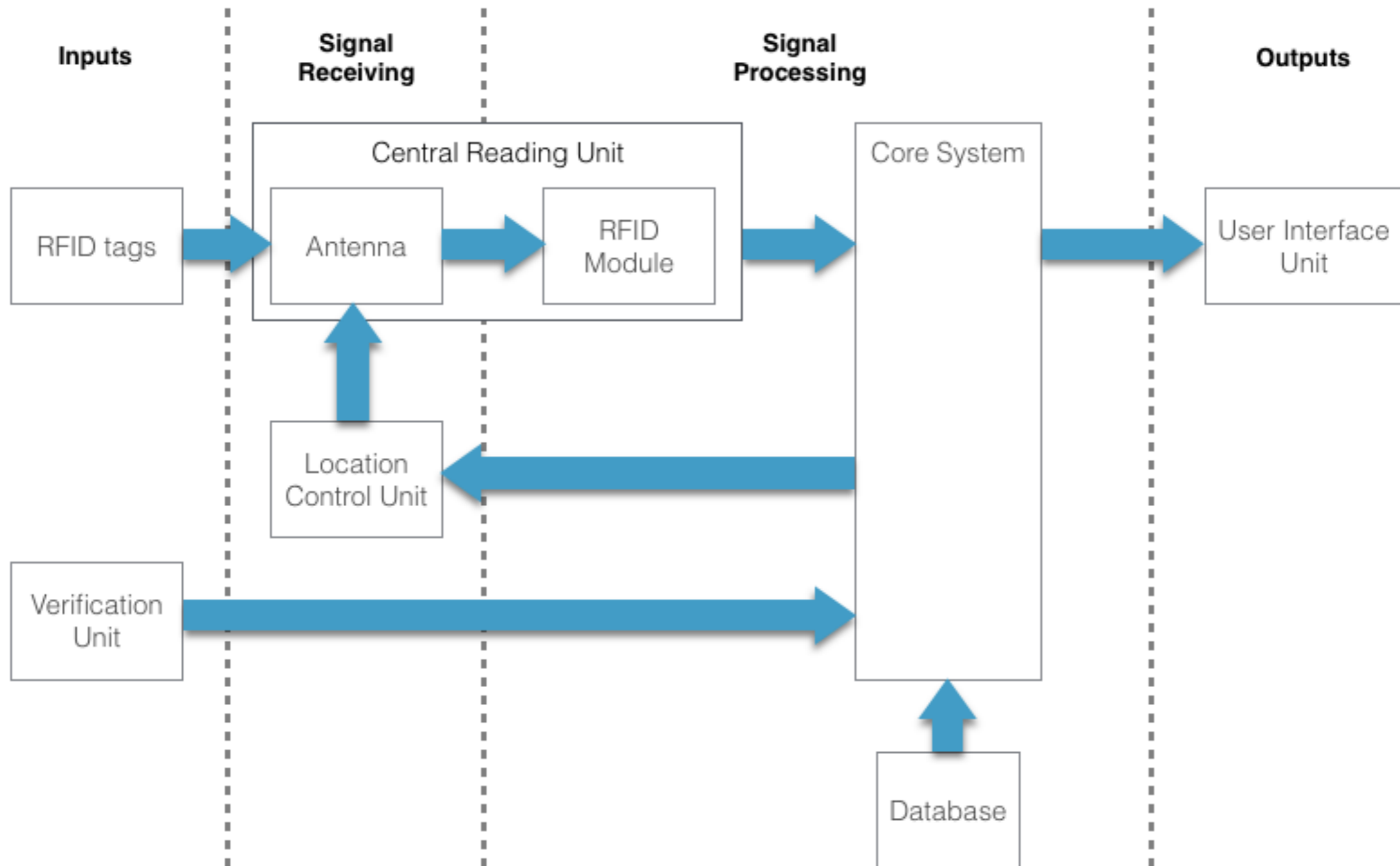
User-Friendly Interface

Anti-Shoplifting

Designed for all types of shoppers



System Overview | High-level design



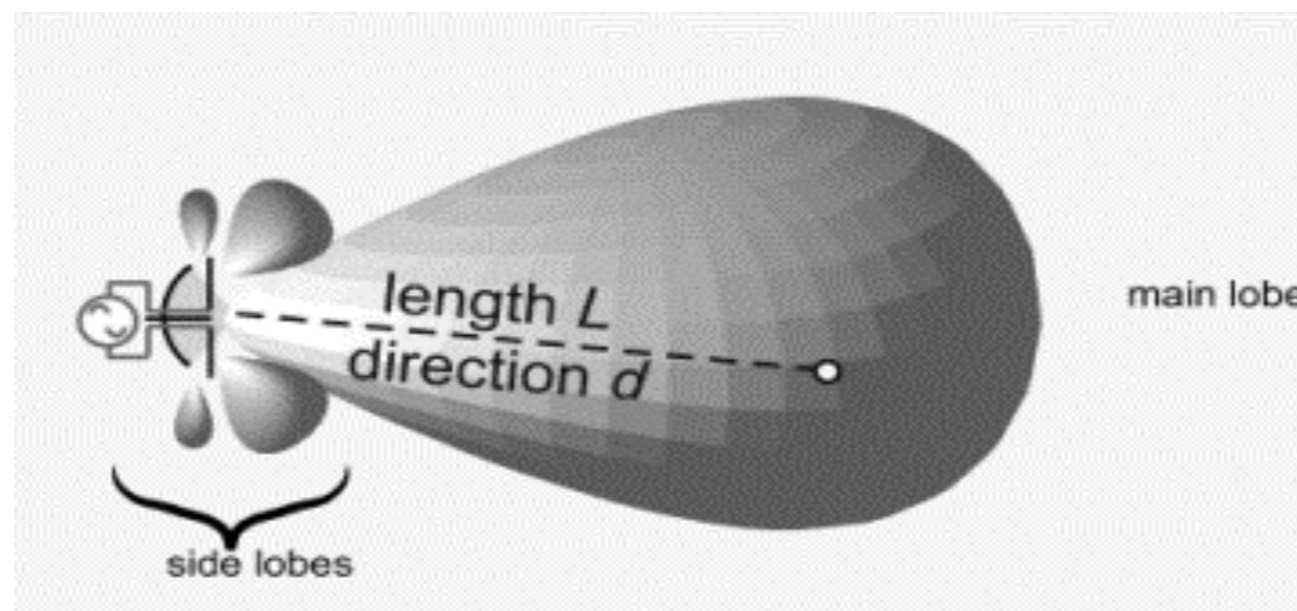
System Overview | Structure

- Ramp to scale platform
- Stable walls which accommodate
 - antenna with angular adjustments
- Made of recycled wood
 - Sustainable
 - Minimal signal interference



System Overview | Location Control Unit

- RFID antenna field background
