Part IV Summary

Part 1 demonstrated how a project vision can be represented as a system solution with use case models.

Part 2 demonstrates a potential solution to the use case model and from which system requirements are derived. A summary of the use case model and architectural design is presented. Activities are assigned to systems using a coloring scheme. [This is similar to a typical Business Process Modeling Notation (BPMN) diagram, but with swimlanes replaced by a coloring scheme]

An analysis of the Shopping System is performed in order to derive the software requirements for this system. (Requirements for changes to other systems are not considered, but may easily be derived from the model. Part of the reason for this is because it is not known which requirements will be satisfied by the hardware and which by software, until the components have been designed.)

A software requirement can be attributed to 1 and only 1 system. Any communication between systems involves hardware, invalidating the definition of 'software requirement'. The software requirements for the Shopping System are derived by assigning functionality and attributes to classes. Thos classes are further refined into states and software requirements are deduced for each state of each class. Sequence diagrams are used to validate that the Shopping System, its classes and their states are consistent and cover the complete scope of the system use case model.

1   The System Architecture

The architecture of the shopping expedition systems is arbitrary and requires expertise from engineers with experience of electronic and hardware design. The following diagram in is a potential design from a software professional, and therefore should not be considered an efficient or even a workable architecture.
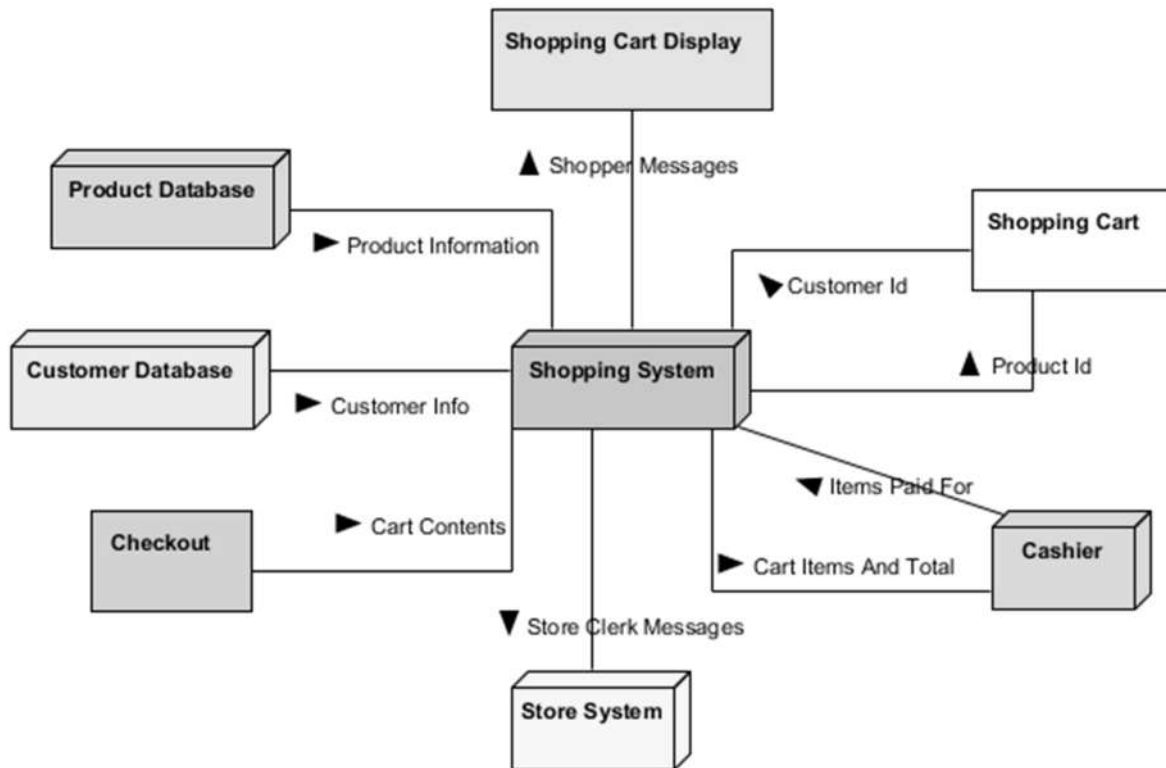

Figure 1:   System Architecture

The box nodes indicate existing and to be software systems. Rectangular nodes indicate hardware systems. The relationships indicate the primary information passing between nodes.

2   Summary Of Both business And System Steps

The following shows 2 views of the complete process as applied to the architecture. As a sequence of textual steps and as an activity diagram.

2.1 Steps

Normal Path

Precondition: Cart is recognised by the store (the cart has a wireless transmitter that broadcasts its location and a shopping cart Id)

Trigger: Customer inserts their store card into the cart card reader

1. The shopping cart card reader reads the customer Id from their shopping card

2. The card reader sends customer card Id and cart Id to the system

3. The system sends the customer Id to the customer database and requests the customer database return information about the customer

4. Customer database informs the system that customer is an approved shopper

5. The system sends a message to the shopping cart message display informing the shopper to empty the cart of all items and that they may begin shopping and their total is zero.

6. The shopper adds an item to the shopping cart (several ways to do this; have the shopper scan a barcode,, have the cart recognize items in the cart using a magnetic strip on the product) (For bulk products, the shopper bags and weighs the item first, then receives a magnetic strip or barcode containing information about the product, which they attach to the item)

7. The shopping cart scanner sends the product Id to the system

8. The system requests that the product database return information about the product

9. The system receives product information from the product database and sends the product name to and updates the total on the cart display

10. The shopping cart approaches a checkout

11. The item detector recognizes the shopping cart and sends the cart Id and number of items in in the shoppers possession to the system (maybe the item detector could recognize the individual items, but the number of items should be sufficient)

12. The system sends a message to the shopping cart display asking the shopper to confirm that they wish to checkout

13. The shopper confirms that they want to checkout their shopping cart

14. The system verifies that the items in the cart match those detected by the item detector

15. The system sends the cart total to the cashier system

16. The cashier system takes payment for the total items in the cart and sends the confirmation to the system

17. The system verifies that the items paid for match those detected by the item detector (do this again just in case anything changes while the shopper is checking out)

