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Vortex

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Vortex Vending Machines

Project Report for CS400 Senior Design

11/25/2013

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Vortex Products is now glad to offer you the latest convenience in the vending machine world. With Vortex's latest mobile application you can now view the contents of all Vortex machines from anywhere in the globe. With items ranging from office supplies to electronics to consumables, you are sure to find exactly what you want!

1) The Story [author: Armstrong]

Lucy is a studious student. She always prepares for class, takes notes, and studies diligently for exams. While in her psychology class on monday, the professor ended the lecture with the simple statement, "Oh, and don't forget the test this week." Many other students looked at each other in panic, annoyance, or just plain resignation. Lucy, of course, remained unfazed. She had read the syllabus, and had already begun preparation for the exam. She was ready. She knew she had a Senior Design paper due that week, and had made sure to get ahead on all of her assignments and studying.

On the way back to her dorm she starts to go buy a scantron, but realizes that she had better get started on the project report. She realized she could just get up early on wednesday and buy one before class, which is exactly what she did.

Two days and one annoying paper later she walks in to class, drops off her backpack, and goes to the Pod store. Other students are already in there buying snacks, drinks, rabbits feet, and scantrons. Waiting patiently in the back of the line, she watches everyone else frantically reviewing notes, quizzing each other or simply staring despondently out the window. After the student ahead of her buys his scantron, she walks up to the cashier.

"One scantron, please," she says calmly.

"I'm sorry, that was the last one."

"...", She says somewhat less calmly. "What do you mean that was the last one? I have a test in 5 minutes!"

"Sorry kid. I would would love to help you. I just don't have any more."

"Aren't there some in the back, or in a closet or something?"

"No, we just put our last box out this morning, but there seem to have been a lot of tests today. If you want to wait until tomorrow we should have some more in," he says cheekily.

Staring back, astonished at what was happening to her, she doesn't even say a word. Whirling around she breaks into a dead sprint. They also sell scantrons in the UC, but she doesn't have much time. She doesn't even want to think about the possibility of them having sold out as well.

Flying through the doorway and out onto the sidewalk, she barely registers the amused and confused looks that the stragglers throw her way. Making it to the UC, she rushes down the stairs, seizes a scantron, dashes to the cash register, and hurls some change at the man across from her before whirling around once more and dashing back up the stairs.

Arriving back at the classroom, two students walk through the door.

"That was really easy," says the first.

"Yea, I just flew through the multiple choice. If I had have known it would be that easy..."

Somewhat relieved, she strides up to the professor.

"Can I have a test?"

"No, sorry honey. But department policy is that I can't let anyone start a test after someone has turned it in."

Meanwhile Bill is working on his senior design project. He needs to have a working prototype by Friday, but in order to finish it he needs a tiny microphone. Walking down to the parts store, he hopes fervently that they have something that can work, but sadly, true to his fears, they have none.

Disappointed, he treks back to the lab. Opening up his laptop, he looks on ebay. Sure enough, they have exactly what he needs for \$3.99. Except for the 5 day shipping, he would be golden. The only nearby retailer that would sell this type of thing is Radio Shack. He calls them, but the only thing they have is a Dynex USB Microphone model number DX-USBMIC13, which is way too big to fit on his tiny robot.

The only other place that would have it is Walmart. 10 miles away. Bill is just a poor college student, and only has other poor college students for friends. Each year his parents had dropped him off with all his stuff in front of his dorm, and each year his parents had come picked him up at the end of the semester. Bill doesn't own a car, and even if he did he would probably be low on gas and not have enough to make it there and back.

"I suppose I need the exercise anyway," Bill thinks, stoically. "It can't be too big a deal if I skip class tomorrow and go for a 10 mile stroll, right?"

Little does Bill know that tomorrow, true to Tennessee weather fashion, temperatures will drop to near freezing. Still survivable, but unavoidably unpleasant.

What do these two stories have in common? They demonstrate a gap between suppliers and consumers. Both people had a need that the marketplace infrastructure simply hasn't provided for. In these college communities there is a need and therefore a potential for profit.

Retailers only have a certain amount of shelf space. They cannot stock too many items, or too much of one item, or they will run out of shelf space. Online stores may be able to provide a large variety of items, but the lag between purchase and delivery makes some transactions untenable.

With our connected vending machine network, we provide a new level of convenience. Users simply download our app, and have an entire stocking system at their fingertips. Lets see how our stories turn out now.

Realizing that she doesn't have time to stop by the UC on Wednesday, Lucy pulls out her smartphone. Sure enough, scantrons are in stock. She reserves one and knows she will be stress-free come Friday morning. Bill pulls out his smartphone. Small speakers are a little too rare to be stored in the machine, but he places an order. In just a couple days a truck will come by to stock all the odd goods that have been ordered, as well as perhaps a few scantrons. Bill saves himself a long walk, and someone, somewhere, has made some money.