- Antennas project lobes into 3D space called a radiation pattern
- Lobes represent areas of antenna sensitivity, while the null spaces outside the lobes are insensitive
- To avoid having tags in the antenna's null space, we could either get more antennas or change antennae orientation

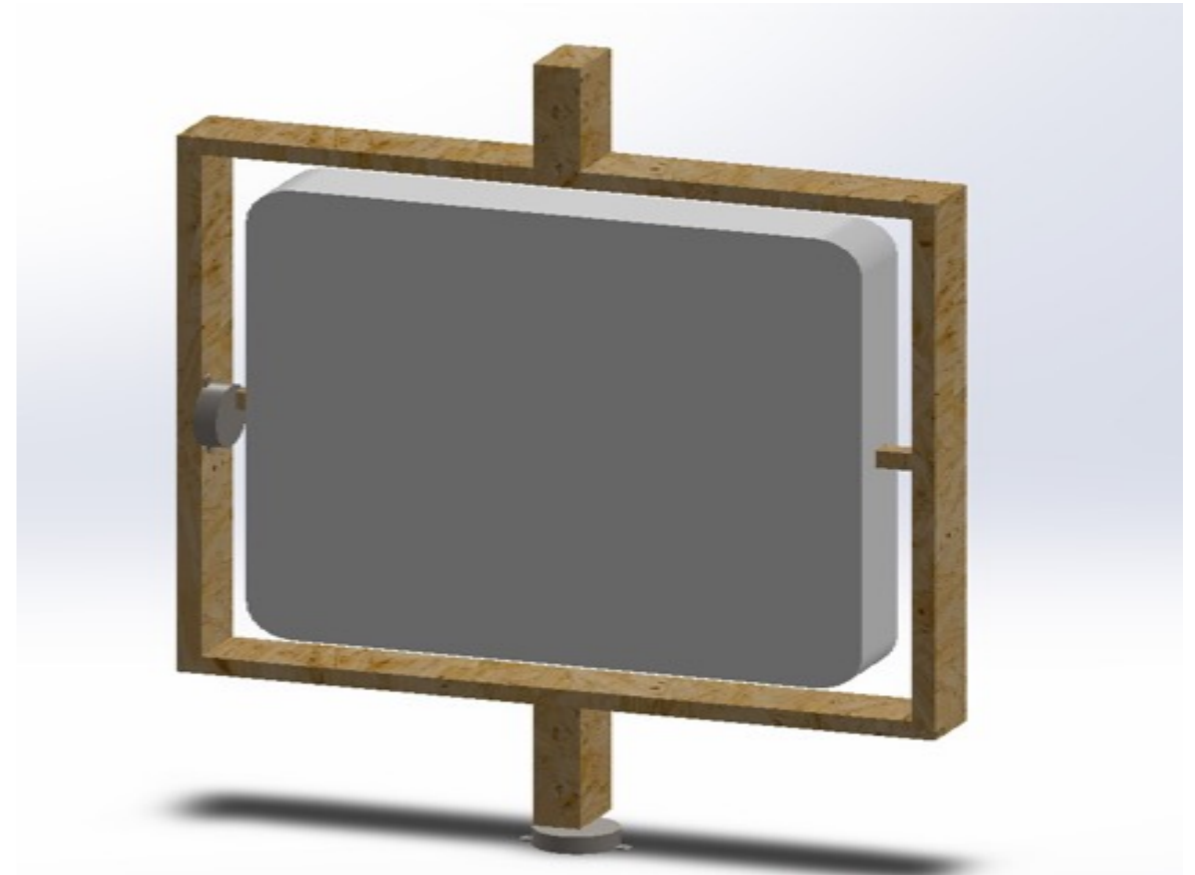


Dobkin, D. M. "RFID Basics: Antenna Gain and Range," in *The RF in RFID, Second Edition, UHF RFID in Practice*, 2nd ed., Waltham, MA: Elsevier Inc., 2013, pp. 76-87.