18. The shopper leaves the checkout and removes their card form the card reader

19. The card reader informs the system that the customer card has been removed from the shopping cart

20. The system informs the customer database that the customer is no longer assigned to the cart (allows for tracking of customer experience while shopping)

A.1 Alternate Path (Customer Card Is Not Readable)

21. At step 1, the customer card cannot be read

22. The card reader sends a message to the system that an unreadable or invalid customer card was inserted

23. System sends a message to the cart display to inform the customer to see customer service

A.2 Alternate Path (Customer Not Eligible To Use The Shopping system)

24. At step 4, the customer database informs the system that the customer is not an approved shopper

25. System sends a message to the cart display to inform the customer to see customer service

A.3 Alternate Path (Shopper Removes Item From The Cart)

26. At step 6, the shopper removes an item from the cart (Again there are several ways to do this; have an unscan option on the shopping cart, detect that a magnetic strip was removed from the cart)

27. The scanner sends the product Id for the removed item to the system

28. System sends a message to the cart display updating the total cost and information about the last item removed

A.4 Alternate Path (Item Not Found)

29. At step 9, the product database informs the system that information about the item cannot be found in the product database

30. The system informs the store display to assist the customer (assume that the store assistant has the ability to enter items manually into the cart)

31. The system sends a message to the cart display requesting that the shopper remove the item and ask for assistance with adding it to the cart.

A.5 Alternate Flow (Shopper Continues Shopping)

32. At step 13, the shopper cancels checkout

33. System sends a message to the cart display for the shopper to leave the checkout area

34. System waits for the item detector to no longer recognize the shopping cart

35. System displays the cart total to the cart display

A.6 Alternate Flow (Shopper Continues Shopping)

36. At step 14 or 17, the system detects that the items in the shoppers possession do not match those being paid for

37. The system informs the store clerk display to assist the shopper at the checkout Id

38. The system sends a message to the cart display to inform the shopper that they need assistance with checking out.
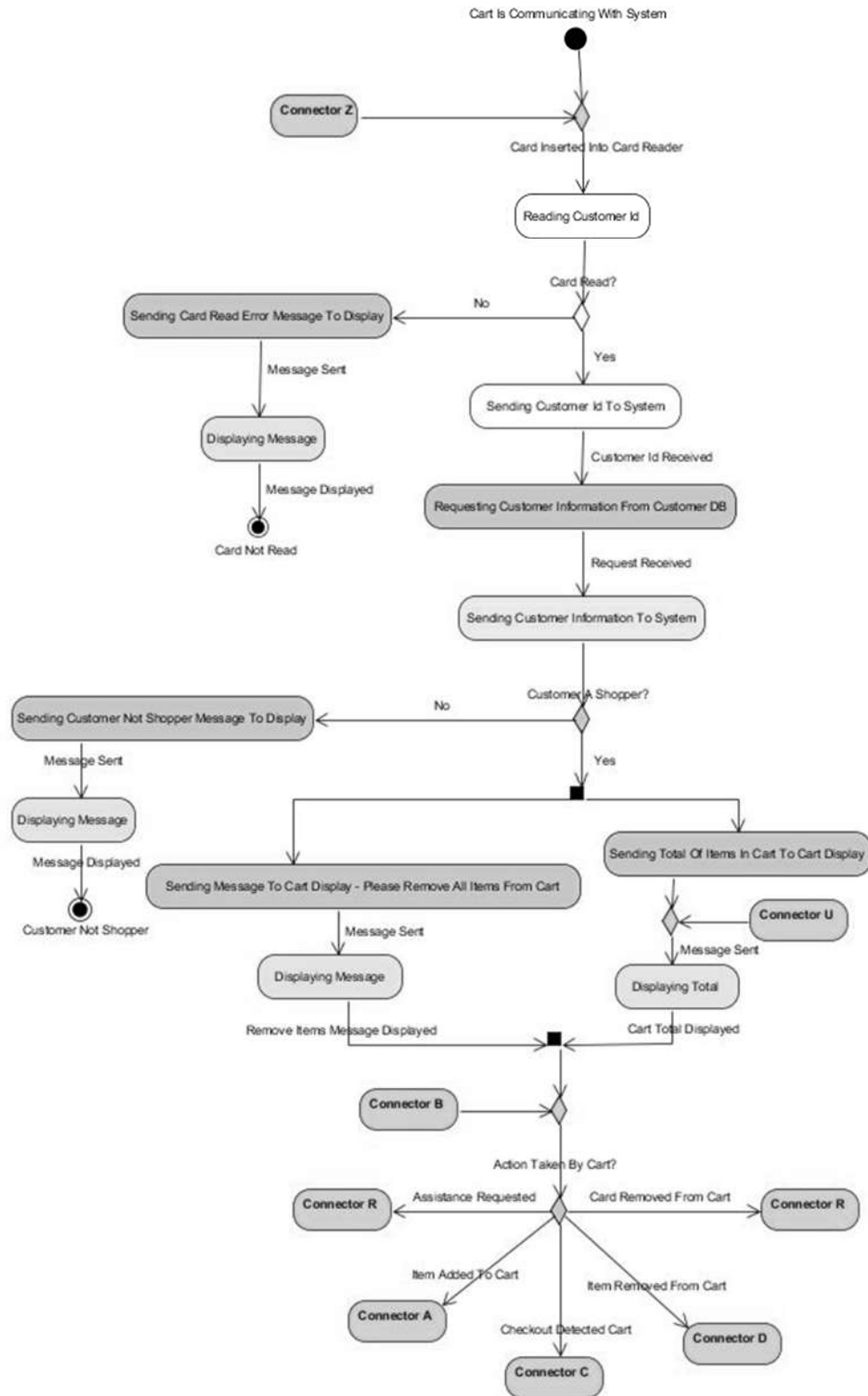
2.2 Acitivity Diagram

Cart Is Communicating With System

●

Connector Z ────────────◇

Card Inserted Into Card Reader

Reading Customer Id

Card Read?