2) Motivation and Market Analysis [author: Sayers]

There are many reasons to develop a vending machine network, which include low maintenance costs and the ability to reach a wide variety of potential customers. Vending machines offer a unique convenience to customers, by presenting customers with the option to buy goods in locations that otherwise would not suit the presence of a full store. Vending machines are currently used to only satisfy the immediate needs of a customer.

There are currently two major usage scenarios for vending machines. A customer wants something, usually consumable, stumbles upon a vending machine and buys something. This is an example of an impulse purchase in which convenience (vending machine location) and chance (sees the vending machine and the vending machine contents satisfy the need) plays a part. This also explains why the purchases in this scenario are typically only food and drink, since the buying decision is based on an immediate need.

The other usage scenario is based on a habitual knowledge of a specific vending machine. This is likely a result of chancing upon a vending machine in scenario one and then continuing to use that machine due to convenience. For this reason, this results in a customer likely purchasing an item of food or drink.

But why isn't anything else bought from vending machines other than food or drink? This is the case because you usually only set your mind on purchasing something from a vending machine when you meet the two above proposed criteria: convenience and chance.

Vending machines by their nature are designed to be convenient, which is down to placing the machine in a convenient location. This should have no impact on why other items cannot be sold in vending machines, and should be left to vending machine owner to determine suitable locations.

The idea of chance is the real cause for the abundance of food and drink vending machines. For most purchases other than food and drink the recognition of the need is not likely to coincide with the moment at which the vending machine is seen. In other words

the purchase does not rely on the element of chance. For this reason, a vending machine has to overcome the criteria of chance in order to viably sell goods that are not food and drink and this establishes the motivation for Vortex Vending.

Vortex vending is motivated by the same two criteria of regular vending machines. The location of Vortex machines, like all vending machine locations, will be carefully selected to provide maximum convenience for customers. This is the premise of a vending machine and is of the highest importance. However, in terms of chance, Vortex will go above and beyond usual vending machines. By creating a mobile application that allows users to view items, reserve items and purchase items from a Vortex machine from any location in the world, we will bypass the criteria of chance. Of course a user may stumble upon a Vortex machine and decide to buy something, but more often than not they will use their application to get all of the information they need to make the purchase. The motivation is that Vortex machines will make customer convenience the only emphasis when providing our vending machines.

Let's take a look at some of the statistics that show the usage of vending machines in the United States of America in order to provide a thorough market analysis. A lot of the following statistics are courtesy of Vend-Resource an online website that provides vending machine business information (A2). According to Statistic Brain, the average annual per capita consumptions of vending machine goods is \$27 (A1). This figure includes repeat customers and new customers alike. What is most striking about this is that currently most food and drink items in vending machines cost around \$1. This indicates that the average person visits a vending machine about 27 times a year. From Vortex's perspective, this indicates that there is a lot of demand for the convenience of visiting a vending machine. By differentiating the products that are sold within a vending machine, and the ability to use a mobile device to screen the contents of a vending machine, Vortex will be able to sell higher cost items while still offering the same optimal level of convenience. There is a lot of opportunity in this market for product differentiation.

According to Vending Times Census, the main locations for vending machines are factories, schools, universities, public locations, government and military, offices, hospitals and other locations (A4). Since we don't envision focusing on non-perishable goods, we would imagine that Vortex products would be ideally suited to universities, public locations and other locations. There may be opportunities to expand into the other areas also, however the above mentioned locations would provide that highest density of customers that would benefit from Vortex machines. For this reason, Vortex would begin by testing the market in public and university locations first. It is also worth noting that public locations made up the highest proportion of total dollar sales by location, accounting for \$15.2 billion out of a total \$42.9 billion in 2009.

It is worth noting that vending machine sales has plateaued over recent years (A4). With people tending towards healthier lifestyles, the food and drink offered in current vending machines are slowly becoming less desirable. This means that the Vortex machines may have the opportunity to provide vending machine owners with an alternative source of money over traditional vending machines. This would help create the Vortex network, which is one of the key points to creating a successful and convenient source of

goods.

Furthering the above point, owners of vending machines appreciate the low labor costs in comparison to total sales revenue. In 2002, the costs paid for labor was only 20% of the total sales revenue provided by vending machine sales (A3). This gives an indication of how low maintenance operating a Vortex machine is and there are likely efficiency changes that have been and could be made to improve this number further. The bureau of labor statistics further breaks down the labor costs of operating vending machines (A5).

Vortex has a strong understanding of customer motivation and has performed an extensive analysis of the vending machine industry. We are confident that we have a unique value proposition that will greatly improve the convenience of products on the market.