System Overview | Location Control Unit

High-level Design

- Arduino Uno Board
- 4 stepper motors(12V 28-BY J48)
- Wood (frame and dowels)

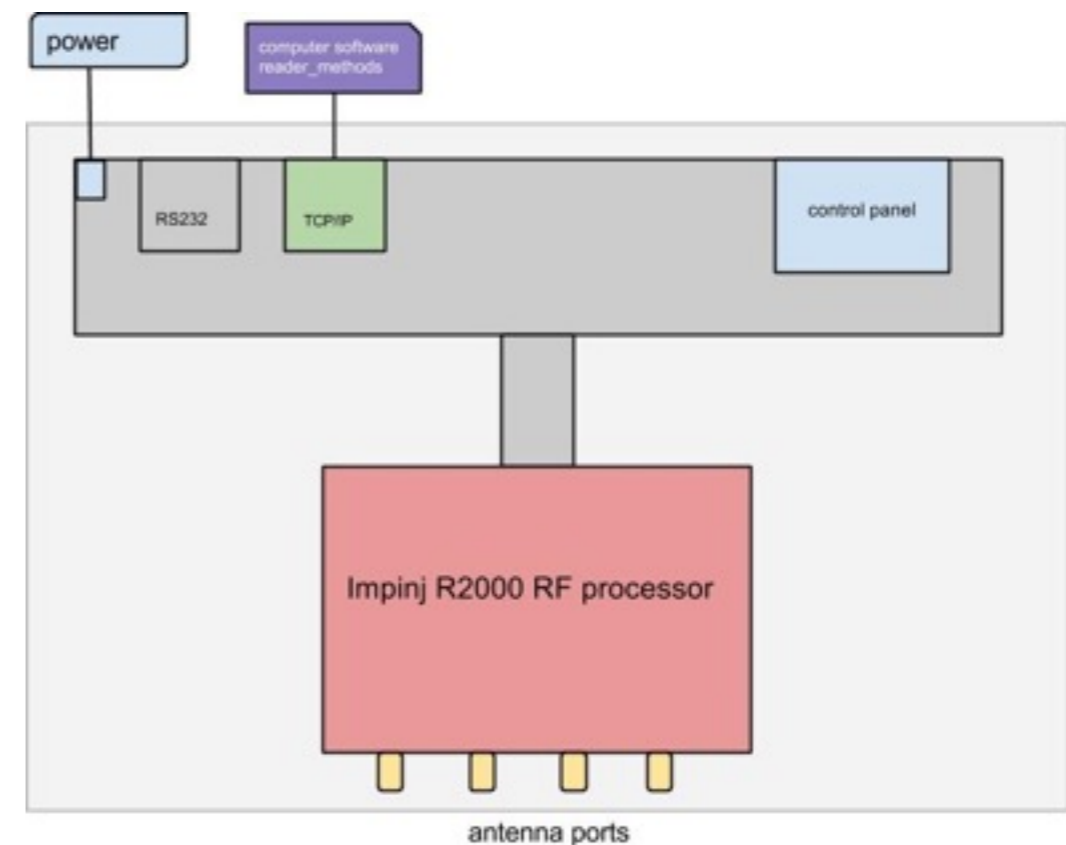


System Overview | Central Reading Unit

- The RFID module is a frequency transceiver operating at ultra-high radio frequency (902MHz~928MHz) to retrieve tag serial numbers.
- The passive RFID tags have radio frequency circuitry, which is activated through induction by the magnetic fields generated by the antennas.



