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*VendiLogic: Vending Machine*Use Case Specification

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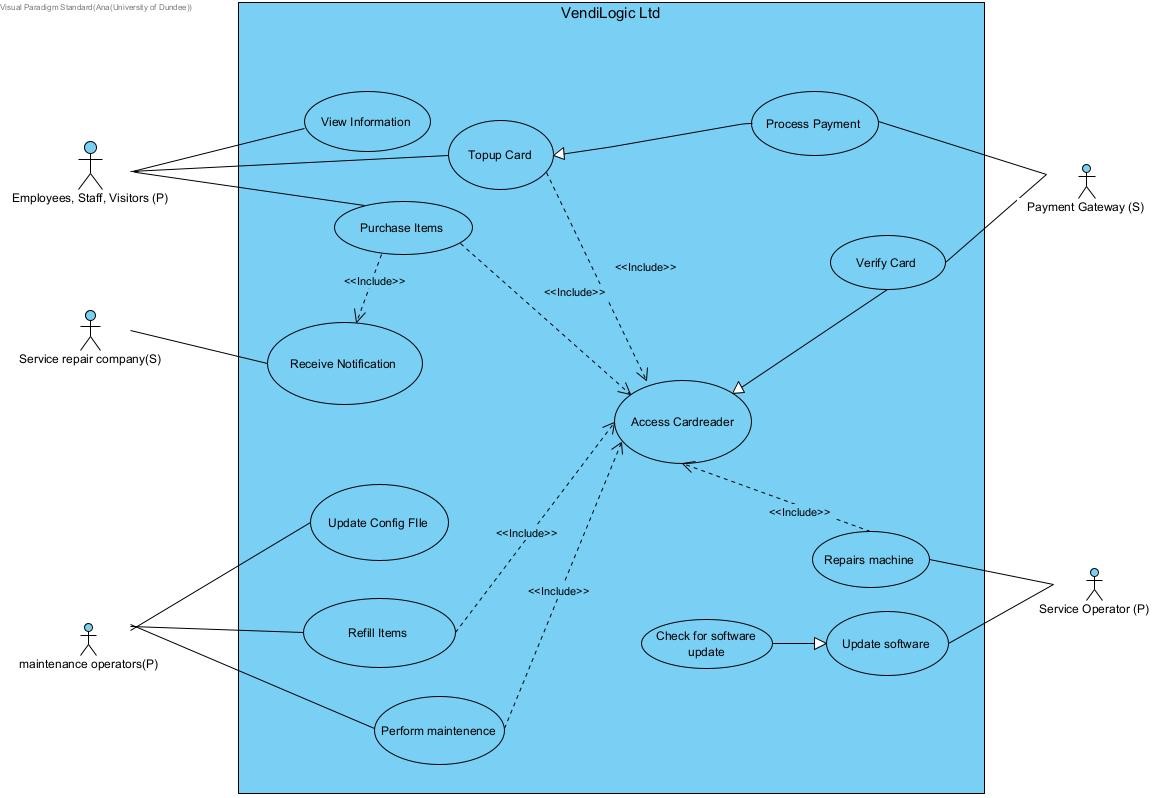
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**USE CASE DIAGRAM(s)**



**STRIDE ANALYSIS**

Spoofing Identity:

**Threat:** Someone could spoof their identity to gain unauthorized access to the vending machine.

**Example:** Someone who does not belong to the company can steal a vending card to access the machine into dispensing snacks without payment.

Tampering with Data:

**Threat**: The data stored in the vending machine's system can be tampered with by anybody.

**Example**: Malicious individuals might try to alter the inventory records to make it appear that more snacks have been sold than have, leading to losses for the vending machine owner.

Repudiation:

**Threat**: An individual could deny their actions or transactions performed on the vending machine.

**Example**: A customer might try to break the machine out of frustration by kicking and later on denying that.

Information Disclosure:

**Threat**: Sensitive information stored within the vending machine's system could be disclosed to unauthorized parties.

**Example**: Personal data, such as bank card or credit card information, PIN number of the special service card, could be intercepted if the vending machine's communication channels are not secure.

Denial of Service (DoS):

**Threat**: An attack could disrupt the normal operation of the vending machine, preventing legitimate users from accessing it.

**Example**: A hacker could launch a DoS attack against the vending machine's software, causing it to become unresponsive and unable to dispense snacks.

Elevation of Privilege:

**Threat**: An attacker could gain unauthorized access to privileged functionalities such as maintenance or service accounts or resources within the vending machine.