3) Measurement of Similar Products [author: Yacoub]

There are convenience stores, gas stations, supermarkets and vending machines wherever we go, and they never seem to go away. The reason for this is because they are doing surprisingly well despite the high maintenance costs and startup costs. Consumer and commercial trends drive the demand for convenience stores. The profitability of individual stores depends on competitive pricing, effective merchandising, and the ability to secure high-traffic locations. Large companies have advantages in purchasing and financing stores. Small companies can compete effectively by acquiring superior locations or offering specialized merchandise or services. The average annual revenue per store that is placed in a perfect location is about \$450,000 for gas station/convenience store combinations and \$145,000 for convenience stores without gas (D1).

Gas stations are surprisingly cheap compared to how much money they bring in. The cost of all property, legal, equipment and setup services is around \$310,500 while revenues from it range around \$300k-\$400k. The major issue with this kind of business is cost of management. The cost of paying everyone's salaries (including your own), taxes, insurances, as well as the store maintenance and losses from theft and expired products can in a case of a gas stations is usually around \$275,000, meaning that it takes many years to pay off the investment (D2).

Other competitors, such as Walmart, are usually located far away from each other and can be found only on big roads far away from downtowns. They have a variety of products available for any possible customer and at a reasonable price. However, they are always located far away from college campuses and tend to target multiple customer groups instead of focusing on a specific one. They are very inconvenient to drive to, and usually require plenty of walking inside the store as well. On top of that, Walmart is paying over 1 billion dollars to run their business per day, meaning that despite claiming to have low prices, they still charge a reasonable amount in order to keep their businesses running (D3).

Our machine however, is taking care of all of those issues in a very efficient way. Machines that are similar to the design that we have planned out cost up to \$6000 to make, but can become as cheap as \$3000 or less if we order in large quantities or make a

contract with a factory instead of company that designs machines. Since our machines are cheap to make, our partners will be able to buy large quantities of them at a time and place them everywhere they want, instead of being bound to a single location, like in the case of convenience stores. Also, since our machines do not require full time employees, and only need a rare one-two hour maintenance per week, our machines can be placed in corporate break rooms, university dorms, club houses and even on every floor of apartment complex if considered profitable. By making it possible to place our machines everywhere, and deliver a variety of items at a relatively low maintenance cost, we can afford to have prices that are lower than other vending machines' prices by 10-20%. Vending machines are much more convenient than big Supermarkets which are usually far away and sometimes in the middle of nowhere. On top of that, with gas prices going up and people still driving high gas consumption vehicles, it might be a lot cheaper for people to buy items from our vending machine than from big supermarkets.

The only other competitor that we have are online stores. Online stores offer items at a very low prices in comparison to supermarkets and most of the time offer free shipping for small items, making it almost unnecessary for anyone to ever go to a tech store and buy overpriced hardware. However, we can compete with them as well. The major reason why people chose amazon is because they offer lots of products, cheap delivery and reasonably priced products, which is the similar to what we offer, but regardless of how fast or when you order, you will still have to wait for a couple of days in order for an item to be delivered. Our vending machine has dynamic inventory, meaning that during exam time, we can begin stocking up our machine with scantrons, pens, cheap mice and keyboards as well as caffeine pills, and eliminating the need to wait for a couple of days while your items are getting shipped from another part of the country.

When it comes to actual profits, vending machines make a relatively small amount per month due to their very limited and monotone inventory. An average vending machine makes about \$250 per month, which is not that high, however our product is very different from typical vending machines and resembles a convenience store a lot more than a vending machine (D6). Unlike other vending machines, our machine offers a variety of inventory and resembles an automated over the counter store or a kiosk, rather than a typical vending machine. Kiosks at the mall make a lot of money in sales, but not as much in profit due to high rental costs (which average about \$3000 per month) and management cost. However, if we use their sales records, and replace the cost of renting a place in mall with the cost of renting a place for a vending machine, and adjust the management cost to something more fitting for a vending machine we end up with numbers such as \$6000 profit per month. However, given the limitations of our machine in terms of amount of inventory that it can hold, and the initial skepticism of people that are going to buy it, we can safely predict only up to about \$2000 in profit per month from a machines that are located in a prime location.

Overall, these statistics show that many of the alternatives to Vortex machines are very expensive, with costs that are prohibitive. This leaves a gap in the market that is perfect for Vortex vending machines to offer a low cost alternative that provides a superior level of convenience to customers.

4) **Measurement of Our Product [author: Yacoub]**

These are the key benefits of our product as compared to our competition:

The big thing that the whole idea builds on is low manufacture and maintenance cost. According to vending machine manufacturers, vending machines on average use up to \$1 per day for electricity (D4). Some of the cheapest vending machines cost under \$1000 and claim to bring in \$3,500 per machine excluding the cost of labour, meaning that vending machines pay themselves off much quicker, and have higher profit margin vs operation exchange margin (D5).