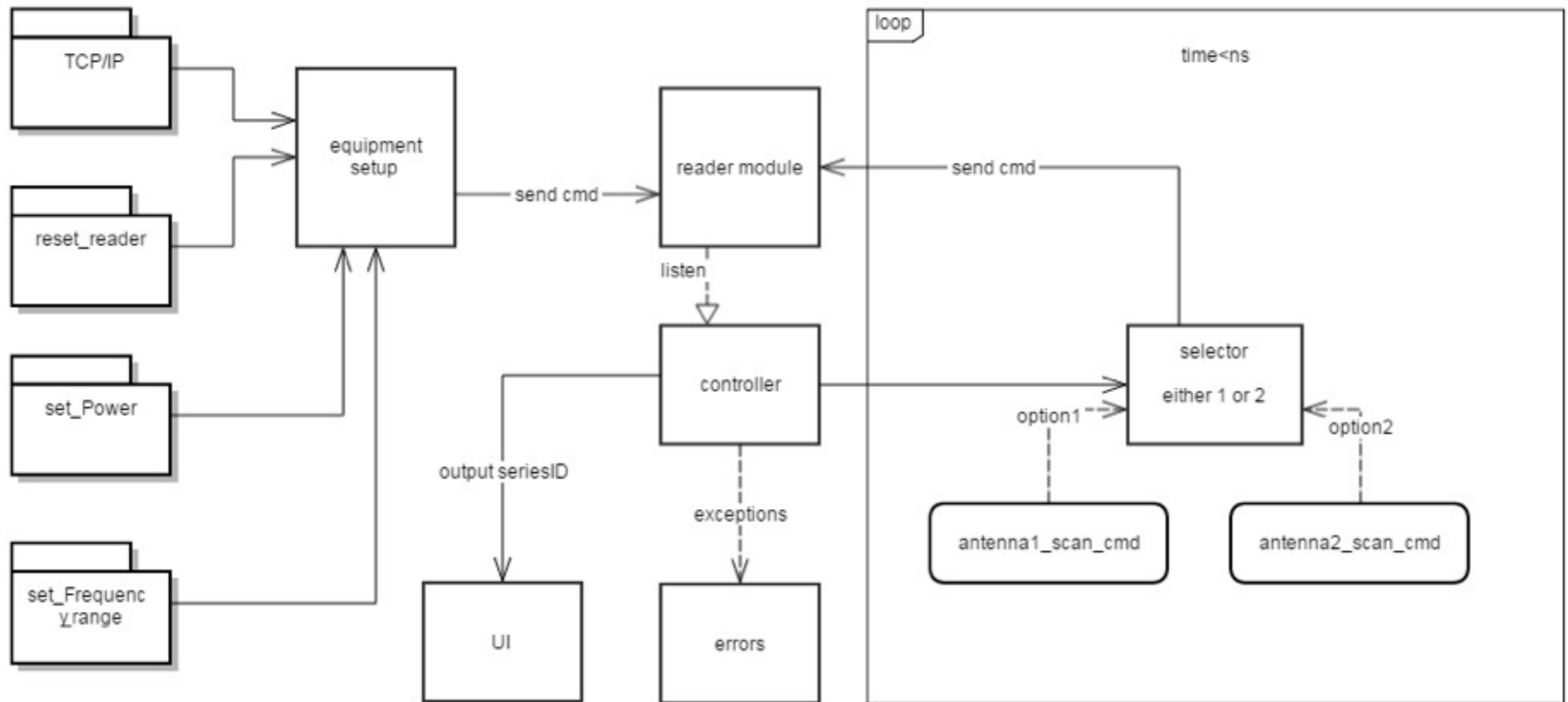
UHF reader model



UHF reader module schematic diagram

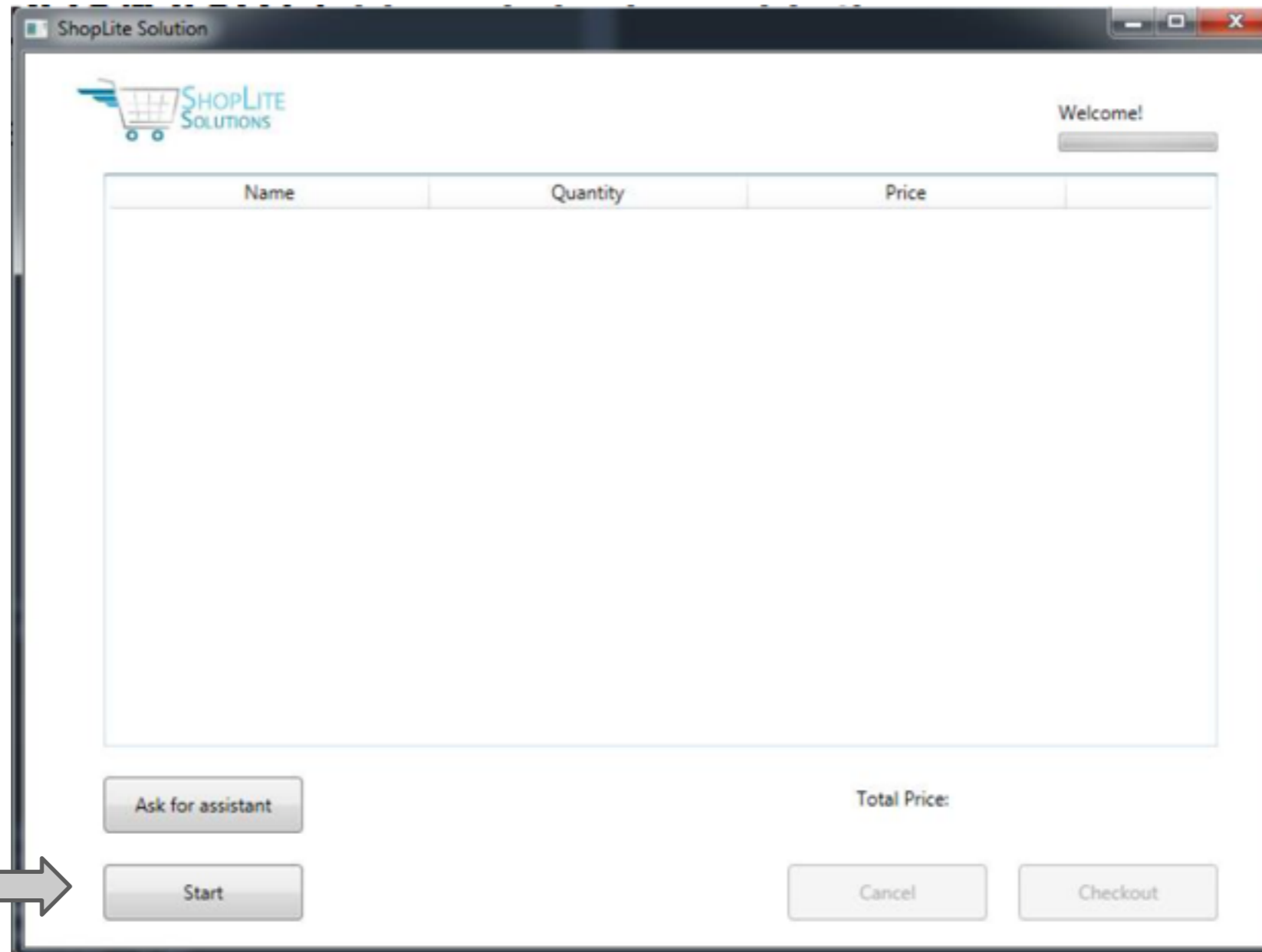
System Overview | Central Reading Unit