Sending Card Read Error Message To Display ◄──── No ──── ◇

Message Sent

Yes

Displaying Message

Sending Customer Id To System

Message Displayed

Customer Id Received

Card Not Read
●

Requesting Customer Information From Customer DB

Request Received

Sending Customer Information To System

Customer A Shopper?

Sending Customer Not Shopper Message To Display ◄──── No ──── ◇

Message Sent

Yes

Displaying Message

Message Displayed

■

Customer Not Shopper
●

Sending Total Of Items In Cart To Cart Display

Sending Message To Cart Display - Please Remove All Items From Cart

Connector U

Message Sent

◇

Message Sent

Displaying Message

Displaying Total

Remove Items Message Displayed

Cart Total Displayed

■

Connector B ────────────◇

Action Taken By Cart?

Connector R ◄──── Assistance Requested ──── ◇ ──── Card Removed From Cart ────► **Connector R**

Item Added To Cart

Item Removed From Cart

Connector A

Checkout Detected Cart

Connector D

Connector C

Figure 2:   Process Summary Overview

2.2.1 Add Or Remove Items
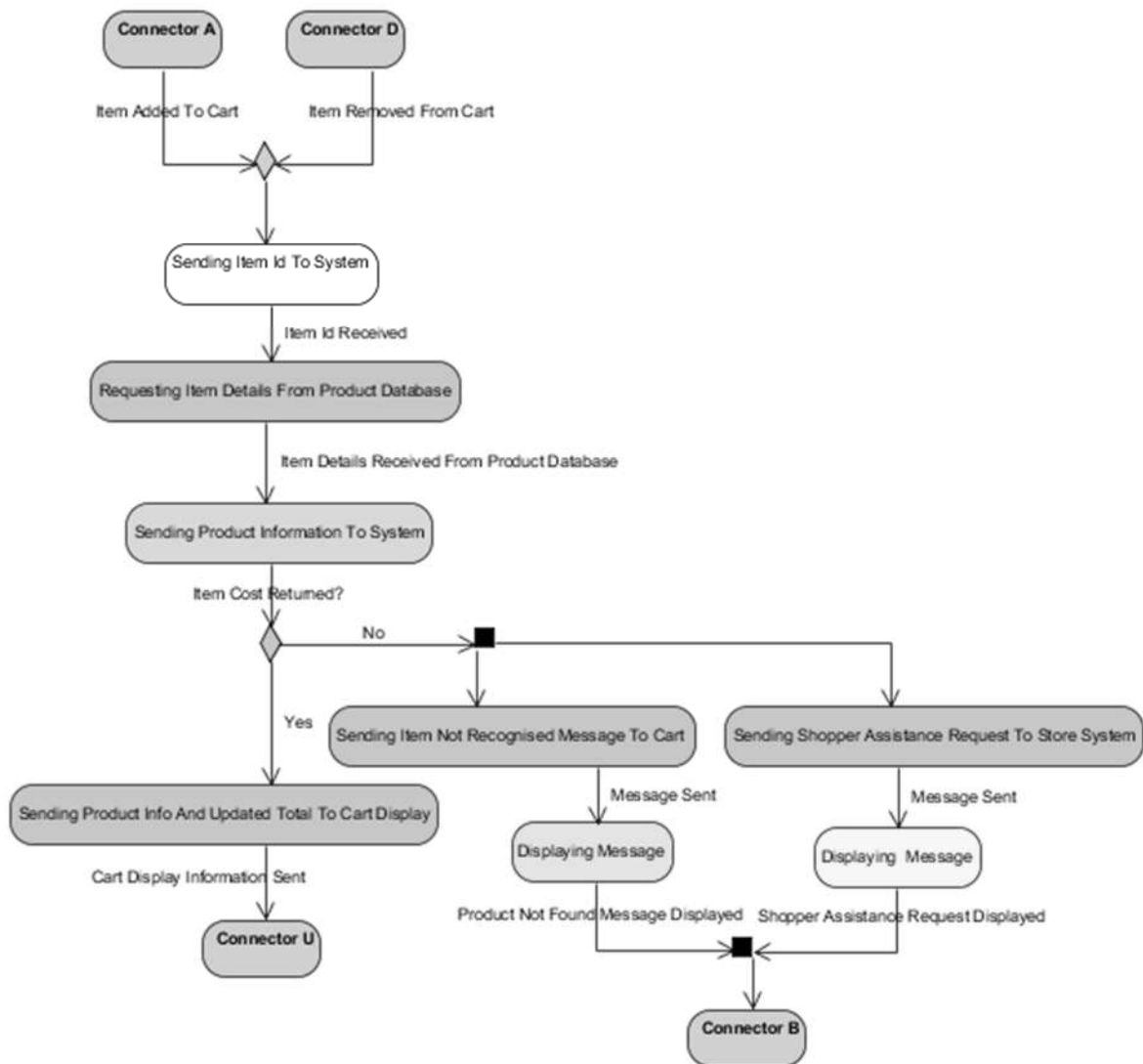
Figure 3:   Add Or Remove Items Process

2.2.2 Checkout Process

Connector C

Cart Detected At Checkout

Sending Cart Id To System

Cart Id Received

Cart Already At Checkout? — Yes → **Connector B**

No

Sending Checkout Message To Cart Display

Message Sent To Cart

Displaying Message

Response Received

Sending Response To System

Response Received From Cart

Response From Cart? — Deny → Sending Message For Shopper To Leave Checkout Area

Confirm

Message Sent

Displaying Message

Sending Cart Items And Total To Cashier

Leave Checkout Area Message Displayed

Cart Contents Sent

Connector B

Cashier Taking Payment

Result Received

Payment Approved? — No

Yes

Requesting Items Detected At Checkout

Request Sent To Checkout Item Detector

Returning Items Detected As Cart Leaves Store

Items Returned

Items Detected Equals Items Paid For? — No → MergeNode

Sending Message To Cart For Shopper To Remove Their Card

Sending Message To Shopper To Wait For Assistance

Sending Message To Store Clerk To Provide Assistance

Shopper Removes Card

Assistance Message Sent To Shopper

Assistance Message Sent To Store Clerk

Connector Z

Displaying Message

Displaying Message

Message Sent

Message Sent

Detecting Card In Cart

Card Removed From Cart

Connector Z

Figure 4:   Checkout Process

2.2.3 Request Assistance

Figure 5:   Request Assistance

3   Shopping System

The shopping system is decomposed into a set of potential classes containing attributes, states and operations.