While most of the current vending machines are selling something very specific, snacks, drinks or toys, our vending machine sells items that are absolutely necessary for the area in which the machine is located and sell a variety of products, and at a cheaper cost. The reason why our product can sell more items and at a lower cost is because of dynamic item list that we have. Each machine does not have a default set number of items that it can have in it, our machines' inventories adjust based on what people want to see in them. For example, if we chose to place a machine in Middle School, or High School, we will be selling notebooks, pencils, pens, erasers in different colors, shapes and sizes; meanwhile machines that we place in colleges and near apartment complexes will have scantrons, cheap headphones, chargers, shot glasses, condoms, scratch lottery and pipes that say for tobacco use only on them (if you have never seen a store that sells all this, just go to sam's store that's almost attached to Vol Hall). What allows us to do that is the fact that we use a system that allows us to get exactly the item that we want out of the machine, regardless when it was put in. Almost all of our items will be placed inside of cheap plastic cases that come in different but pre-defined sizes. Our machine will know how to deal with different boxes and different sizes and know how to arrange them during load and give them to customers when they make a purchase. Our reserve and order system will allow customers to reserve items that they need, as well as order items if they are currently not present inside of a machine that customers use. Since we can have a variety of different items in different numbers, we can have a selection that's similar to a selection of a convenience store, but with lower prices. Our key plan is to sell a lot of items, with lower revenue margin in order to completely destroy our competition at first as well as attract attention. Shortly after people get used to buying items from our machines and we get good reputation, we will be able to increase prices just a little bit without worrying about increasing number of customers.

People have been always choosing places that they buy items from based on convenience. Some people find it very convenient to not have to drive for 30 minutes and then walk in a freezing cold place for a while and are okay with paying slightly more for their products, while others are willing to sacrifice some comfort for extra cash. Our machine will be able to help both. Since our machines will be placed everywhere, and our item prices are going to be very cheap, people will be able to save more money and time by using our machine. The software that comes with the machine also provides a very convenient way

for customers to buy our products. By just opening an application, users will be able to see what is inside of every machine, reserve items, and order items that are out of stock and have them delivered within next few days. Our software also takes care of reserve list, making it very convenient and safe for people to get their items from machine. On top of that, our software keeps track of all purchases made during different times as well as different provides information necessary for managers to make decisions on what type of products to stock up on.

Our machine carries a variety of items. It carries non-perishable goods, such as headsets, scantrons, mice and cables as well as some perishable goods. Some of our machines can be engineered to have a freezer and be able to store meat in a sanitary way for a couple of days (this function is order only). By delivering items such as milk, meat and other perishable goods, we can eliminate the need for people to ever use convenience stores.

Despite the fact that there are products that provide services which are slightly similar to our's, none of the machines that are currently out can provide the service that we are hoping to provide. We have a step up on every competition in every possible area, from other vending machines and small convenience stores, to supermarkets and big online stores such as amazon.

Another reason why our machine is very likely to be successful is because the way people buy things now have changed. Before people would go to a specialized store, and spend lots of time talking to the people who were there in order to decide what kind of device or tool they want to buy, however since almost everyone has access to the internet today, people no longer need to spend hours in the store listening to biased material, and can just go on a forum and read reviews/recommendations. This works out greatly for our vending machine, because that will eliminate the need for us to write extensive reviews and/or have a person working at the support center answering questions about products. We still provide some description for the products that are available on our website, as well as allow people to post reviews and comments, however we will not need to pay for a person to stay near a vending machine and explain what each product does. Also, we are going to be less likely to lose money on returns because we will not make a return process, making it impossible for people to buy a hundred things and then return all of them after using them for a week or two.

5) Design Decisions [author: Armstrong]

In some ways, when we first began this project we had no idea what we were doing. None of us had ever designed a mobile app, built a vending machine or used php. We had strong programming skills and had the drive to make it work however. For this reason we had many changes in our design for the project, and the final project was distinct from our original conception both internally and externally.

This was certainly not from lack of original planning. At the beginning we spent a lot of time discussing how to implement queries, which location had authority when there were conflicting data. We discussed how the machine should handle network failure cases and

what the network should do about it. We probably discussed all this a little too much and been better served to start designing prototypes, but this discussion undoubtedly worked out many of the kinks that would have haunted us had we not been so careful at the outset. We knew which of our goals were stretch goals, what options we had to explore, and how we were going to divide the labor.