CRU Back End Software Design



System Overview | User Interface Unit

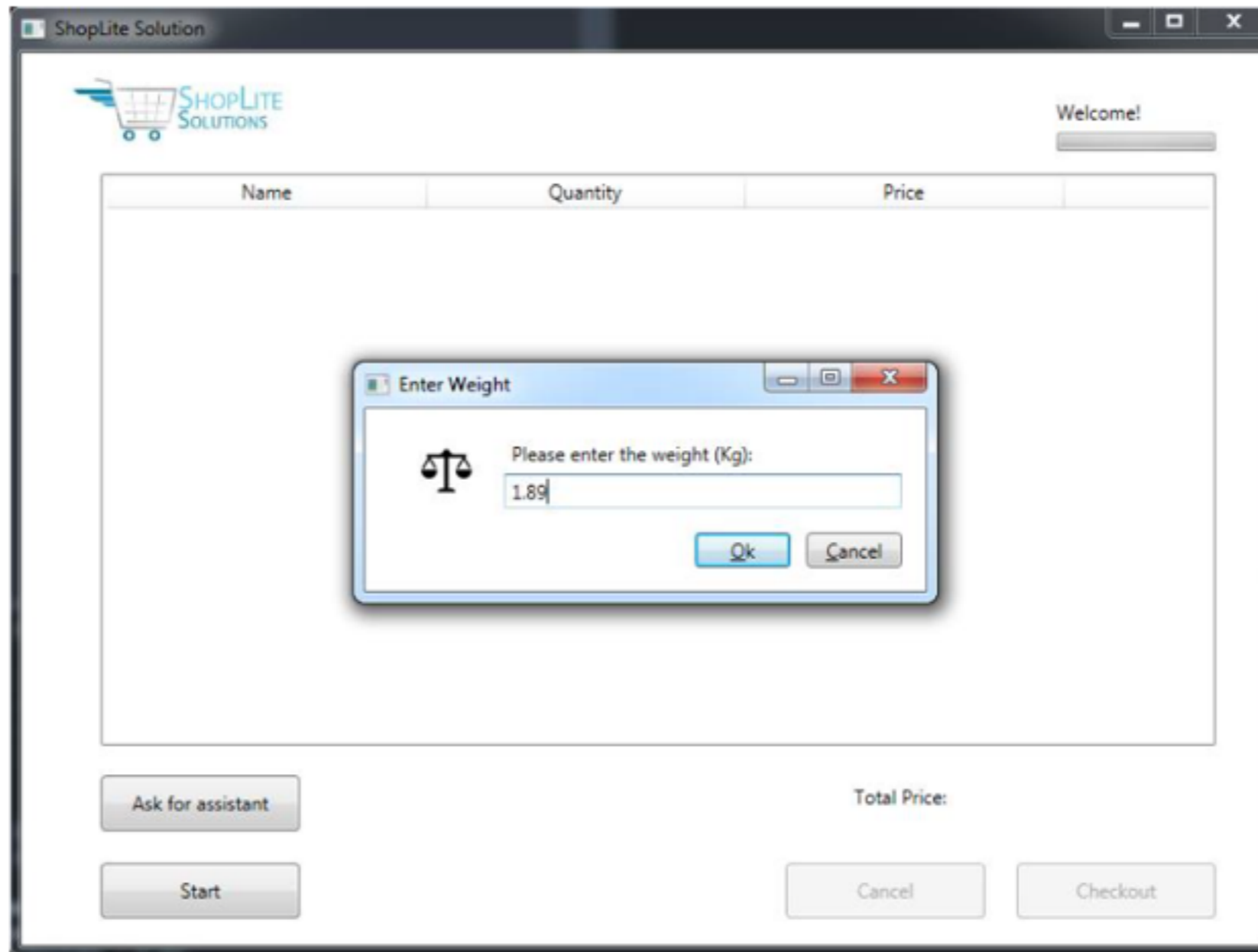
Start-up screen



Click "Start" 