**Example**: Exploiting a software vulnerability to escalate their privileges and gain administrative control over the vending machine, allowing them to manipulate its operations.

UC1 View Information

This use provides the capability for a customer to view the account balance and product information on the screen.

Basic Flow of Events

The use case begins when ­*an employee, staff or a visitor of the company* inserts the card to the cardreader.

|  |  |
| --- | --- |
| System: | Detects that a card has been inserted and attempts to read the information from the card on the basis that is a valid card from the company. |
| System: | Verifies the card. |
| System: | Determines the products that could be purchased by the customer based on the available credit on the card and displays them on the screen along with the shelf number, name and price of the product. |
| Customer: | Views the product information to decide the purchase |

UC2 Purchase Item: water

This use provides the capability for a *customer* to successfully make a purchase based on the options available on the screen and dispense the corresponding item.

Basic Flow of Events

The use case begins when ­a customer selects the shelf number for the item they wish to purchase.

|  |  |
| --- | --- |
| System: | Receives the selection information. |
| System: | Considering the choice to be water, dispense a cup onto the dispensing tray and then dispense the water into the cup. |
| System: | Afterwards, notify the customer that their drink is ready. |
| System: | Then deducts the cost of the water from the customer’s vending card and return their card to them. |
| Customer: | Receives the notification and picks up the item from the dispenser tray and then collects the vending card. |
| System: | Now vending machine will conduct stock checks. |

Alternative Flows

A1 – Purchase Item: Food

This use provides the capability for a *customer* to successfully make a purchase based on the options available on the screen and dispense the corresponding item.

|  |  |
| --- | --- |
| System: | Executes the selection information. |
| System: | Considering the choice to be food item, Instruct the food dispenser to dispense the item on the relevant shelf. |
| System: | Detects that the item has fallen into the collection drawer at the bottom. |
| System: | Instruct the customer to remove their item from the collection drawer. |
| System: | Afterwards, unlocks the collection drawer to allow the customer to remove their purchased item |
| Customer: | Collects the item(s) from the collection drawer |
| System: | Deducts the cost of the item from the customer’s vending card and return their card to them |
| Customer: | Collects the vending card |
| System: | Now vending machine will conduct stock checks, record the number of cups or containers in the machines through stock checks |
|  |  |

**A2 – No Products Available**

This alternative flow arises if there are no products available in the vending machine.

|  |  |
| --- | --- |
| Customer: | Inserts the vending card into the card reader. |
|  | If there are no products available in the vending machine: |
| Vending Machine: | Display a message indicating unavailability. |
| Vending Machine: | Prompt the customer to try again later or select a different product. |
|  | End the use case |

**A3 – Water Dispensing Error**

This occurs if there is an error in dispensing water.

|  |  |
| --- | --- |
| Customer: | Selects to dispense a cup of water. |
|  | If there is an error in dispensing water (e.g., cup not dispensed, water not filled). |
| Vending Machine: | Display an error message. |
| Vending Machine: | Refund any credits deducted from the customer's card. |
|  | End the use case. |

**A4 – Food Dispensing Error**

This occurs if there is an error in dispensing food.

|  |  |
| --- | --- |
| Customer: | Selects to dispense a food item. |
|  | If there is an error in dispensing food (e.g., item not dispensed, incorrect item dispensed): |
| Vending Machine: | Display an error message. |
| Vending Machine: | Refund any credits deducted from the customer's card. |
|  | End the use case. |

**A5 – Customer Fails to Retrieve Item**

This occurs if the customer fails to retrieve the purchased item from the collection drawer within a specified time limit.

|  |  |
| --- | --- |
| Actor: | If the customer fails to retrieve the purchased item from the collection drawer within a specified time limit: |
| System: | Display a reminder message. |
|  | If the item is not retrieved within the additional time: |
| System: | Return the item to stock. |
| System: | Refund any credits deducted from the customer's card. |
|  | End the use case. |

UC3 Top-up card

This use provides the capability for a *customer* to successfully top up the amount of credit on their vending card through the vending machine.

