

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING  
THE UNIVERSITY OF TEXAS AT ARLINGTON**

**SYSTEM REQUIREMENTS SPECIFICATION  
CSE 4316: SENIOR DESIGN I  
FALL 2021**



**VENDING SERVICES  
AUTOMATED VENDING & RESERVATION SYSTEM**

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## REVISION HISTORY

Revision	Date	Author(s)	Description
0.1	10.25.2021	HL	document creation
0.2	11.05.2021	WA, HL, SS, NW	complete draft

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# 1 PRODUCT CONCEPT

This section summarizes the interactions and general workflow for the smart vending machine. A server will handle all orders, payments, reservations, etc. It will dictate commands to the smart vending machine. The smart vending machine will send status reports and inventory information back to the server. The user will primarily use a touchscreen or a mobile app, both for payment and for ordering.

## 1.1 PURPOSE AND USE

The smart vending machine should be able to a) allow ordering from remote locations via mobile app b) reservations / inventory checks from remote locations c) ordering without a phone using touchscreen d) vending goods.

## 1.2 INTENDED AUDIENCE

We expect it to be used either by people who frequent the building it is located in / around (using mobile app) or by random visitors with the touch screen. Commercially, we would expect this to be bought by vending service companies (for large corporations, universities, etc.) or small businesses for convenience. This product is designed for a wide spectrum of potential customers. It is intended for general use.

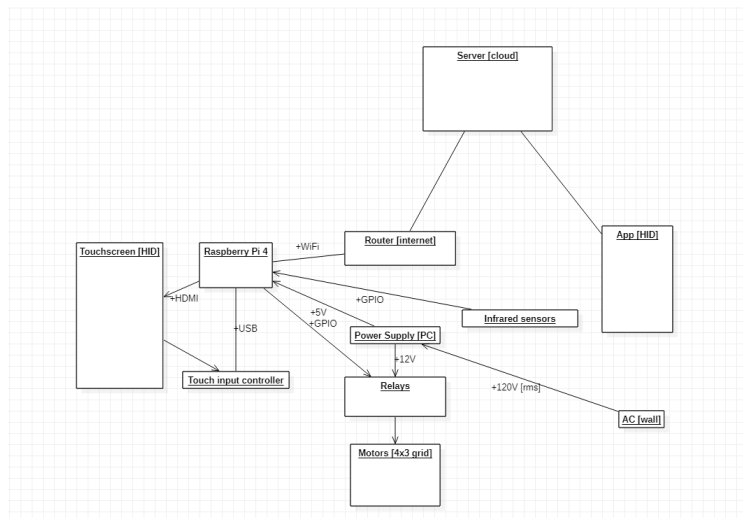


Figure 1: Subsystems and components

## 2 PRODUCT DESCRIPTION

This section provides an overview of our vending machine and related systems. The main aspects of the project will be defined here. The key interactions or features will be described in detail in this section.

### 2.1 FEATURES & FUNCTIONS

Our vending machine is composed to two major components: the physical vending machine and the mobile app. The physical machine will act as a normal vending machine that accepts payments with cash or card, and it will communicate with the mobile app to dispense items that the user has reserved in advance. Users will interface with the machine through a touch screen connected through a Raspberry Pi. The internal functions will also be controlled with the same Raspberry Pi. The mobile app will communicate with the machine through a central server that will keep track of the inventory. The mobile app is where users can pay for items in advance and reserve them in the machine. After the user orders a item, the app will then generate a unique code that the user will enter into the machine to retrieve their item. See Figure 1 above for a list of systems.

### 2.2 EXTERNAL INPUTS & OUTPUTS

#### Inputs

Name	Description	Use
Order Code	Six-digit numeric code generated from app for a user's order	To obtain user's reserved order from the machine
User order	List of user's selected order from app	To create a order and update available inventory in the machine
User payment	Payment taken from user	To purchase items
User information	User phone number and preferences	Used to create user's account
Secret controls password	Code for individuals to perform maintenance	To access secret controls menu

#### Outputs

Name	Description	Use
Items	The items from the machine	To be dispensed after the user enters their order number

### 2.3 PRODUCT INTERFACES

We will have two interfaces, APM (AVRS Physical Machine) touchscreen and mobile app. They both will have the same general UX (User eXperience) for users. On the APM touchscreen, admins will have access to a admin sign on page via a combination of presses (hidden menu) and a password which will allow them to view reports (anti-theft, sales, errors, etc.) and update or correct inventory as needed. As for re-stocking, there will be a key on the back door. Admins will also have a way to check machine statuses remotely. Users will use the APM touchscreen primarily for item selection and reservations. On the mobile app, users will have access to machine selection, item selection, ordering, reserving, order history, etc.