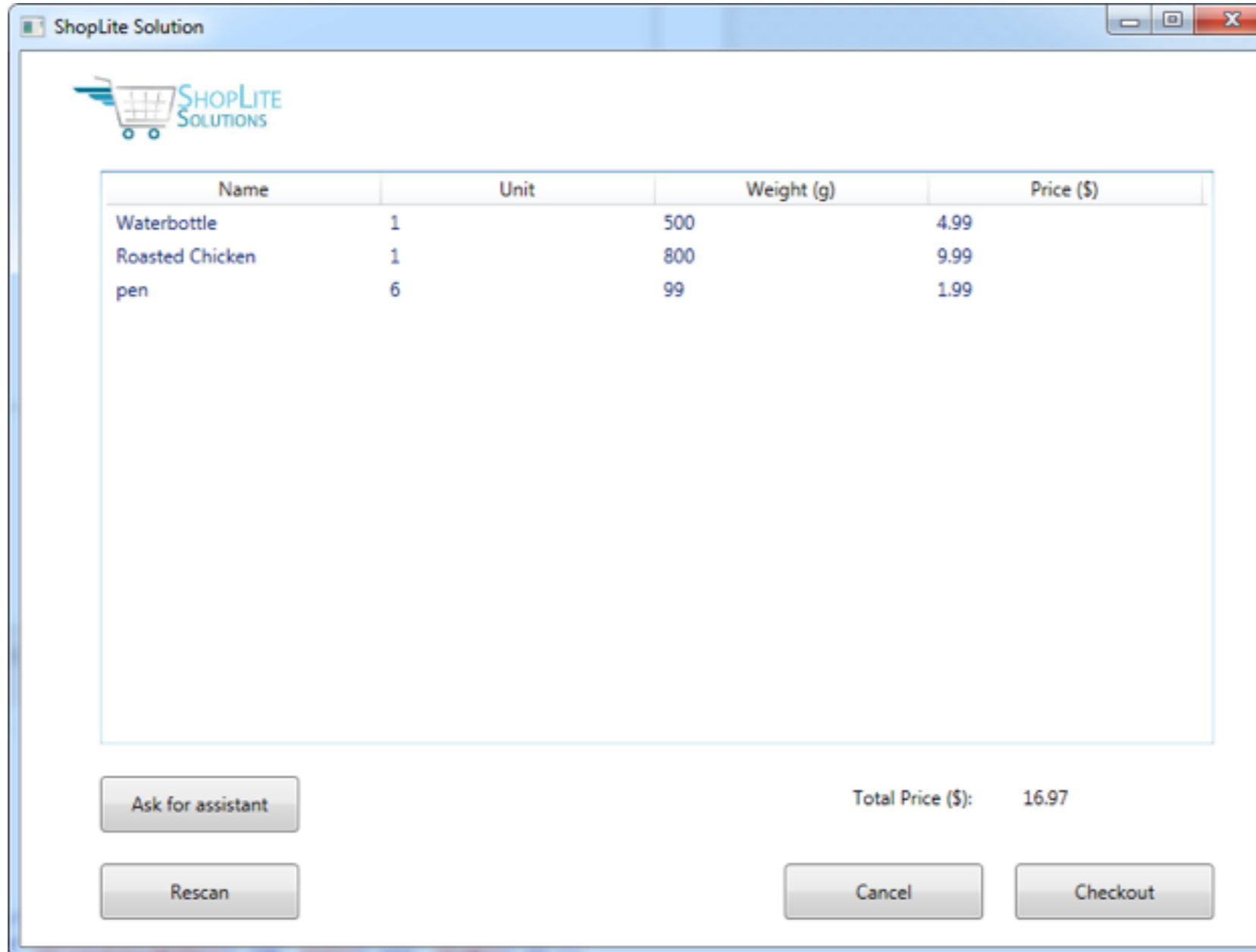
System Overview | User Interface Unit

 Enter weight on scale



System Overview | User Interface Unit

Display output



The screenshot displays the ShopLite Solution user interface. At the top left, there is a logo for ShopLite Solutions. Below the logo is a table with the following data:

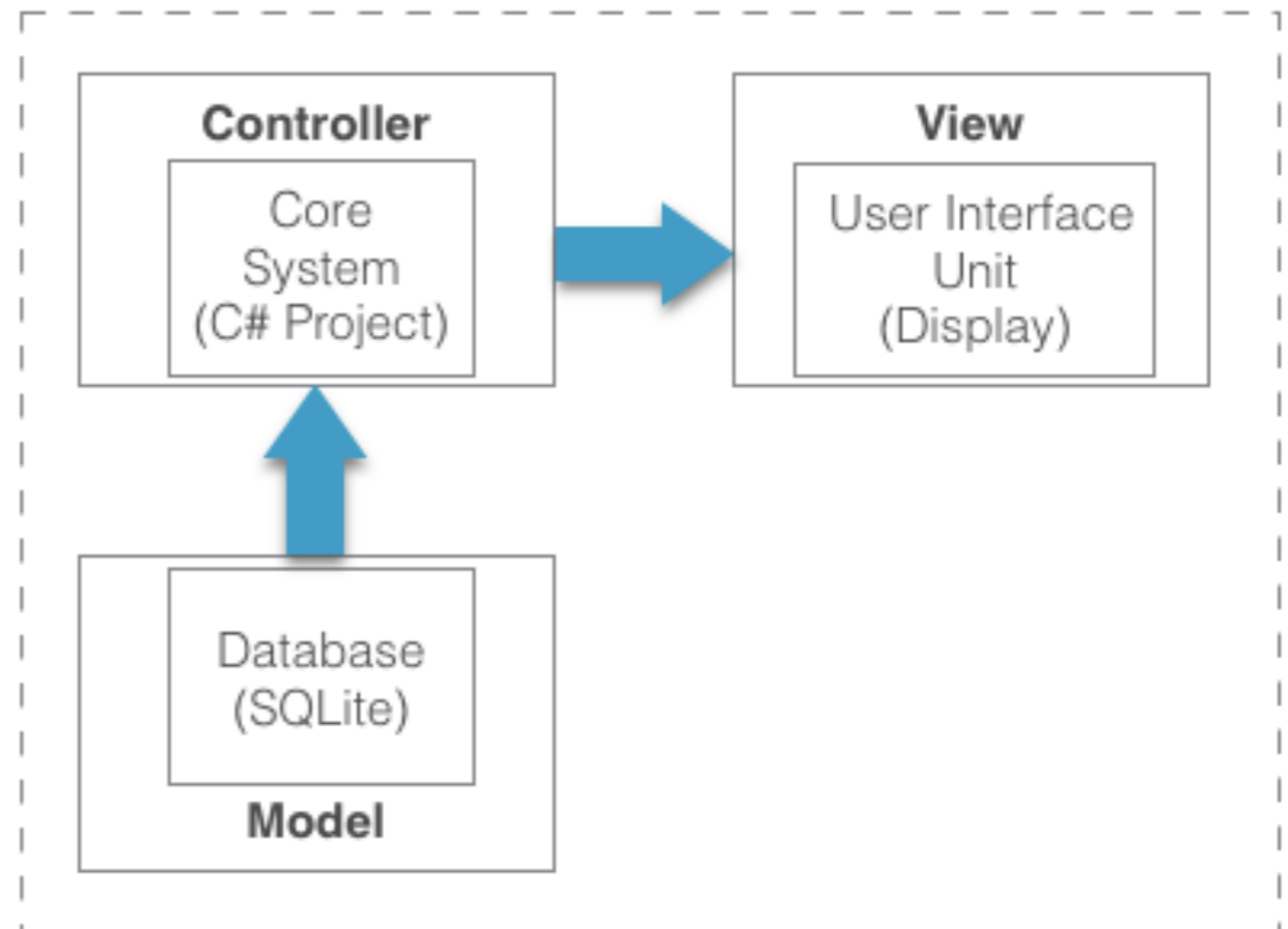
Name	Unit	Weight (g)	Price (\$)
Waterbottle	1	500	4.99
Roasted Chicken	1	800	9.99
pen	6	99	1.99

At the bottom of the window, there are several buttons: "Ask for assistant", "Rescan", "Cancel", and "Checkout". On the right side, the total price is displayed as "Total Price (\$): 16.97".