The biggest thing that changed was our plan to have some sort of actual physical machine for use. Building the machine was almost completely out of the question as none of us had any real experience with circuits, motors or hardware design, and we already needed to build the network model, design the app, and set up the server mechanisms. However, luckily for us, we thought, Dimitri had an industry connection that might just make it possible. Hours were invested in vending machine and patent research, and we were hopeful about a positive outcome. Unfortunately nothing has come out of it thus far. This is an example of a decision that was made for us. There was nothing any of us could do except shell out thousands of dollars for a generic vending machine that wouldn't even meet our needs. This plan fell by the wayside as time constraints mandated that we move on to other, more essential parts of our project.

Another very large design decision was the platform used for our application. At the beginning, Chad wanted to design the app for IOS devices. He owned an iPad, and therefore already had the equipment needed for testing, but the using the Apple development environment costs money, and even though we could very likely have gotten funding from the university for that license, this hurdle caused us to first investigate the Android platform. Although beginning the project was difficult due to lack of experience with the Eclipse and the Android design pattern, we ultimately decided to go with Android.

There were several reasons for this decision. Firstly, Dimitri also owned a tablet, but his ran the Android operating system. Although Chad was the one in charge of app development this allowed us to do the necessary testing without having to make additional purchases. Secondly, we had heard that Android was more developer friendly. Because none of us had first hand experience of this, we had to rely on secondary accounts, but our discovery that IOS development required money certainly lent credence to the claim. Thirdly, Android development is based on Java, which we all knew fairly well. IOS development uses objective-c, which none of us had any experience with. Without a doubt it would have been easy enough to learn, but it was one more thing that would have to be done if we picked IOS. Fourthly, and probably most importantly, was simple inertia. Despite some problems with Eclipse, we very quickly had a simple "Hello World" program running on a virtual machine. After doing lots of research on Android development, there didn't seem to be any compelling reason to start from scratch. Ultimately, we reached a consensus in a group meeting. Android seemed like it was good enough, and once again Father Time urged us to pick up the pace and move on.

Another design decision was how to handle the server communication. None of us had any experience using php, GET or POST requests, or whatever other unknown technology that should be used to handle such things. We did, however, remember a sockets lab from CS360, and hypothesised that we could use that combined with a C program to store info in a custom file format and retrieve it upon request. After some quick

research, it seemed that our other option was using php in connection with an sql server. We divided the research. Alexander would look into the sockets option, and Chad would try the php solution. There were Android libraries for both, and both Alexander and Chad built working proofs of concept for the server, but ultimately one solution had to be chosen. There was some minor head butting on this issue. Both Chad and Alexander had invested time in their respective solutions, and therefore hoped to see their solution used. Ultimately Chad proved to be the more stubborn. There were very clear examples of similar, working code using php, and php allowed for a very clear interface with sql databases. From our previous CS classes we knew that sql was designed to handle exactly this sort of thing anyway. The prototype was built with php, and the final version eventually followed.

There were other, smaller changes along the way. The app flow was not as eventually conceived; a decision made imperiously by Chad during design. The sql table format evolved after original design. Eclipse was adopted almost instantaneously once we saw how it was integrated with Android, even though we had the underlying assumption that we would be working with vi, as we had in most of our other classes. The three outlined in the paragraphs above were the biggest design decisions we made, however, and our product would have been very different, and likely inferior, if we had made them any other way. Ultimately we worked well as a team, navigating and exploring options better than any of us would have been able to do as an individual.

6) **Manual [author: Sayers]**

Terms and Conditions:

1. General
 - 1.1. By installing the Application, you agree to be bound by these terms of use. Please review them carefully before installation and/or acceptance.
2. Definitions
 - 2.1. The “Application” shall mean the software provided by Vortex Vending to offer services related to Vortex Vending and Vortex Vending’s services to be used on mobile telephones and/or handheld devices and any upgrades from time to time and any other software or documentation which enables the use of the Application.
3. Proprietary Rights and Licenses
 - 3.1. All trademarks, copyright, database rights and other intellectual property rights of any nature in the Application together with the underlying software code are owned either directly by Vortex Vending or by Vortex Vending’s licensors.
 - 3.2. Vortex Vending hereby grants you a worldwide, non-exclusive, royalty-free revocable license to use the Application for your business and personal use in accordance with these Terms and Conditions.
4. Conditions of Use

- 4.1. You will not, nor allow third parties on your behalf to make and distribute copies of the Application, attempt to copy, reproduce, alter, modify, reverse engineer, disassemble, decompile, transfer, exchange or translate the Application, or create derivative works of the Application of any kind whatsoever.
- 4.2. The Application is currently made available to you free of charge for your personal, non-commercial use. Vortex Vending reserves the right to amend or withdraw the Application, or charge for the Application or service provided to you in accordance with these Terms and Conditions, at any time and for any reason.
- 4.3. You acknowledge that the terms of agreement with your respective mobile network provider will continue to apply when using the Application. As a result, you may be charged by the mobile network provider for access to network connection services for the duration of the connection while accessing the Application or any such third party charges as may arise. You accept responsibility for any such charges that arise.
- 4.4. If you are not the bill payer for the mobile telephone or handheld device being used to access the Application, you will be assumed to have received permission from the bill payer for using the Application.