## 3 CUSTOMER REQUIREMENTS

This section discusses about the requirements of the observable features and functions of the product that will be encountered by its users. The requirements specified in this section are created with, and must not be changed without, specific agreement of the intended customer/user/sponsor.

### 3.1 APPEARANCE

#### 3.1.1 DESCRIPTION

The exterior of the APM will have a matte white appearance, and our army green livery (decals and logo) will be prominently displayed on the top portion of the machine and on the sides. The serial number plate will be riveted to the inside wall of the machine. The APM will have a glossy black touchscreen for user interaction, a radio antenna for communications mounted on the top, and a transparent window for customers to view items for sale. The internals of the APM must be separated into several compartments for items, electronics, and pickup. The mobile app will also follow these color guidelines.

#### 3.1.2 SOURCE

This source of this requirement is William Anderson, Han Le and Sean Slater, members of Vending Services.

#### 3.1.3 CONSTRAINTS

The specified color must be commercially available in paint and vinyl capable of adhering to the steel of which the APM is manufactured (See Packaging Requirement 4.1 for specific colors). The serial number plate must be of .032 inch Aluminum in order to withstand stamping of large amounts of characters. The touchscreen used is a 7.9 inch 1280 x 400 TFT panel right-justified of the front panel. There will be a large transparent window left-justified on the front panel. On the side and on the top, there is a ventilation louver to allow for fresh air and exhaust heat. On the rear of the APM, there will be a access door to access the internals of the machine. At the bottom of the front panel is an access door to retrieve orders.

#### 3.1.4 STANDARDS

The standards for this requirement is HEX color specifications. [1]

#### 3.1.5 PRIORITY

The priority of this requirement is critical, it is a must have or this product is a failure. Every aspect of the look and feel has been carefully considered to prevent potential issue or controversy that may arise from this product.

### 3.2 SELECT AN ITEM

#### 3.2.1 DESCRIPTION

Customers may select up to six different items, since the vending machine will initially have six individual unique items. Users using the mobile app may also view their shopping cart with the items in it. Users may also change the items and their amounts in the shopping cart.

#### 3.2.2 SOURCE

William Anderson and Sean Slater, members of Vending Services.

#### 3.2.3 CONSTRAINTS

The user must have an verified account created with AVRS to view, add, and modify items in a shopping cart. At the APM, an account is not required to order items for sale. The process for selecting items will



be similar to the mobile app.

#### **3.2.4 STANDARDS**

There are no applicable standards for this requirement.

#### **3.2.5 PRIORITY**

The priority of this requirement is critical, it is a must have or this product is a failure

### **3.3 PLACING AN ORDER**

#### **3.3.1 DESCRIPTION**

Customers may make a reservation to pick up an item at a vending machine location. Customers will receive an order code to use at the machine to pick up their order. Customer is using the vending machine without the app may not need to make a reservation, simply make a payment and the items ordered will be dispensed.

#### **3.3.2 SOURCE**

The source of this requirement is William Anderson, member of Vending Services.

#### **3.3.3 CONSTRAINTS**

The customer must have an account with the mobile app in order to place reservations

#### **3.3.4 STANDARDS**

There are no applicable standards for this requirement.

#### **3.3.5 PRIORITY**

The priority of this requirement is critical, it is a must have or this product is a failure

### **3.4 MANAGE ACCOUNT INFORMATION**

#### **3.4.1 DESCRIPTION**

Customers may manage their account information by changing the phone number that they use for account authentication, change the payment method, and changing the email address.

#### **3.4.2 SOURCE**

The source of this requirement is from all members of Vending Services

#### **3.4.3 CONSTRAINTS**

The user must have set up a verified account in the mobile app. The account must have all these aspects previously entered in order to change them.

#### **3.4.4 STANDARDS**

There are no applicable standards for this requirement.

#### **3.4.5 PRIORITY**

The priority of this requirement is critical, it is a must have or this product is a failure

### **3.5 PICKUP AN ORDER**

#### **3.5.1 DESCRIPTION**

Customers making and placing orders through the mobile app will be required to pick up their items within 24 hours, before the reservation expires and their money is refunded. Customers will receive an

order code and they will go to the machine selected for pick up, and enter in the code to the machine and then the machine will promptly dispense their order.

### **3.5.2 SOURCE**

The source of this requirement is Sean Slater and William Anderson, members of Vending Services

### **3.5.3 CONSTRAINTS**

The customer must have made an order through the mobile app. The customer must also have an order code that was given to them when the order was placed. The customer must also pick up their order by the time specified.

### **3.5.4 STANDARDS**

There are no applicable standards for this requirement.

### **3.5.5 PRIORITY**

The priority of this requirement is critical, it is a must have or this product is a failure

## **3.6 MAKING A PAYMENT**

### **3.6.1 DESCRIPTION**

The customer will be able to view the price of each item and a running total of their order on the APM and the mobile app. The customer will be able to add a "payment card" and use it to place an order on the mobile app. At the APM, there will be an NFC module for a user to tap the payment card to pay for their items.