3.1   Context Diagram

The context diagram in Figure 6: shows the Shopping System and its interfaces to external systems. Each external system is a potential class within a Shopping System design.
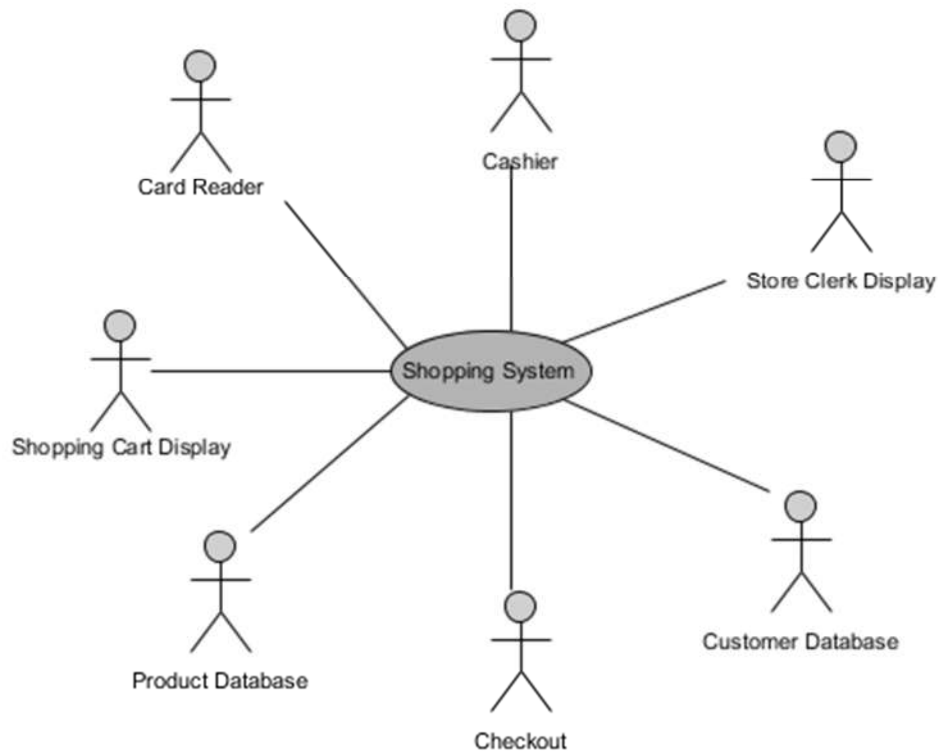
Figure 6:   The Shopping System Context Diagram

3.2   Classes

Initial classes and their identifying attributes are shown in Figure 13:
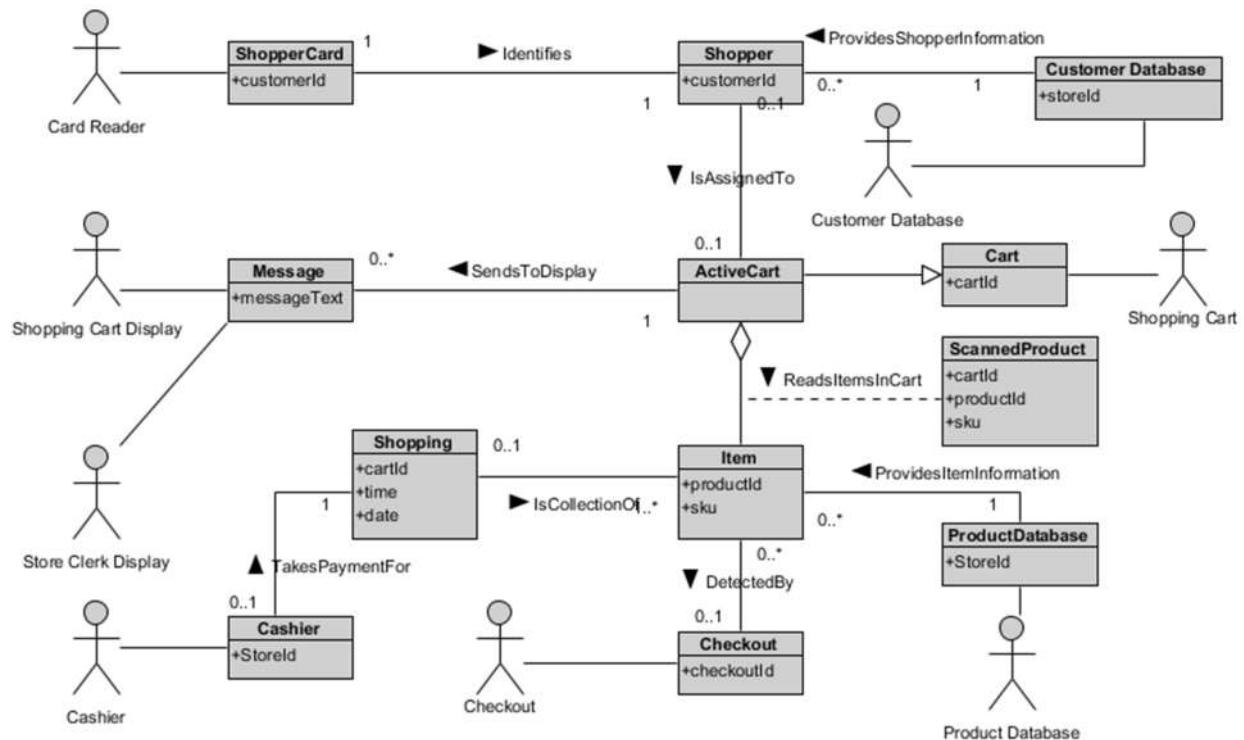
Figure 7:   Initial Classes With Identifying Attributes

Classes are part of the shopping system. Actors represent the external entities with which the system interacts.