5. Termination

- 5.1. Vortex Vending may terminate the use of the Application at any time by giving notice of termination to you.
- 5.2. Upon any termination, the rights and licenses granted to you herein shall terminate, and you must cease use of the Application.

6. Limitation of Liability

- 6.1. In no event will Vortex Vending be liable for any direct, indirect, special, punitive, exemplary or consequential losses or damages of whatsoever kind arising out of your use or access to the Application, including loss of profit or the like whether or not in the contemplation of the parties, whether based on breach of contract, tort (including negligence), product liability or otherwise.
- 6.2. Vortex Vending is not liable to you for any damage or alteration to your equipment including but not limited to computer equipment, handheld device or mobile telephones as a result of the installation or use of the Application.
- 6.3. Nothing in these Terms and Conditions shall exclude or limit Vortex Vending's liability for death or personal injury caused by negligence or for fraud or fraudulent misrepresentation or any other liability which cannot be excluded or limited under applicable law.

7. Disclaimer of Warranties

- 7.1. To the maximum extent permitted by law, and for the avoidance of doubt, Vortex Vending hereby disclaims all implied warranties with regard to the Application. The Application and software are provided "as is" and "as available" without warranty of any kind.

Warnings:

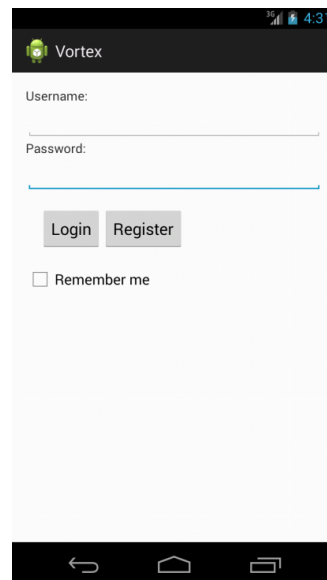
1. Application
 - 1.1. All usage of the Application must be as described in the Terms and Conditions.
 - 1.2. The Application may cause damage to the mobile telephone and/or handheld device during installation or during use. The user accepts all responsibility for this risk upon accepting the Terms and Conditions, installation and/or accessing the Application.
 - 1.3. Vortex Vending does not guarantee that any product, price, inventory or any other information displayed by the Application is representative of the true product, price, inventory or any other information displayed by the Vortex Vending Machine.
 - 1.4. The Application may not update to display changes in inventory immediately, due to purchases, restocking and/or for any other reason.
 - 1.5. The Application requires access to the mobile telephone and/or handheld device's current location. This information will be kept strictly confidential.
 - 1.6. The Application is merely provided as a reference ("as is").
2. Products
 - 2.1. The products contained within Vortex Vending Machines are subject to the Terms and Conditions of the respective manufacturer.
 - 2.2. Vortex Vending does not guarantee the quality of products contained within Vortex Vending Machines.
 - 2.3. The products contained with Vortex Vending Machines are subject to the health, safety, environmental and any other risks that are defined by the respective manufacturer of the product. Consult the manufacturer to find out about these risks.
3. Vending Machines
 - 3.1. Any improper usage, operation, moving and/or other actions may result in injury. Vortex Vending is not responsible for such actions and/or the resulting injuries.
 - 3.2. Any of the actions described above may result in environmental harm. Vortex Vending is not responsible for such actions and/or the resulting environmental consequences.
 - 3.2. Vortex Vending Machines' availability is subject to the availability of electricity, internet and any other required resource. Vortex Vending is not responsible for any downtime due to a disruption of these resources.
 - 3.3. Vortex Vending Machines' inventory is subject to the restocking by the respective owners. Vortex Vending is not responsible for any downtime due to a disruption of these services.

Setup:

In order to set up and install the application, click on the link on the project weblog. Once you click the link you should be presented with a menu asking you to confirm your

download of the android apk file required to access the Vortex application on your android device or your download should start automatically. Confirm the download if required and the application will be loaded onto your device. At this point the apk is not available on the android market since the design process is only in alpha stages. We anticipate publishing a version to the android market as soon as we are satisfied with the operational and structural integrity of the code.

Once the application is installed on the mobile telephone or handheld device, you will need to create an account. The account will give you access to the vending machine contents information, order history information and the ability to order and reserve items for purchasing. Open the application on your android device.