### **3.6.2 SOURCE**

Sean Slater and Noah Walker, members of Vending Services

### **3.6.3 CONSTRAINTS**

In this iteration of the project, Vending Services will be using programmable NFC magnetic-stripe cards that will be preloaded with "money". Due to legal concerns from the Department of Computer Science and Engineering at UTA, we will not be accepting or processing real payment cards, coins, or cash as of this time.

### **3.6.4 STANDARDS**

There are no applicable standards for this requirement.

### **3.6.5 PRIORITY**

The priority of this requirement is high, it is a must have or this product is a failure

## **3.7 LOADING A MACHINE**

### **3.7.1 DESCRIPTION**

All vending machines must contain items for sale. To provide business value, several different unique products of varying amounts must be placed in a vending machine for users to buy. The APN is designed to hold up to 72 items of six different unique types.

### **3.7.2 SOURCE**

William Anderson and Sean Slater, member of Vending Services

### **3.7.3 CONSTRAINTS**

Maintenance Personnel will be given a unique physical key to unlock the service door of the machine. Then, the physical unit must be turned off by a flip of a switch from the internal power supply. Then, the large bus connector must be removed from the relay board. Then the locking lever holding in the motor assembly may be released and slid out for loading items.

### **3.7.4 STANDARDS**

There are no applicable standards for this requirement

### **3.7.5 PRIORITY**

The priority of this requirement is critical, it is a must have or this product is a failure

## 4 PACKAGING REQUIREMENTS

This section covers the packaging requirements of the AVRS Physical Machine (APM) and mobile app that will be observed in the development of the APM and the mobile app. These requirements are to be the first impressions that a customer may have with the mobile app and the APM, as such it is critical to be considered in development.

### 4.1 HARDWARE PACKAGING

#### 4.1.1 DESCRIPTION

the machine will be shipped partially assembled and will require some assembly to make it fully operational. Inside the machine, it should contain the motor-product bin sub-assembly, a pair of photo-electric sensors, a cast iron weight with the Anti-Theft Security Module, Relay Control Module, Power Distribution Module , Internal Power Supply, Wireless Module & Antenna, and the Vending Computer Sub-Assembly. The matte white appearance will be of color code #FDFBF9 and the vinyl stickers will be of color code Army Green #4b5320.

#### 4.1.2 SOURCE

This source of this requirement is William Anderson and Sean Slater, members of Vending Services..

#### 4.1.3 CONSTRAINTS

All items in the machine must be present and connected in accordance to the steps located the instruction manual provided to the installer by Vending Services(See Other requirements for more information for configuration). The vinyl stickers will be pre-installed during manufacture.

#### 4.1.4 STANDARDS

The standards for this requirement is the HEX color specifications [1].

#### 4.1.5 PRIORITY

The priority of this requirement is critical, as the machine is required to turn on in order to operate.

### 4.2 AVRS OS PACKAGING

#### 4.2.1 DESCRIPTION

The custom OS software for the APM will come prepackaged on a 64GB MicroSD card as that is the main boot interface that the vending computer operates on. A separate 64GB USB flash drive may be provided in the event of drive failure which contains an image of AVRS OS, a custom operating system designed for APM units. AVRS OS will be derived off of Ubuntu Linux 21.10 or later.

#### 4.2.2 SOURCE

This requirement is part of the CSE Senior Design project specifications and all members of Vending Services.

#### 4.2.3 CONSTRAINTS

Upon first boot, maintenance personnel are required to enter the serial code of the machine, and ensure internet connection where it may communicate with a server for validation. For flashing AVRS OS, maintenance personnel may use a computer with startup drive imaging software to reflash AVRS OS to another SD card.

#### 4.2.4 STANDARDS

There are no applicable standards here.

#### **4.2.5 PRIORITY**

The priority of this requirement is critical, as AVRS OS is required to operate the machine.

### **4.3 MOBILE APP PACKAGING**

#### **4.3.1 DESCRIPTION**

The AVRS mobile application must be available as a free download on the iOS App Store and Google Play for Android versions. Customers may also be able to use the mobile app on iPadOS, MacOS devices with Apple Silicon and ChromeOS but Vending Services will not be supporting these systems directly.

#### **4.3.2 SOURCE**

This requirement is specified by William Anderson and Noah Walker, members of Vending Services.

#### **4.3.3 CONSTRAINTS**

The user must have a compatible iOS device that runs iOS 12.0 or later. For Android users, any device that supports Android 8.0 or higher is required for the AVRS mobile app. The user must accept all agreements of each respective app store and sign into their account.