- The card reader provides the customer identity to the system.
- The customer database provides information about the shopper to the system.
- The shopping cart display provides the shopper with information about their shopping experience.
- The store clerk display provides the store clerks with information about the shoppers experiences.
- The cashier handles payments and receipts for shopping that is in the cart.
- Shopping is the collection of items in a shopping cart.
- The checkout recognizes the cart and the items contained within it.
- The product database provides the system with information about an item.
- Scanned products are those that are placed within a shopping cart.
- An cart is any cart that is recognized by the system.
- An active cart is a cart that has been assigned to a shopper.

3.3 Interaction Diagrams

The following diagrams demonstrate how the shopping system use cases are satisfied by the model in the previous class diagram.

3.3.1 Assign Cart To Shopper
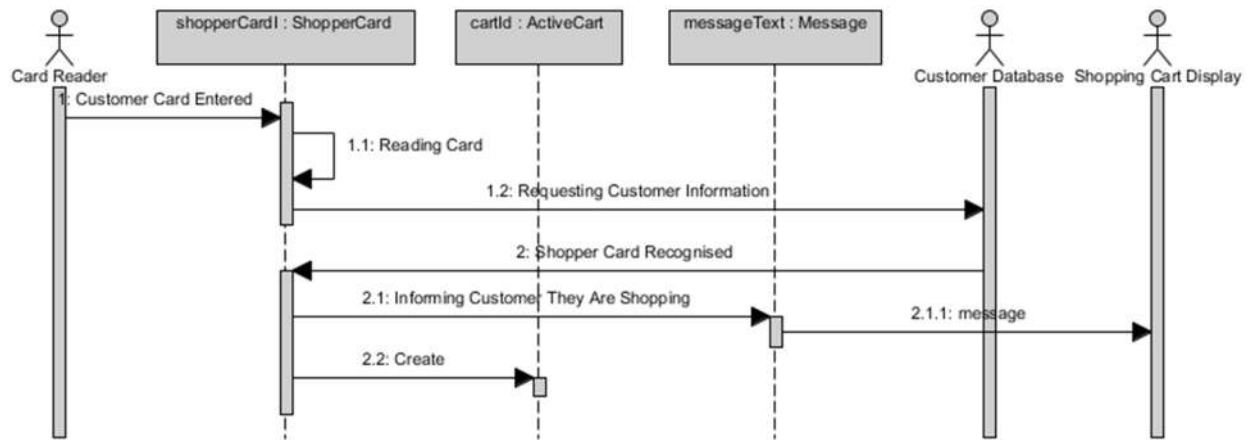
Figure 8:   Assign Cart To Shopper Sequence Diagram