Upon opening the device you should be presented with the above login screen. There is a sign in and a register button. The functionality of the sign in button will be discussed in the usage section of the manual. The register button will take you through the registration process, which will help you create a Vortex account. Click on the register button and you will be taken to the registration screen.

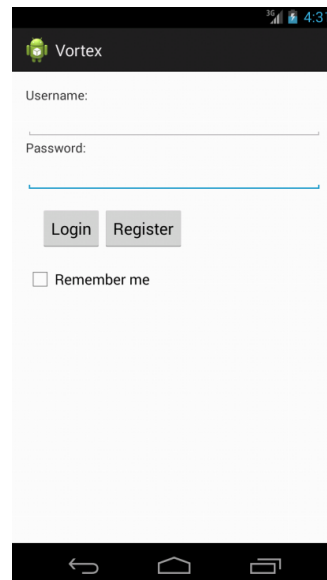
Enter a valid username and password combination. Note that you must check the box regarding accepting the Terms and Conditions before you can use the application. The Terms and Conditions are listed in this manual above. Once you have checked the box, you may click the register button and your account will be created. You will be automatically be logged on upon registering your account.

You are now ready to use the application. How to use the application will be covered in the usage section of the manual below.

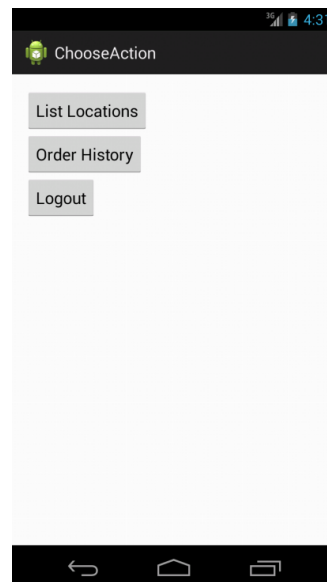
Use:

In order to use the application, open the application on your mobile telephone or

handheld device if you have not done so already.

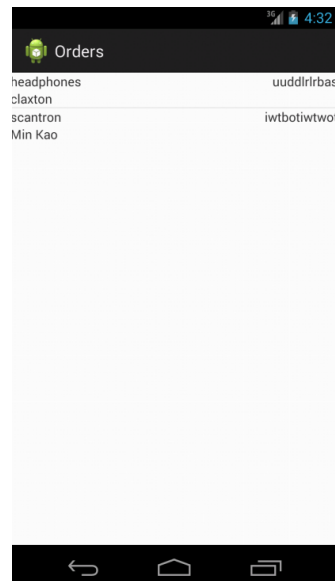


Upon opening the device you should be presented with the above login screen. Enter your valid username and password combination and click the sign in button. If you incorrectly enter your username and/or password, you will have to try again before you can access the application. There is also a check box that enables you to have your login information stored, which is convenient if you plan to use the application often. Upon successfully entering your details, you will be taken to the menu screen below.

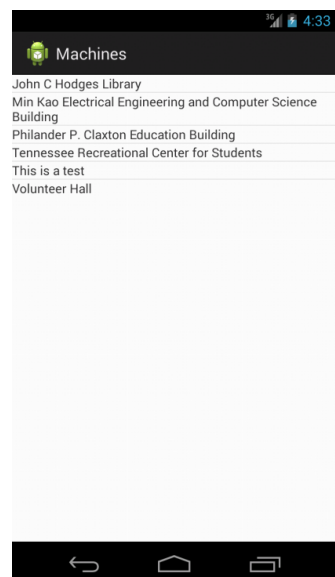


There are two options other than the log out option at this point. To review the order history, select the order history button. This will allow you to review your successfully

completed past orders. It will also show you the access codes, which you will need to enter into the Vortex Vending Machine in order to collect your item. A screen similar to the following will appear with your current order history.

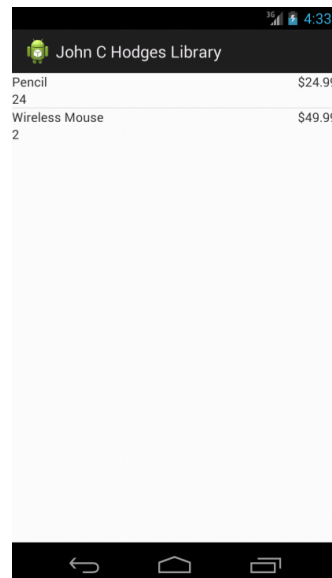


To review the available vending machine options, select the list locations button. This will list all of the available Vortex Vending Machines alphabetically. In future versions of the application, this list will be ordered by distance from your current location. A screen similar to the following will appear with a list of vending machines.



To view the contents of the vending machines, select the machine on the list that you want to see the contents of. This will list the items that are both in and out of stock in

your selected vending machine. The item names will be listed alphabetically along with the price and the current inventory. Upon selecting a vending machine, you will be taken to a screen with a list of items similar to the one below.