#### **4.3.4 STANDARDS**

The applicable standards for this requirement are the Apple App Store Review Guidelines, Developer Policy Guidelines for Google Play, and their respective user agreements. [2] [3]

#### **4.3.5 PRIORITY**

The priority of this requirement is critical, as the user must be able to use the app to make reservations.

## **5 PERFORMANCE REQUIREMENTS**

This section covers the performance requirements of the APM and mobile app that will need to be fulfilled before it may be approved for use by our customers, maintenance personnel and the general public. Additionally, the fulfillment of these requirements will reduce the number of liabilities and issues that Vending Services will face now and in the future with AVRS.

### **5.1 RESERVATION PERFORMANCE**

#### **5.1.1 DESCRIPTION**

The customer may place an order from anywhere around the world, so long that there is an Internet connection from the main device itself that the customer places an order on. As such a reservation needs to be available for pick up at the machine in a timely manner.

#### **5.1.2 SOURCE**

Han Le and Sean Slater, members of Vending Services

#### **5.1.3 CONSTRAINTS**

The customer must be able to pick up their order within 10 minutes of ordering

#### **5.1.4 STANDARDS**

There are no applicable standards for this requirement.

#### **5.1.5 PRIORITY**

The priority of this standard is high as it is important to customer acceptance and desirability

### **5.2 DELIVERY PERFORMANCE**

#### **5.2.1 DESCRIPTION**

Once a customer has entered in their six-digit order code to pick up from the APM, the machine will need to be able to quickly dispense all of the items in the order list so that customers may enjoy their orders as soon as possible.

#### **5.2.2 SOURCE**

Sean Slater and Han Le, members of Vending Services

#### **5.2.3 CONSTRAINTS**

The customer must be able to receive all items in an order in under 1 minute or less. The customer must have placed an order that is available for pickup.

#### **5.2.4 STANDARDS**

There are no applicable standards for this requirement

#### **5.2.5 PRIORITY**

The priority of this standard is high as it is important to customer acceptance and desirability

### **5.3 STARTUP PERFORMANCE**

#### **5.3.1 DESCRIPTION**

Any downtime on a vending machine is lost business value, as such, the APM must be able to be able to be operational within a very short amount of time to accept orders from potential customers. This requirement is meant for startups following inventory additions to the machine by maintenance personnel.

### **5.3.2 SOURCE**

William Anderson and Sean Slater, member of Vending Services.

### **5.3.3 CONSTRAINTS**

The APM will be powered on, connected to the internet, and be fully operational within 10 minutes.

### **5.3.4 STANDARDS**

There are no applicable standards for this requirement

### **5.3.5 PRIORITY**

The priority of this standard is high as it is important to customer acceptance and desirability

## **5.4 APP PERFORMANCE**

### **5.4.1 DESCRIPTION**

The client app and AVRS OS is the first impression that customers will have with AVRS. It is very important that the customer is not left with a bad impression of the client app as this could directly affect the business value of this project

### **5.4.2 SOURCE**

Noah Walker and William Anderson, members of Vending Services.

### **5.4.3 CONSTRAINTS**

The user interface will be free from lag and must be fast in performing tasks. Transitions between screens and tasks will be done so that it appears as responsive as possible. The app and AVRS OS will be optimized to use as little storage and memory space as reasonably possible.

### **5.4.4 STANDARDS**

There are no applicable standards for this requirement

### **5.4.5 PRIORITY**

The priority of this standard is high as it is important to customer acceptance and desirability

## **6 SAFETY REQUIREMENTS**

This section covers the safety requirements of the AVRS Physical Machine (APM) and mobile app that will need to be fulfilled before it may be approved for use by our customers, maintenance personnel and the general public. Additionally, the fulfillment of these requirements will reduce the number of liabilities and issues that Vending Services will face now and in the future with AVRS.

### **6.1 SHARP OBJECTS**

#### **6.1.1 DESCRIPTION**

The APM must be designed and built such that there are no sharp objects or characteristics that may cause injury to users, vendors, and maintenance personnel who may use the APM. The human-interaction device must also have some sort of protections to prevent injury to users who may break it.

#### **6.1.2 SOURCE**

The sources of this requirement is CSE Senior Design project requirements and NSF/ANSI 25-2021 [4]

#### **6.1.3 CONSTRAINTS**

The APM will be constructed from automotive-grade, 18-gauge steel with rounded corners and edges to minimize the chance of cuts due to unfinished and/or jagged metal from the manufacturing process. Additionally, the transparent window of the APM will be made of clear plexiglass to reduce the chance of breakage and reduce the chance of injury to users. The plexiglass will be bonded to the APM chassis using 3M two-part, commercial-grade epoxy #DP8407NS. The touchscreen component of the vending computer sub-assembly will have some sort of tempered glass protection and be bonded to the machine with Tesa #4605 double-sided heat-resistant adhesive tape.