3.3.2 Card Read Error
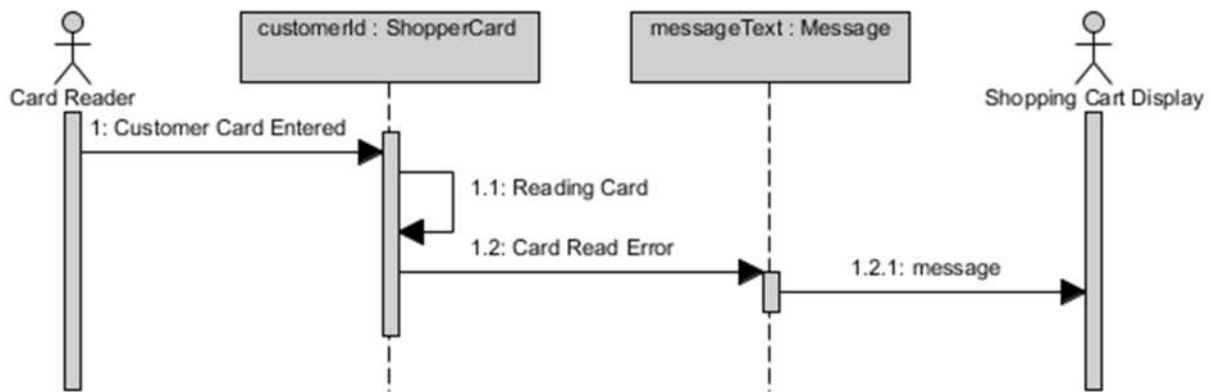
Figure 9:   Card Read Error Sequence Diagram

3.3.3 Checkout
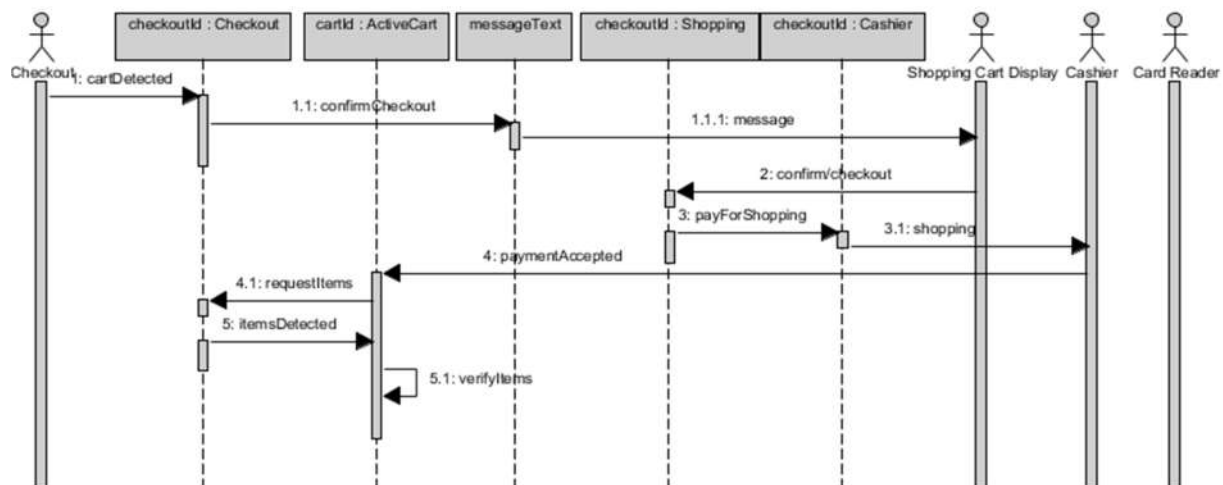
Figure 10: Checkout Sequence Diagram

3.3.4 Checkout Incomplete
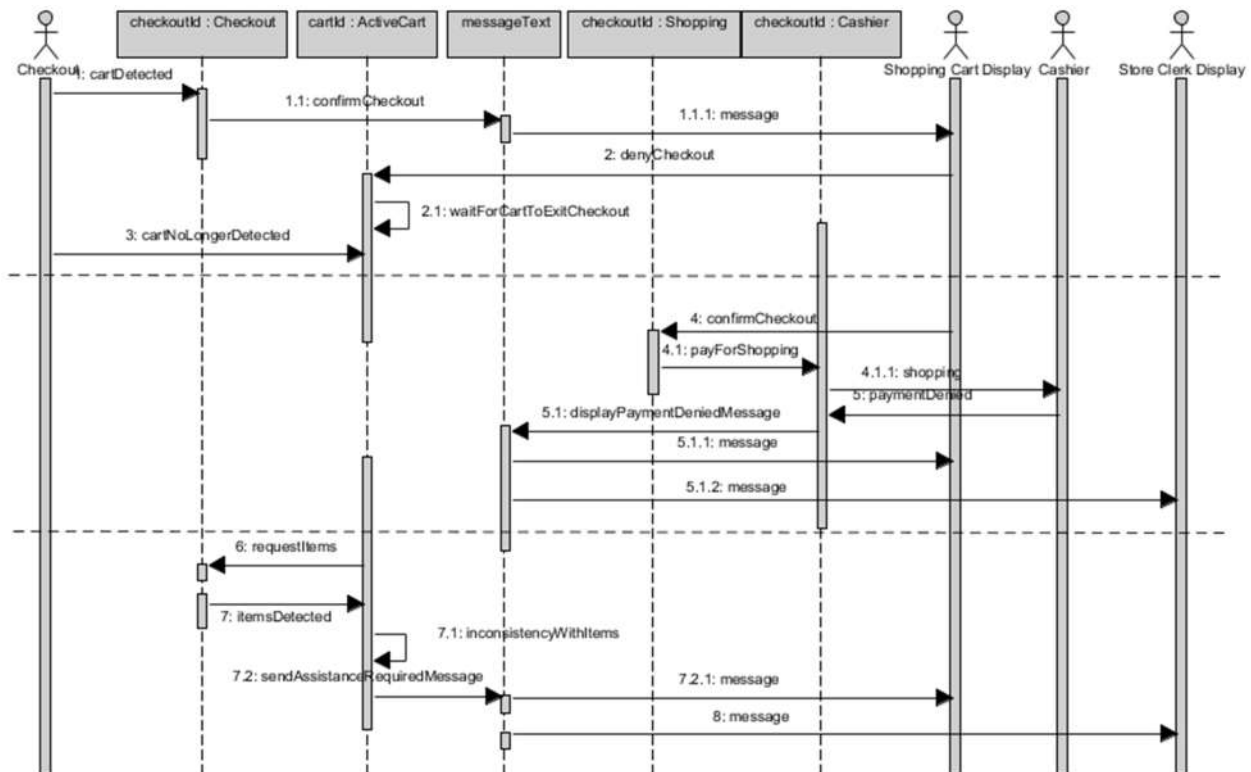
Figure 11:   Checkout Incomplete Sequence Diagram

3.3.5 Customer Not Shopper