Basic Flow of Events

The use case begins when an employee, staff or a visitor of the company inserts the card and choose the Top-up option on the screen and the vending card runs out of credit.

|  |  |
| --- | --- |
| System: | Detects that a card has been inserted and attempts to read the information from the card on the basis that is a valid card from the company. |
| System: | Having verified the card, displays a ‘topup’ option on the display, alongside the standard display which shows the current items available and the balance if the vending card runs out of credit. |
| Customer | Selects the “Topup” option by touching the display screen. |
| System: | Displays a pop-up to enter the bank card or credit card (card number, expiry date, CVC code)of the customer along with the amount of credit they want to add to their vending card (up to a maximum of £30) |
| Customer: | Customer enters all the information correctly. |
| System: | The machine will verify the amount to be upto £30 then it will use the machine’s mobile network connection to communicate with the Very Good Vending Payment Server, which will authorize the transaction, process the payment, and return confirmation that it has been successful |
| Customer: | Receives the confirmation and proceed with the purchase. |

UC4 Access card reader: customer

This use provides the capability for a *customer* to insert a card to get the correct authorization to communicate with different components of the machine and perform several tasks.

Basic Flow of Events

The use case begins when a *customer or a service provider* to insert a vending card into the vending machine.

|  |  |
| --- | --- |
| System: | Detects that a card has been inserted and attempts to read the information from the card on the basis that is a valid card from the company. |
| System: | Having verified the card, determines the products that could be purchased by the customer based on the available credit on the card and displays them on the screen along with the shelf number, name and price of the product. |
| Customer: | Views the product information to decide the purchase |

Alternative Flows

A1 – Access card reader: Maintenance operator

The use case begins when a maintenance operator to insert a special service card into the vending machine.

|  |  |
| --- | --- |
| System: | Detects that a card has been inserted and attempts to read the information from the card (i.e. the operator’s name, their employeeID, a 4-digit PIN, and an access level on the basis that is a valid card from the company. |
| System: | Having verified the card, the machine changes the display to allow the operator to enter their PIN. |
| Maintenance operator: | Enters a 4 digit PIN on the touch screen panel. |
| System: | Verifies whether the PIN entered by the operator correctly matches that on their card. |
| System: | If yes, then the software will unlock a service panel on the vending machine if the access level is 1. |
| Maintenance operator: | The operator can then perform tasks |

A2 – Access card reader: Service operator

The use case begins when a service operator to insert a special service card into the vending machine.

|  |  |
| --- | --- |
| System: | Detects that a card has been inserted and attempts to read the information from the card (i.e. the operator’s name, their employeeID, a 4-digit PIN, and an access level on the basis that is a valid card from the company. |
| System: | Having verified the card, the machine changes the display to allow the operator to enter their PIN. |
| Service operator: | Enters a 4 digit PIN on the touch screen panel |
| System: | Verifies whether the PIN entered by the operator correctly matches that on their card. |
| System: | If yes, then the software will unlock a service panel and additional components within the machine that go beyond the remit of a basic maintenance on the vending machine if the access level is 2. |
| System: | The operator can then perform whatever repairs they require. |

UC5 Perform maintenance

This use provides the capability for a *Maintenance operator* to successfully perform the cleaning task.

**Basic Flow of Events**

The use case begins when a Maintenance operator gains access to the service panel.

|  |  |
| --- | --- |
| Actor: | Maintenance Operator initiates routine maintenance tasks. |
| Actor: | The maintenance operator accesses the vending machine for routine maintenance. |
| Vending Machine: | Prompts the maintenance operator to begin the maintenance process. |
| Actor: | Maintenance Operator refills products in the food dispenser. |
| Actor: | The maintenance operator opens the food dispenser. |
| Vending Machine: | Verifies that the correct items are being placed onto the correct shelves by comparing them with the information in the configuration file. |
|  | If any discrepancies are found, the system alerts the maintenance operator to rectify the issue. |
| Vending Machine: | Once verified, the maintenance operator refills the products in the food dispenser. |
| Actor: | Maintenance Operator refills cups in the water dispenser. |
| Actor: | The maintenance operator opens the water dispenser. |
| Vending Machine: | The system verifies the number of cups currently available in the dispenser by querying the relevant component for status information. |
| Vending Machine: | If the number of cups is below a certain threshold, the system alerts the maintenance operator to refill the cups. |
|  | Once verified, the maintenance operator refills the cups in the water dispenser. |
| Actor: | Maintenance Operator refills the water jug. |
| Actor: | The maintenance operator opens the water jug compartment. |
| Vending Machine: | The system verifies the water level in the jug by querying the relevant component for status information. |
|  | If the water level is below a certain threshold, the system alerts the maintenance operator to refill the water jug. |
| Actor: | Once verified, the maintenance operator refills the water jug. |