#### **6.1.4 STANDARDS**

The applicable standards for this requirement is ISO 7823-1 (E) [5] and ASTM D638 - 14.

#### **6.1.5 PRIORITY**

The priority of this requirement is moderate, and should have for proper product functionality

### **6.2 ANTI-ROCK PROTECTION**

#### **6.2.1 DESCRIPTION**

The APM must have some sort of anti-rock protection such that it protects customers from tipping over which may cause serious bodily injury or death. Additionally, the APM must also contain a theft deterrent to would-be thieves in order to protect inventory and valuable electronic systems. The anti-rock protection must also serve to counteract potential user abuse to the APM.

#### **6.2.2 SOURCE**

The source of this requirement is William Anderson and Sean Slater, member of Vending Services

#### **6.2.3 CONSTRAINTS**

The APM will utilize an anti-rocking mechanism known as the Anti-theft Security Module, which consists of a GPS, IMU, and a cast-iron 50 pound weight. Additionally, the APM is to be constructed of automotive-grade steel which should be resistant to moderate forms of abuse. The unit will report a tip event to the maintenance personnel which will require a reset of the system. The system must be inspected for damage and repaired accordingly. During this period, the system will be out of service and the mobile app will communicate such messages to users.



#### **6.2.4 STANDARDS**

There are no applicable standards for this requirement

#### **6.2.5 PRIORITY**

The priority of this requirement is moderate, and should have for proper product functionality

### **6.3 ELECTRICAL SAFETY**

#### **6.3.1 DESCRIPTION**

The APM must have various safeguards to prevent electrical power overloads, shorts, and shocks which may result in a fire and/or electrocution. The APM must also have secure connections with all electrical components and systems to prevent arcing, shorts, and component failure. The APM must have current overload protection through the use of fuses in the Power Distribution Module and in the internal power supply.

#### **6.3.2 SOURCE**

The source is Section 250 of the National Electric Code (NEC [6], and William Anderson and Sean Slater, members of Vending Services.

#### **6.3.3 CONSTRAINTS**

The APM will be grounded at various points on the chassis. The internal power supply will use a standardized 3-prong power plug with a built-in ground. All six motors in the Motor-Product Bin sub-assembly will be using Molex MX150 six-pin male connectors. The Main Power Distribution Module will contain six 20A blade-type, ATO-size [7] fuses and six Molex MX150 [8] six-pin female connectors.

#### **6.3.4 STANDARDS**

The standards for the power supply plug is the NEMA 5-15-P [9] standard. The standards for the fuses is covered under ISO 8820-3 [10] and SAE J1284 [11].

#### **6.3.5 PRIORITY**

The priority of this requirement is moderate, and should have for proper product functionality

### **6.4 ENVIRONMENTAL PROTECTIONS**

#### **6.4.1 DESCRIPTION**

The APM must be only operated in a well-lit room, area, or space that can be kept clean and is protected from overhead leakage from drains and piping or other contamination. Additionally, surfaces and openings of the APM must be cleanable and not cause damage to items for sale. All external openings of the APM must be filtered and/or sealed to prevent insect or rodent infestation.

#### **6.4.2 SOURCE**

The source of this requirement is from the City of Arlington and NSF/ANSI 25-2021 [4], the city where the vending machine will be operated.

#### **6.4.3 CONSTRAINTS**

The APM will be located so that the space around and under it can be readily cleaned and there is no place for insects and rodents to nest. Additionally, all surfaces and openings of the APM will be able to be cleaned with common household cleaners to prevent the spread of disease.

#### **6.4.4 STANDARDS**

The standard for this requirement of this requirement is the NSF/ANSI 25-2021 [4].

#### **6.4.5 PRIORITY**

The priority of this requirement is moderate, and should have for proper product functionality

### **6.5 FOOD PROTECTION**

#### **6.5.1 DESCRIPTION**

All items offered for sale through vending machines must be manufactured, processed, and prepared in establishments that comply with all applicable local, state, and federal laws and regulations. They must be wholesome and free from spoilage, contamination, and adulteration. All packaged foods or beverages must be labeled in compliance. All items will have a calorie count prominently displayed in the mobile app and on the APM itself in the menu.

#### **6.5.2 SOURCE**

The source of this requirement is the Uniform Food, Drug and Cosmetic Act of 1938 [12] and NSF/ANSI 25-2021.

#### **6.5.3 CONSTRAINTS**

All items will be sealed in original packaging and the APM will be only operated indoors at temperatures between 55 and 90 degrees Fahrenheit. Care will be taken to ensure that Vending Services product suppliers receive unspoiled items.