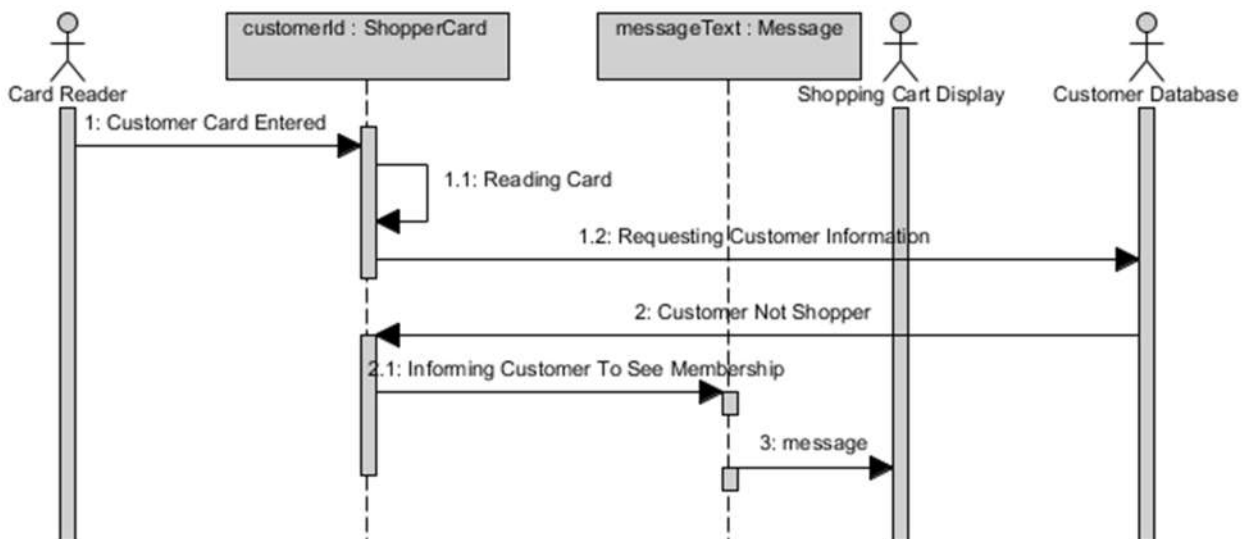
Figure 12:   Customer Not Shopper Sequence Diagram

4   Shopping System High Level Design
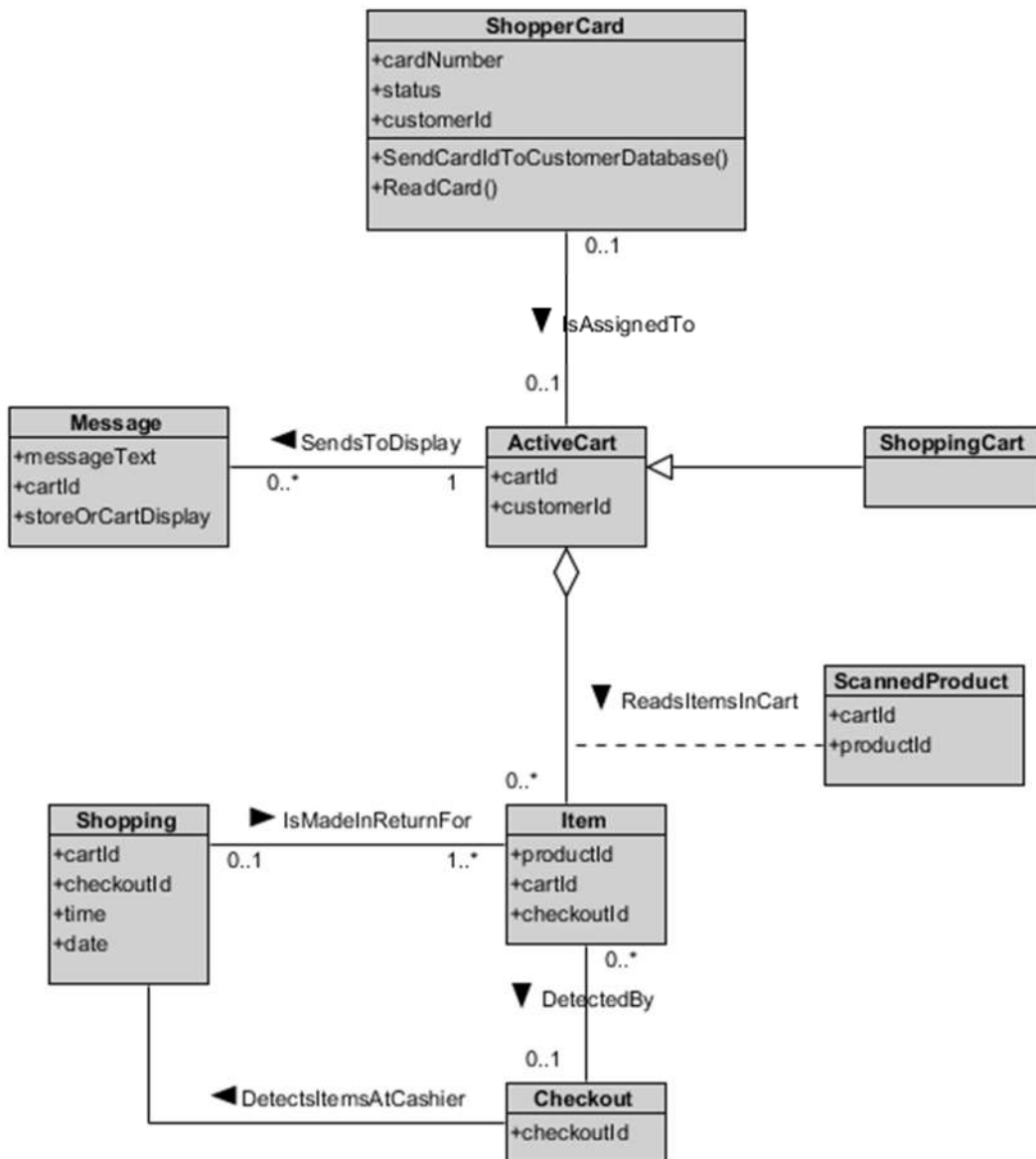
Figure 13: Shopping System Class Diagram

4.1 Shopping System Communication Diagrams

4.1.1 Overview
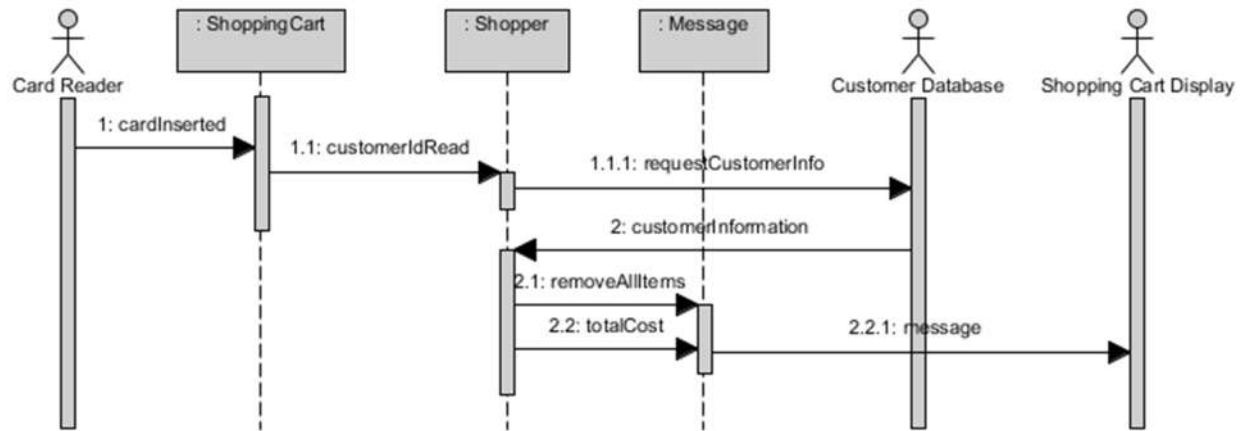
Figure 14: Class Interaction Overview