System Overview | User Interface Unit

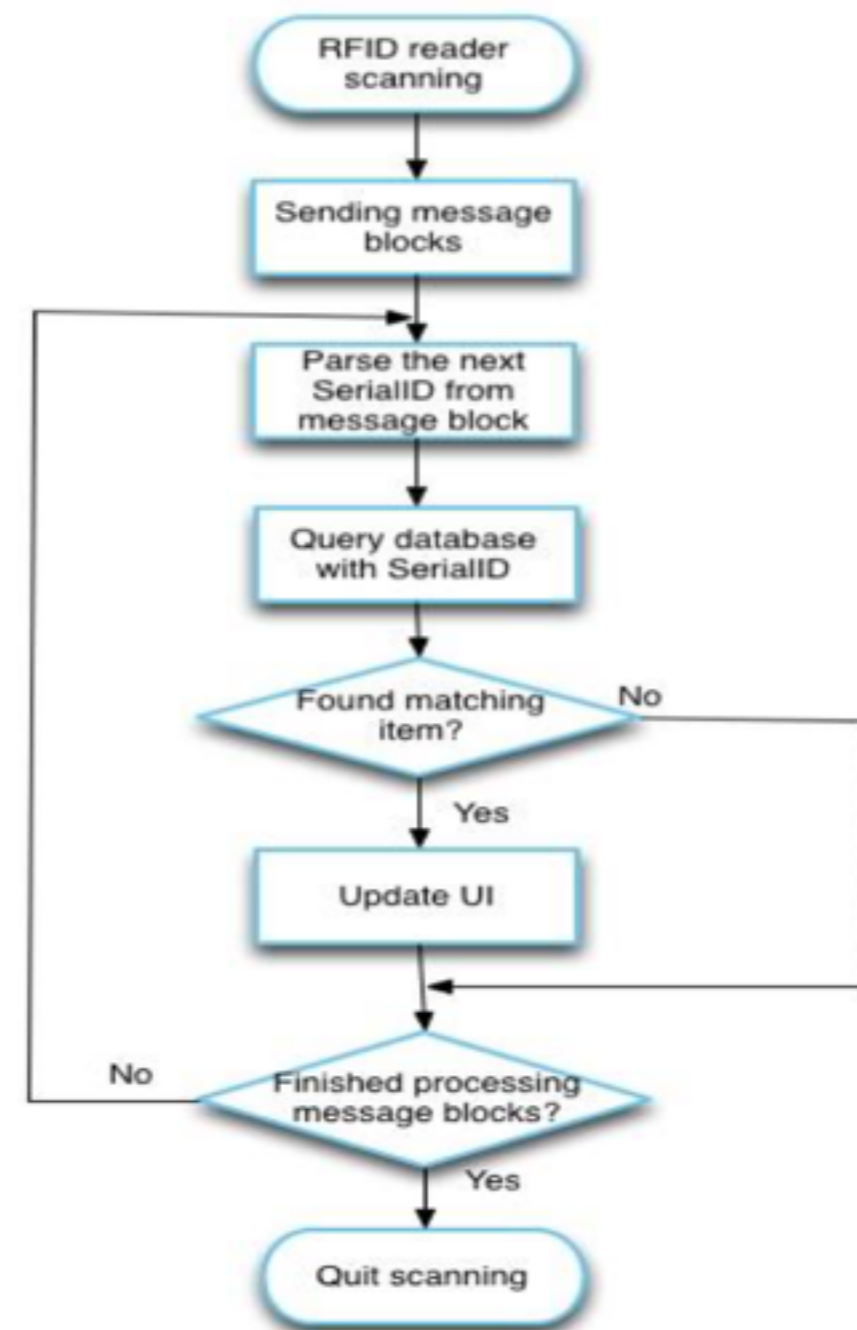
User Interface Architecture

- Model (SQLite)
- View (XAML)
- Controller (C#)