#### **6.5.4 STANDARDS**

The standard of this requirement is the NSF/ANSI 25-2021 [4]

#### **6.5.5 PRIORITY**

The priority of this requirement is moderate, and should have for proper product functionality

### **6.6 ILLEGAL AND/OR DANGEROUS PRODUCTS**

#### **6.6.1 DESCRIPTION**

Harmful and/or Illegal products, such as but not limited to: tobacco products, weapons, drugs, alcohol, etc. will not be sold at the APM. Vending Services will only sell food based items in APM units to the public.

#### **6.6.2 SOURCE**

The source of this requirement is numerous. The tobacco ban is regulated by the Texas Health and Safety Code Sec. 161.086 [13]. CSE Seiner Design project requirements expressly prohibits the sale of weapons and drugs. The Texas Alcoholic Beverage Code Â§5.57, Section 51.09 [14] and Texas Health and Safety Code Sec. 161.086 prohibits the sale of alcohol at unattended vending machines.

#### **6.6.3 CONSTRAINTS**

Maintenance personnel are required to restock the machine using a pre-approved inventory stocking plan by Vending Services. The inventory stocking plan will be in full compliance of these regulations described above.

#### **6.6.4 STANDARDS**

There are no applicable standards for this requirement.

#### **6.6.5 PRIORITY**

The priority of this requirement is moderate, and should have for proper product functionality

## **7 MAINTENANCE & SUPPORT REQUIREMENTS**

This section covers the requirements for continued use and operation. The vending machine will need to be periodically restocked or repaired. Restocking will be the most common maintenance item but repairs might need to be performed in the field. The customer will have access to information and support to complete repairs as needed.

### **7.1 ITEM RESTOCKING**

#### **7.1.1 DESCRIPTION**

The APM automatically keeps track of the inventory level of all items inside. Restocking will be done from the rear of the machine using the lockable rear door. This is the most common maintenance requirement required by a vendor.

#### **7.1.2 SOURCE**

The source of this requirement is Han Le and Sean Slater, members of Vending Services.

#### **7.1.3 CONSTRAINTS**

The APM will notify maintenance personnel through a cloud-based system when the inventory is in need of replenishment. When the unit is depleted, the APM will enter standby mode and prominently warn potential customers that items are out of stock. Maintenance personnel are then required to reload the machine and reset the system. Documentation will be provided to complete these steps.

#### **7.1.4 STANDARDS**

There are no applicable standards for this requirement.

#### **7.1.5 PRIORITY**

The priority of this requirement is high. Restocking should be easy and ergonomic from the rear of the machine.

### **7.2 SOURCE CODE**

#### **7.2.1 DESCRIPTION**

The source code will be available on the internet for users to view, use, and modify code without the need for permission or publication of changes.

#### **7.2.2 SOURCE**

The source of this requirement is all of the members of Vending Services.

#### **7.2.3 CONSTRAINTS**

The AVRS OS, mobile app and all related code and documentation will be available and hosted on GitHub. Vending Services will ensure the repository is open to the public.

#### **7.2.4 STANDARDS**

The standards that apply for this requirement is the MIT License. [15]

#### **7.2.5 PRIORITY**

The priority of this requirement is low. Open-source would allow advanced users to add features or fix issues well into the future.

## **7.3 ERROR HANDLING**

### **7.3.1 DESCRIPTION**

Occasionally, errors will occur with the AVRS mobile app and the APM. Errors must be dealt with gracefully so as to not impede operation or give a bad impression to clients.

### **7.3.2 SOURCE**

The source of this requirement is William Anderson and Sean Slater, members of Vending Services.

### **7.3.3 CONSTRAINTS**

There will be several different levels of errors: warning, error, fatal. Warnings will only be for tracking issues. Errors will be recoverable. Fatal will be unrecoverable.

### **7.3.4 STANDARDS**

There are no applicable standards for this requirement.

### **7.3.5 PRIORITY**

The priority of this requirement is critical. It must be considered in the development of AVRS or it will be a failure.

## **7.4 HARDWARE FAILURE**

### **7.4.1 DESCRIPTION**

There is a risk that a component of the APM may fail. As such, the APM will need to alert maintenance personnel and shut down sales in this event.

### **7.4.2 SOURCE**

The source of this requirement is William Anderson and Sean Slater, members of Vending Services.

### **7.4.3 CONSTRAINTS**

There will be hardware checks / monitoring present in the APM. Any hardware failure will result in the APM entering an "out of order" state. The extent of monitoring will depend on the amount of time for testing.

### **7.4.4 STANDARDS**

There are no applicable standards for this requirement.

### **7.4.5 PRIORITY**

The priority of this requirement is high. It must be considered for customer acceptance and desirability

## **7.5 WARRANTIES**

### **7.5.1 DESCRIPTION**

All AVRS software and APM hardware and schematics is free to use "as-is" by the public, as such there will be no warranty issued and Vending Services will not be liable for issues that may stem from the use of this product.