**Alternative Flows**

**A1 – Update Config File**

This use provides the capability for a *Maintenance operator* to successfully update the product information by copying a new config file onto the hard disk of the machine. There will be a configuration file on the hard disk of the machine which specifies the product information, so the system knows what products are available, their cost, and which shelves they are on

The use case begins after a maintenance operator successfully adds or removes the stocks in the vending machine or when the shelf number that a product has been placed onto changes.

|  |  |
| --- | --- |
| Actor: | The operator then performs various tasks such as doing any internal or external cleaning of the machine. Then update the details of the products which are in the machine and copy the new configuration file onto the hard disk of the machine. |
| Vending Machine: | The vending system will automatically send confirmation to the service company that the maintenance is complete |

**A2 – Incorrect Product Placement**

This alternative flow arises if the maintenance operator places incorrect items into the food dispenser shelves.

|  |  |
| --- | --- |
| Actor: | If the maintenance operator places incorrect items into the food dispenser shelves: |
| Vending Machine: | The system detects the discrepancy between the items placed and the configuration file. |
| Vending Machine: | Display an error message indicating incorrect product placement. |
| Vending Machine: | Prompt the maintenance operator to rectify the issue by placing the correct items into the corresponding shelves. |
|  | End the use case. |

**A3 – Low Memory Space for Configuration File Update**

This arises if the maintenance operator attempts to update the configuration file but there is insufficient memory space.

|  |  |
| --- | --- |
| Actor: | If the maintenance operator attempts to update the configuration file but there is insufficient memory space: |
| Vending Machine: | Display an error message indicating low memory space. |
| Vending Machine: | Prompt the maintenance operator to free up space or use an alternative method to update the configuration file. |
|  | End the use case. |

**A4 – Component Query Failure**

If the system fails to query the components for status information.

|  |  |
| --- | --- |
| Vending Machine: | If the system fails to query the components for status information (e.g., cups in the water dispenser, water level in the jug): |
| Vending Machine: | Display an error message indicating the failure to retrieve component status. |

**A5 – Maintenance Operator Error in Refilling**

This alternative flow arises if the maintenance operator makes an error while refilling products or components

|  |  |
| --- | --- |
| Vending Machine: | If the maintenance operator makes an error while refilling products or components (e.g., spills water, overfills dispenser): |
| Vending Machine: | Display an error message indicating the error made during maintenance. |
| Vending Machine: | Prompt the maintenance operator to correct the error and proceed with the maintenance tasks. |
|  | End the use case. |

UC6 Repairs machine

This use provides the capability for a *Service operator* to successfully perform the servicing task.

**Basic Flow of Events**

|  |  |
| --- | --- |
| Actor: | Service Operator initiates a service visit. |
| Actor: | The service operator arrives at the vending machine site to perform annual hardware checks or in response to a fault report. |
| Vending Machine: | The system recognizes the service operator and prompts them to begin the service process. |
| Actor: | Fault Detected during Dispensing Process |
| Vending Machine: | If a fault is detected during the dispensing process (e.g., unresponsive component): |
| Vending Machine: | The vending system automatically sends a fault report to the service company. |
| Vending Machine: | The fault report includes the name(s) of the faulty component(s), machine ID, and the date and time of the fault. |
| Vending Machine: | The system prompts the service operator to address the reported faults. |
| Actor: | Service Operator accesses the machine. |
| Vending Machine: | The service operator inserts a special service card into the card reader. |
| Vending Machine: | The system reads the information from the service card, including the operator’s name, employee ID, PIN, and access level. |
| System: | If the access level is level 2 (service), the system unlocks the service panel to allow access to additional components within the machine. |
| Actor: | Service Operator performs repairs. |
| Vending Machine: | The service operator identifies and addresses the faults reported or conducts routine hardware checks. |
| Vending Machine: | The system provides options on the display panel for the service operator to perform additional actions during the service visit. |
| Actor: | Check for Updates Option Selected |
| Vending Machine: | The service operator selects the 'Check for Updates' option. |
| Vending Machine: | The current version number of the vending machine will be sent to the service company’s ‘service notification system’ to determine whether any newer versions of the software is available. If a newer version is available, the relevant files will be downloaded directly to the vending machine and a message displayed to the service operator that they should restart the vending machine after the service has finished. |
| Actor: | Now the operator finishes by turning the power off and on again. When the system powers up again, the newer software files will automatically come into place, and the software version number will have been updated too. |

**Alternative Flows**

**A1 – Service Operator Authentication Failure**

This occurs if the service operator fails to provide correct authentication details.