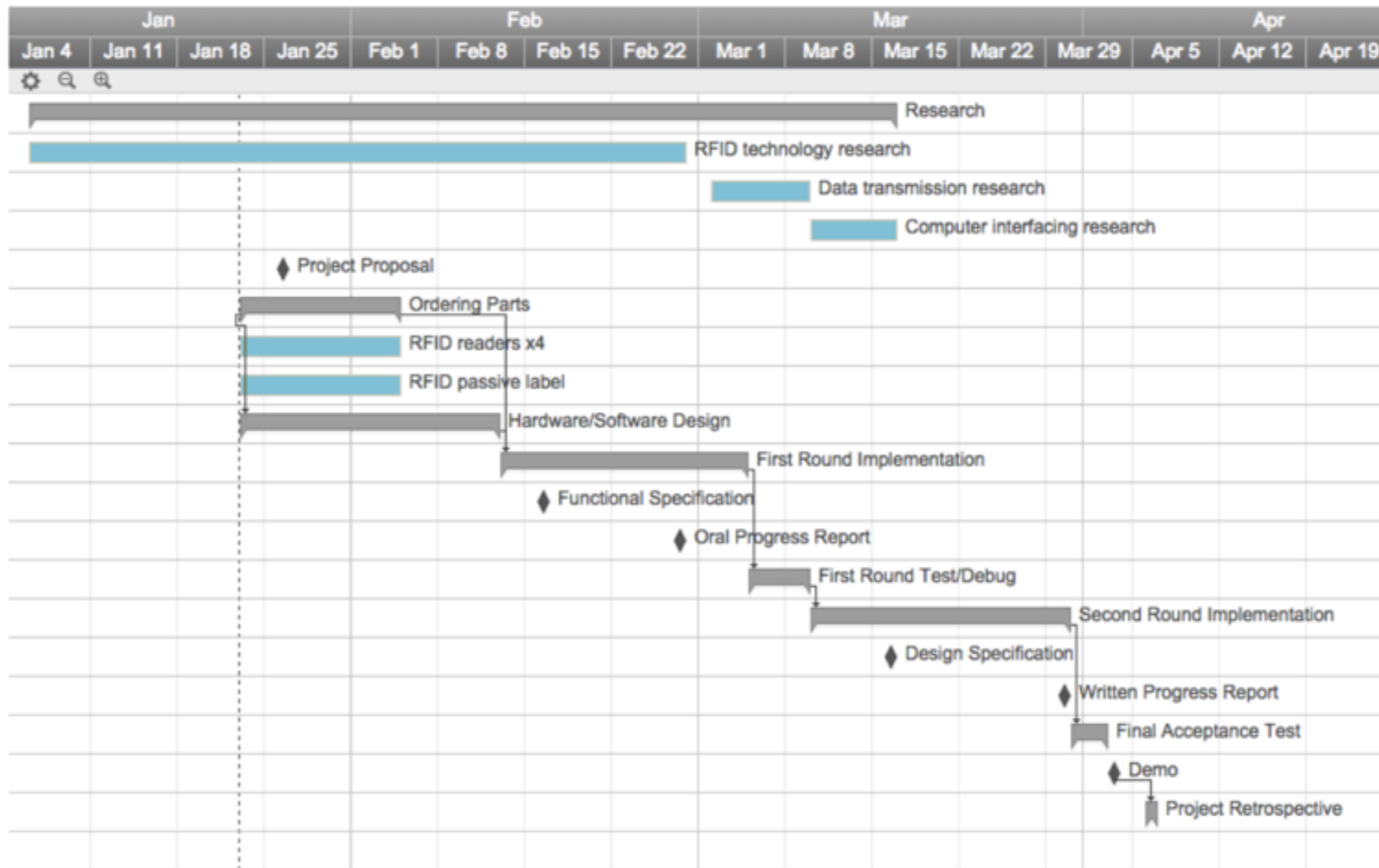
System Overview | User Interface Unit

User Interface Update Logic



Logistics Overview | Timeline

Original Timeline



Logistics Overview | Budget

<i>Items to Purchase</i>	<i>Estimated</i>	<i>Actual</i>
<i>RFID Reader</i>	<i>\$800</i>	<i>\$675.07</i>
<i>Antennas</i>		<i>\$159.56</i>
<i>Cables</i>		<i>\$34</i>
<i>Motors</i>	<i>N.A.</i>	<i>\$151</i>
<i>miscellaneous materials</i>	<i>N.A.</i>	<i>\$40</i>
<i>Groceries</i>	<i>N.A.</i>	<i>\$30.36</i>
<i>delivery fee</i>	<i>N.A.</i>	<i>\$188.81</i>
<i>Guide light</i>	<i>\$20</i>	<i>N.A.</i>
<i>Digital Scale</i>	<i>\$20</i>	<i>free</i>
<i>Cart</i>	<i>\$50</i>	<i>free</i>
<i>RFID Tags</i>	<i>\$20</i>	<i>free</i>
<i>Microcontroller</i>	<i>\$50</i>	<i>free</i>
<i>Wood frames</i>	<i>N.A.</i>	<i>free</i>
<i>Total</i>	<i>\$910</i>	<i>\$1278.8</i>

- The total expense of the project was **\$1278.8**, which exceeded the initial estimated budget of **\$910**.
- **SFU ESSEF** donated \$600 of funding.
- **Invelin Co. Ltd.** supplied free RFID tags
- **BC. scale Co. Ltd** generously lent the Salter Brecknell PS500 high precision bench scale

sponsors:



Logistics Overview | Challenges

Integration of subsystems

- RFID equipment
- High precision bench scale
- Arduino microcontroller, drivers, and motors

RFID antenna node positions causing low accuracy during the scanning process

Location control unit adjustment difficulties

Logistics Overview | Major Changes

- Added verification unit but manual user input of weight is needed
- Location control unit performs angular adjustment instead of physical position adjustment

Future Implementations

Structural improvement

- Plastic gate with better shielding

Hardware improvement

- Motors with higher power
- RFID reader customization to allow for impedance matching of liquids
- Industrial floor scale

User Interface improvement

- Scale reading integration
- Touchscreen

Future Plans | Business Case

Unit cost will decrease due to large production

Current unit cost: \$1278.8

Projected unit cost: \$900

Sale price: \$1500

Profit margin = **\$600**/unit.



Future Plans | Business Case

Raising Fundings

**KICK
STARTER**



THE GLOBAL STAGE FOR INNOVATION



Learnings

- ❖ The importance of good team dynamics
- ❖ Flexibility in budget and timeline
- ❖ Time management and project planning skills
- ❖ Arduino coding and development
- ❖ RFID technology interfacing
- ❖ Problem solving skills

Acknowledgements

 Special thanks to the following:

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Friends and Family

Without your support this project would not have been possible. Thank you!

LiteSpeed Gate



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Questions?