### **7.5.2 SOURCE**

The source of this requirement is William Anderson and Sean Slater, members of Vending Services.

### **7.5.3 CONSTRAINTS**

Any clients will have to first acknowledge the warranty information before the machine can be set up. After setting up, no warranty specific information needs to be displayed again. As such, end-users should not need to see warranty information.

### **7.5.4 STANDARDS**

There are no applicable standards for this requirement.

### **7.5.5 PRIORITY**

The priority of this requirement is low. It would be nice to have with this product.

## **7.6 MAINTENANCE SOFTWARE**

### **7.6.1 DESCRIPTION**

There will be a section of the software designed for machine maintenance. The extent of this depends on how much time we have to develop it. At a basic level, it will allow updating stock or resetting errors.

### **7.6.2 SOURCE**

The source of this requirement is William Anderson and Sean Slater, members of Vending Services.

### **7.6.3 CONSTRAINTS**

This section of software needs to be hidden from the end user, but easily callable for maintenance work. It also needs to be bare-bones for reliability. It should be built before the front-end user-accessible components of the software.

### **7.6.4 STANDARDS**

There are no applicable standards for this requirement.

### **7.6.5 PRIORITY**

The priority of this requirement is high. This is probably the most important part of the software besides AVRS OS.

## **7.7 TECHNICAL DOCUMENTATION**

### **7.7.1 DESCRIPTION**

The schema / exploded-view parts diagram will be available and shipped with the product. Parts will be listed as well as manufacturer / parts number. There will be a table which shows parts specifications in case a part were to ever be discontinued. There will also be a wiring diagram. As for software it will be open source and commented on GitHub, time permitting.

### **7.7.2 SOURCE**

The source of this requirement is from all of members of Vending Services.

### **7.7.3 CONSTRAINTS**

The parts diagram will need to be legible, orthographic, and include fastener information. Wiring diagrams will need to be color coded (matching wiring) and traversable. Software comments should be user-friendly and detailed. The parts listings should have all relevant information for a stand-in or aftermarket part to work properly without system modification.

### **7.7.4 STANDARDS**

There are no applicable standards for this requirement.

#### **7.7.5 PRIORITY**

The priority of this requirement is low. It would be nice to have with this product.

## **8 OTHER REQUIREMENTS**

This section will address the account and machine first time setups. Users will set up their account on the app. Client will set up the machine when it is started for the first time. Both will be relatively straightforward and have a focus on UX (User eXperience).

### **8.1 ACCOUNT SETUP**

#### **8.1.1 DESCRIPTION**

New users will be presented with an account setup prompt. The account is necessary to view order history, manage payment methods, add items to cart, reserve items, and place orders. Account setup should focus on the least amount of clicks, information gathering, and legibility. UX should be top priority for a good first impression. The faster we can get a user through the account setup, the more likely they are to keep the app and use the vending machine services.

#### **8.1.2 SOURCE**

The source of this requirement is William Anderson and Sean Slater, members of Vending Services

#### **8.1.3 CONSTRAINTS**

User must have a telephone number and a smartphone running a supported OS. They can choose to give the app location permissions.

#### **8.1.4 STANDARDS**

There are no applicable standards for this requirement.

#### **8.1.5 PRIORITY**

The priority of this requirement is critical. This section is practically mandatory for users to place reservations remotely.

### **8.2 MACHINE SETUP**

#### **8.2.1 DESCRIPTION**

The machine setup process will be two steps. First, the client will have to assemble the internals and connect up the wiring harnesses. Second, the client will need to run through software prompts to set up location, inventory, preferences, serial number, etc.

#### **8.2.2 SOURCE**

The source of this requirement is William Anderson and Sean Slater, members of Vending Services

#### **8.2.3 CONSTRAINTS**

Clients will need to input the following information: location, inventory information, serial number, network information, background images, and preferences. Hardware setup will be straightforward and might not require any instructions if we use different plugs for each item (think PC's, no way to mix up plugs).

#### **8.2.4 STANDARDS**

There are no applicable standards for this requirement.

#### **8.2.5 PRIORITY**

The priority of this requirement is high. It is particularly important for the customer that they can set up the machine as easily as possible.

## **9 FUTURE ITEMS**

This section covers requirements that were discussed about in development, but due to current constraints with the initial release, Vending Services is unfortunately unable to implement into AVRS. However, in future iterations of this project, the following requirements listed will be implemented into AVRS.

### **9.1 MULTIPLE APMs**

#### **9.1.1 DESCRIPTION**

Added customer value is obtained when the APM is nearby to where they placed the order. As such, multiple APMs will cover an even wider geographical area to allow more customers to make orders at an APM.

#### **9.1.2 SOURCE**

The source of this requirement is all of the members of Vending Services.

#### **9.1.3 CONSTRAINTS**

More APM will allow to receive more orders and ensure complete orders for the customers.