|  |  |
| --- | --- |
| Actor: | If the service operator fails to provide correct authentication details (e.g., incorrect PIN): |
| Vending Machine: | Display an error message indicating authentication failure. |
| Vending Machine: | Prompt the service operator to re-enter the correct authentication details. |
| Vending Machine: | End the use case if the correct authentication details are not provided after multiple attempts. |

**A2 – Fault Report Transmission Failure**

This flow arises if there is a failure in transmitting the fault report to the service company's interface.

|  |  |
| --- | --- |
| Vending Machine: | If there is a failure in transmitting the fault report to the service company's interface (e.g., network connectivity issues): |
| Vending Machine: | Store the fault report locally for later transmission. |
| Vending Machine: | Alert the service operator about the transmission failure. |
| Vending Machine: | Prompt the service operator to manually transmit the fault report or troubleshoot the network connectivity issue. |

**A3 – Software Update Check Failure**

This arises if there is a failure in checking for software updates.

|  |  |
| --- | --- |
| Vending Machine: | If there is a failure in checking for software updates (e.g., server communication error): |
| Vending Machine: | Display an error message indicating the failure to check for updates. |
| Vending Machine: | Prompt the service operator to retry the software update check or proceed without updates. |
|  | End the use case if the issue persists and updates cannot be checked. |

**A4 – Software Update Download Failure**

This arises if there is a failure in downloading the software updates.

|  |  |
| --- | --- |
| Vending Machine: | If there is a failure in downloading the software updates (e.g., insufficient memory, file corruption): |
| Vending Machine: | Display an error message indicating the failure to download updates. |
| Vending Machine: | Prompt the service operator to troubleshoot the issue or contact technical support for assistance. |
|  | End the use case if the updates cannot be downloaded successfully. |

UC7 Update software version

This use provides the capability for a *System to download and install* the new update on the software.

Basic Flow of Events

The use case begins when ­a service operator Inserts a special service card.

|  |  |
| --- | --- |
| System: | Detects that a card has been inserted and attempts to read the information from the card on the basis that is a valid card from the company. |
| System: | Having verified the card, displays additional options to the service operator. For example, one initial option will be a ‘Check for Updates’ option. |
| Service operator: | Selects the above mentioned options. |
| System: | The current version number of the vending machine will be sent to the service company’s ‘service notification system’ to determine whether any newer versions of the software are available. |
| System: | If a newer version is available, the relevant files will be downloaded directly to the vending machine through the mobile network connection. |
| System: | Now System will notify the service operator that they should restart the vending machine after the service has finished. |
| Service Operator: | Now the operator finishes by turning the power off and on again. |
| System: | When the system powers up again, the newer software files will automatically come into place, and the software version number will have been updated too. |

UC8 Update config file

This use provides the capability for a *Maintenance operator* to successfully update the product information by copying a new config file onto the hard disk of the machine. There will be a configuration file on the hard disk of the machine which specifies the product information, so the system knows what products are available, their cost, and which shelves they are on.

Basic Flow of Events

The use case begins after ­a maintenance operator successfully add or remove the stocks in the vending machine or when the shelf number that a product has been placed onto changes.

|  |  |
| --- | --- |
| Service operator: | Then update the details of the products which are in the machine and copy the new configuration file onto the hard disk of the machine. |
| System: | The vending system will automatically send confirmation to the service company that the maintenance is complete. |

UC9 Receive notification: Restock report

The use case begins when low stock is detected for one or more items in the vending machine. When it is detected that the machine has begun to run out of certain items, the software will notify a service company that maintains the vending machine.

Basic Flow of Events

|  |  |
| --- | --- |
| System: | Prepares a stock report which contains the following: for each item in the machine, its name and current stock level; the date and time of the report; the ID of the vending machine to which the report relates. |
| System: | Once the stock report has been prepared, the system will send the report to the ‘service notification system |
| Servicing Company: | Sends a service operator subsequently to restock the machine |

Alternative Flows

A1 – Receive notification: Faulty report

The use case begins when a fault is detected in the machine during the dispensing process (such as a component becoming unresponsive).

|  |  |
| --- | --- |
| System: | vending system will automatically send a fault report to the service company to request that a service operator should visit the machine. The fault report will contain the name(s) of the component(s) that are detected as being faulty along with the machine’s ID and the date and time that the fault was detected |
| Servicing Company: | Sends a service operator subsequently to fix the machine |

A2 – Receive notification: Maintenance Completion

The use case begins when the maintenance has been concluded by an operator.

|  |  |
| --- | --- |
| System: | Automatically send confirmation to the service company that the maintenance is complete. |
| System: | A maintenance report will be sent to the service notification system (mentioned previously) which contains the following: the employee ID of the maintenance operator; the ID of the vending machine; the current date and time. |

SUPPLEMENTARY REQUIREMENTS

R1 Sleep Mode

As this is a periodic process, the system should check if it has been idle already or not. For instance, in if event failure occurs, the system shall enter a sleep mode.