Click on a desired item in order to either order or purchase that item. Items that are in stock can be reserved for purchase on location, or purchased on the mobile device. Items that are out of stock can be ordered, which will send a request to replenish the stock and the item will be reserved for your purchase upon availability. The functionality at this point is limited to only ordering and reserving items, but purchasing of items will shortly be implemented. A message will appear to confirm your order/reservation/purchase upon successful completion of the transaction.

After clicking on the screen anywhere you will be taken back to the machine items. To review the order, click the back button on your mobile telephone or handheld device until you get back to the menu screen. By clicking the order history button, you should now see your purchase at the top of the list. The confirmation number and the specific Vortex Vending Machine associated with your order will be listed.

When you reach the conveniently located Vortex Vending Machine associated with your order, you will need to enter the confirmation code associated with your order. At this point you will need to pay for your order. This process could vary slightly from machine to machine, but credit and debit cards will both be accepted.

The final step is to take your item out of the Vortex Vending Machine. You have now successfully purchased your first item from a Vortex Vending Machine. You can continue to use the mobile application to view purchasable items at convenient locations and at cheap prices.

Code Organization:

In order to download the application, follow the guidelines outlined in the setup section of this manual. This will give access to the most recent working and tested version of the Android application.

The application is created using Eclipse as the IDE with Java as the programming language, since Android is coded in Java. This is where we manage the appearance and the functionality of the application itself. The code for this project is divided into separate functions to represent the operation of each page within the final application. The code uses PHP to query and access the information stored in a MySQL database. This is where the queries and interactions with the MySQL database are managed. The database is currently hosted by a free online database service; however as the development of the system progresses the database will be relocated to private servers. The current database is solely a test database to ensure that we are able to test prototypes often in order to ensure that we are maintain the integrity of our code at all stages of the design process. There is also a website, which enables database management conveniently. We use this method as the primary means of adjusting the data in the MySQL database as it creates a simple and easy to use GUI that enables all the required database management functionality.

Access to the project code can be reached through the project weblog (www.vortex-products.webs.com). The code can be modified and improved by the public. The developers maintain a backup copy of the most recent working and tested version of the code. This will prevent malicious attempts at destroying the code from impacting the current customer base of Vortex Vending Machines. Access to the database at this point is strictly limited to the developers of the code, since public access to database information could easily lead to fraudulent behavior. The website is currently not available for modification by the public due to the access it would give the public to the database.

In order to modify and improve the application code, visit the project weblog. There is a combination of links specifying the type of files that you can view and modify. Currently there is the java files required to modify the application processes including the visuals of the application. We recommend using Eclipse to modify these files, but it is not required. There is a set of php files that govern the interactions between the application and MySQL server database, which can also be modified and improved. Finally there are a set of vending machine management files, which we currently use to examine and modify the database contents.

All of these files have been stored in either a zip or a tarball for convenience of loading and moving them. Any files can be modified and sent back to any of the three project developers listed at the head of this report. We will examine the changes made to the files and will update the current version if they are deemed to have improved the current code base. We appreciate any help from developers and will acknowledge any major contributions to the success of the project. All code that is currently available is a work in process, so it is within reason that at this point many changes will need to be made to bring the code up to publishable standards. If you make significant changes to the current code base, we require that code is commented so that we can understand the changes easily and ensure the integrity of the changes that are made. It is worth noting that the current database is a test database so changes to the contents and status of the database is

permitted, but we ask that changes be kept to a minimum since it is likely that other developers will be using the database at the same time as you.

7) **References Cited**

(A1)

<http://www.statisticbrain.com/vending-machine-industry-statistics/>

(A2)

<http://www.vend-resource.com/book/surveys-and-vending-industry-statistics>

(A3)

<http://www.vend-resource.com/sites/default/files/ec0244i02%5B1%5D.pdf>

(A4)

<http://www.vend-resource.com/sites/default/files/Vending-Times-Census-2010.pdf>

(A5)

http://www.bls.gov/oes/current/naics4_454200.htm

(D1)

<http://www.firstresearch.com/industry-research/Convenience-Stores-and-Truck-Stops.html>

(D2)

<http://thompsonhall.com/starting-your-own-gas-station-minnesota-business-attorney/>

(D3)

<http://www.marketwatch.com/investing/stock/wmt/financials>

(D4)

http://www.michigan.gov/documents/CIS_EO_Vending_Machine_05-0042_155715_7.pdf

(D5)

<http://vendingmachinesoc.tripod.com/id11.html>

(D6)

<http://adviceaboutfinance.com/2012/02/18/making-a-1000-a-month-off-of-10000-through-vending-machines/>