#### **9.1.4 STANDARDS**

There are no applicable requirements for this standard

#### **9.1.5 PRIORITY**

The priority of this requirement is for the future (not feasible in this version of the product, but should be considered for a future release).

### **9.2 REAL PAYMENTS**

#### **9.2.1 DESCRIPTION**

The APM and AVRS mobile app will have a real payment system that will actually take real money out of a user's bank account when they order an item.

#### **9.2.2 SOURCE**

The source of this requirement is all of the members of Vending Services.

#### **9.2.3 CONSTRAINTS**

The APM will accept debit cards, credit cards, and contactless payments such as Apple Pay, Samsung Pay, or EMV cards. AVRS will work with Visa, MasterCard, Discover, and American Express payment processing systems.

#### **9.2.4 STANDARDS**

There are no applicable standards to this requirement

#### **9.2.5 PRIORITY**

The priority of this requirement is for the future (not feasible in this version of the product, but should be considered for a future release).

### **9.3 COIN/CASH ACCEPTANCE AT AN APM**

#### **9.3.1 DESCRIPTION**

The customers can pay with cash and coins at an APM, and they are able to take change from the APM for orders that cost less than their payment.



### **9.3.2 SOURCE**

The source of this requirement is all of the members of Vending Services.

### **9.3.3 CONSTRAINTS**

The APM can only take \$20 bill or less than, and will not accept bills over \$20. Also, the APM can accept all standard coins excluding half-dollar.

### **9.3.4 STANDARDS**

There are no applicable standards to this requirement

### **9.3.5 PRIORITY**

The priority of this requirement is for the future (not feasible in this version of the product, but should be considered for a future release).

## **9.4 SELECTING LOCATION**

### **9.4.1 DESCRIPTION**

Customers willing to purchase and or reserve products through making a reservation in the app will have the option of viewing several locations in selecting a default location within their account settings.

### **9.4.2 SOURCE**

The source of this requirement is all of the members of Vending Services.

### **9.4.3 CONSTRAINTS**

The app will show many locations of the APM so that the customers can choose a location to pick up their order, or can find the nearest APM easily.

### **9.4.4 STANDARDS**

There are no applicable requirements for this standard

### **9.4.5 PRIORITY**

The priority of this requirement is for the future(not feasible in this version of the product, but should be considered for a future release).

## REFERENCES

- [1] “Color hex color codes,” <https://www.color-hex.com/>, Nov 2021.
- [2] “App store review guidelines,” <https://developer.apple.com/app-store/review/guidelines/>, Nov 2021.
- [3] “Developer policy center,” <https://play.google.com/about/developer-content-policy/>, Nov 2021.
- [4] “Food equipment standards,” <https://www.nsf.org/standards-development/standards-portfolio/food-equipment-standards>, Nov 2021.
- [5] “Iso 7823-1:2003,” <https://www.iso.org/standard/33450.html>, Sep 2018.
- [6] “National electric code section 250,” [https://www.mikeholt.com/mojonewsarchive/GB-HTML/HTML/NECArticle250Sections250.1-250.4 20020123.htm](https://www.mikeholt.com/mojonewsarchive/GB-HTML/HTML/NECArticle250Sections250.1-250.4%2020123.htm), Nov 2021.
- [7] “Ato/atc blade type fuses,” <https://powerwerx.com/atc-ato-blade-type-fuses>, Nov 2021.
- [8] “Mx150 sealed and unsealed connector system,” [https://www.molex.com/molex/products/family/mx150\\_sealed\\_connector\\_system](https://www.molex.com/molex/products/family/mx150_sealed_connector_system), Nov 2021.
- [9] “Nema 5-15p adapter blocks: Wall receptacle adapters,” <https://shop.worldcordsets.com/shop/product-lines/NEMA-515-20Plug-Adapters>, Nov 2021.
- [10] “Iso 8820-3:2015,” <https://www.iso.org/standard/58088.html>, Jun 2018.
- [11] “J1284: Blade type electric fuses - sae international,” [https://www.sae.org/standards/content/j1284\\_198804/](https://www.sae.org/standards/content/j1284_198804/), Nov 2021.
- [12] “21 u.s. code Â§ 331 - prohibited acts,” <https://www.law.cornell.edu/uscode/text/21/331>, Nov 2021.
- [13] “Health and safety code chapter 161. public health provisions,” <https://statutes.capitol.texas.gov/Docs/HS/htm/HS.161.htm>, Nov 2021.
- [14] “Texas alcoholic beverage code 5.57,” <https://irp-cdn.multiscreensite.com/88a7ea3d/files/uploaded/TABC-Code-as-of-9-1-2015.pdf>, Sept 2015.
- [15] “The mit license,” <https://opensource.org/licenses/MIT>, Nov 2021.