*Rationale: This has to be done in order to maximize the energy efficiency of the system. This could be substantial gap spaced out throughout the day in the system usage.*

R2 Error Handling

The system shall include strong error handling strategies and notification alerts to gracefully manage the error conditions or exceptions.

Rationale: Error handling is the integral part for the lasting execution of program functions irrespectively of what unplanned and unexpected situation may occur.

R3 Data Encryption

These sensitive data consist of configuration files and transaction records. This data shall be kept in an encrypted form to prevent unauthorized access.

*Rationale: Encryption of sensitive info aids for avoiding data breaches as well as gives you the needed level of confidentiality, integrity and authenticity of such info.*

R4 Secure Authentication

All users' authentication procedures – maintenance and service operator logins – shall have security measures applied to them, i.e. multi-factor authentication (MFA).

*Rationale: Full authentication is effective in preventing strangers from connecting to the system and, therefore, protecting against identity theft and unauthorized actions.*

R5 Audit Trail

The system may need to keep rigorous audit logs of all user activities, such as maintenance and other service operations activities, for the purpose of accountability and traceability.

*Rationale: Through audit trails, the ability to monitor user activities, pick up on suspicious actions and investigate security incidents or cases of non-compliance is made possible.*

R6 Regular Security Updates

The vending machine software should be regularly adapted to get security patches and bug fixes that will close detected frailties and make the system more secure.

*Rationale: Security updates to be regularly performed helps to reduce the risks of security and maintain a system that keeps up with the threats of today's cyber world.*

R7 Physical Security Measures

Security being a predominant issue, the vending machine shall be well protected using extreme measures not to allow unauthorized access or tampering with cameras and tamper-resistant enclosures.

*Rationale: The physical security aspects may assist to prevent the theft, vandalism and unauthorized alteration of the hardware and/or vending machine components.*

R8 Disaster Recovery Plan

The system should be equipped with a disaster recovery plan in the form of a document capable of restoring the services in case of system failure, data loss or other disaster events.

*Rationale: A disaster recovery plan ensures the business stays active and running with its backup, restoration, and system recovery procedures outlined.*

R9 Secure Communication Protocols

All of the communication of the vending machine with the external systems including the service notification system and the payment server should be encrypted by secure communication protocols (e.g. TLS) to prevent listening in and information intercepting.

*Rationale: The data exchanged between the vending machine and the external entities is safe and secure in communication protocols with the protocols being able to establish confidentiality and integrity of the data with the aim of ensuring that sensitive information is protected from unauthorized access or tampering*.

R10 Role-Based Access Control

The system shall use role-based access control (RBAC) as a mean to manage access to system functionalities and data based on the users’ roles and permission settings.

*Rationale: Role-based access control is intended to provide users with only the indispensable privileges to accomplish their job duties, thereby, minimizing possible unauthorized access and data leak trends.*

R11 Intrusion Detection System

Vending machine shall be supported by an IDS system with an aim to detect and prevent any suspicious or malicious events such as unauthorized access, device fluctuations or administrative interference.

*Rationale: A way to detect intrusion in the context of security is a tool which represents a trigger system, helping to spot out security threads in real-time, allowing timely response and minimizing potential damage to the system.*

R12 Secure Boot Process

The security for the vending machine shall be implemented via a secure boot process to ensure the integrity and authenticity of the firmware and software through the system startup.

*Rationale: Secure boot performs one of the main functions by not allowing running illegitimate/tampered firmware/software component that might result in malware injection or unauthorized system modifications.*

R13 Data Restoration and Data Recovery

This system shall periodically back up critical data such as configuration files, record of transactions, and logs of the audit; and it will also implement powerful mechanisms for data recovery in case of data loss or corruption.

*Rationale: Data backup and recovery mechanisms are mandatory measures for providing data integrity, availability, and continuity of operations; and reducing potential losses or corruption of data resulting in the disruption of system operations and business activities.*