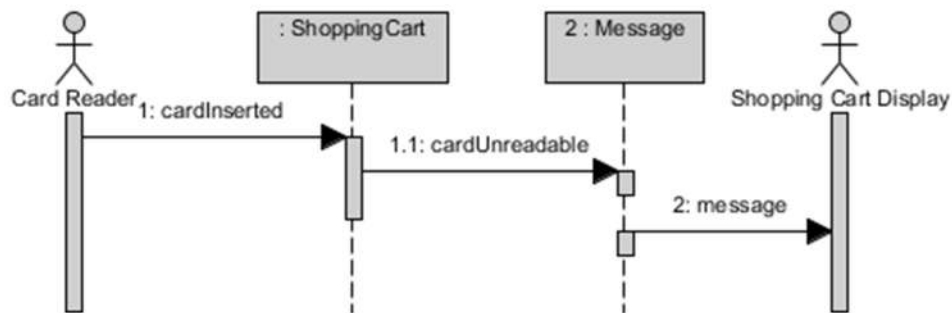
Figure 15: Card Not Readable
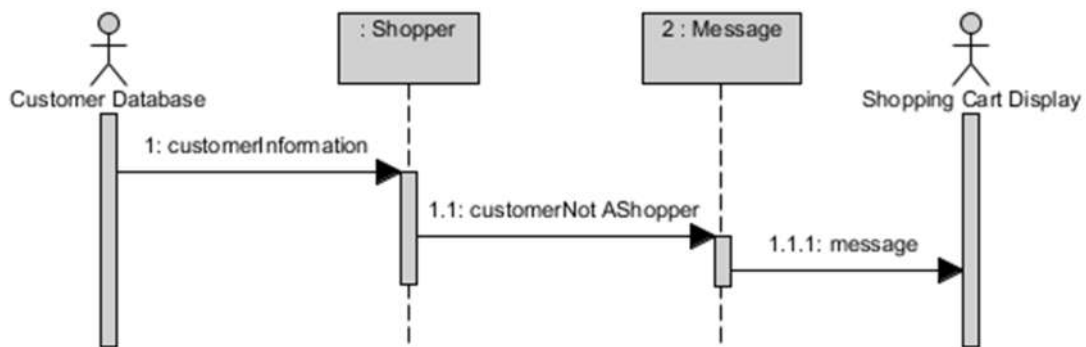
Figure 16: Customer Not A Shopper

4.1.2 Change Items In Shopping Cart
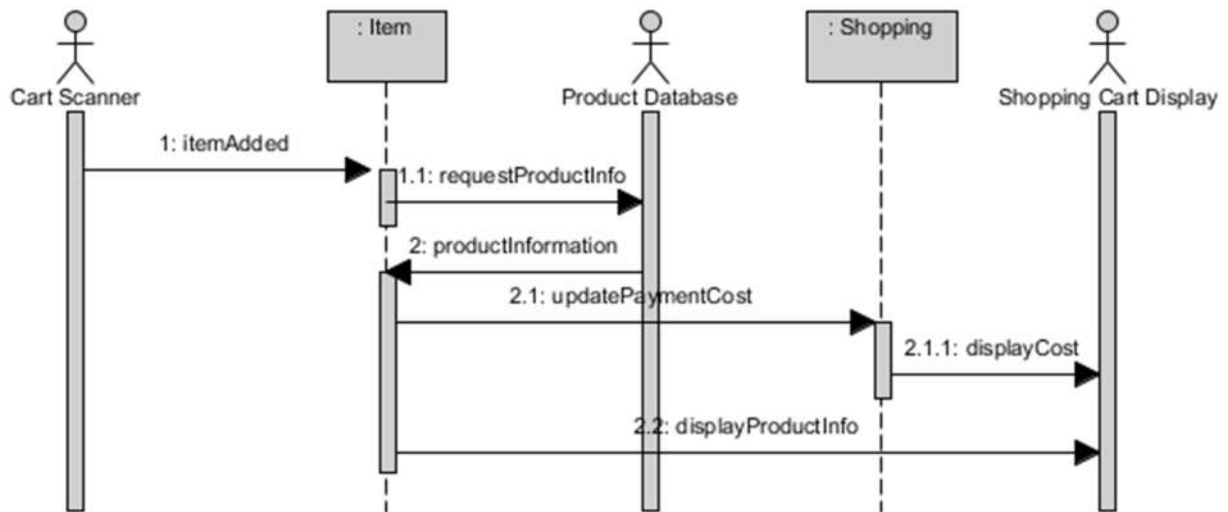
Figure 17: Add Or Remove Item
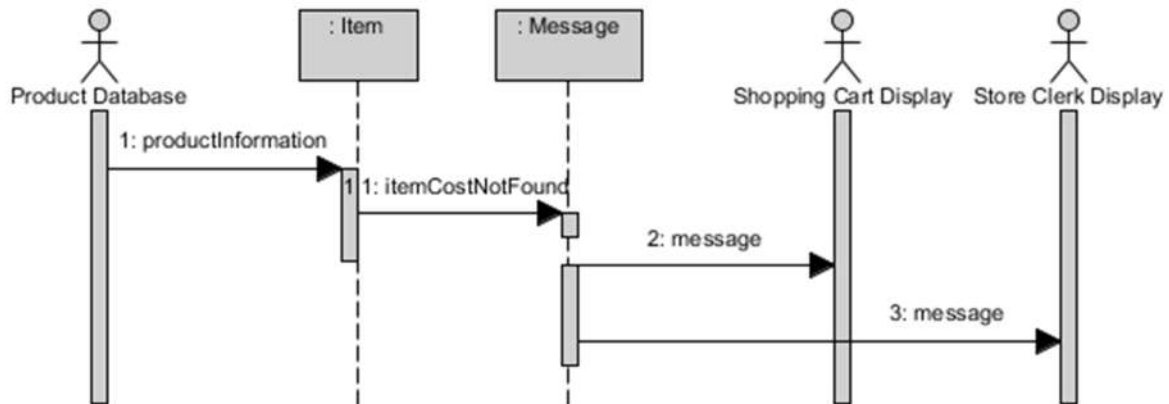
Figure 18: Item Not Found

4.1.3 Checkout Shopping Cart
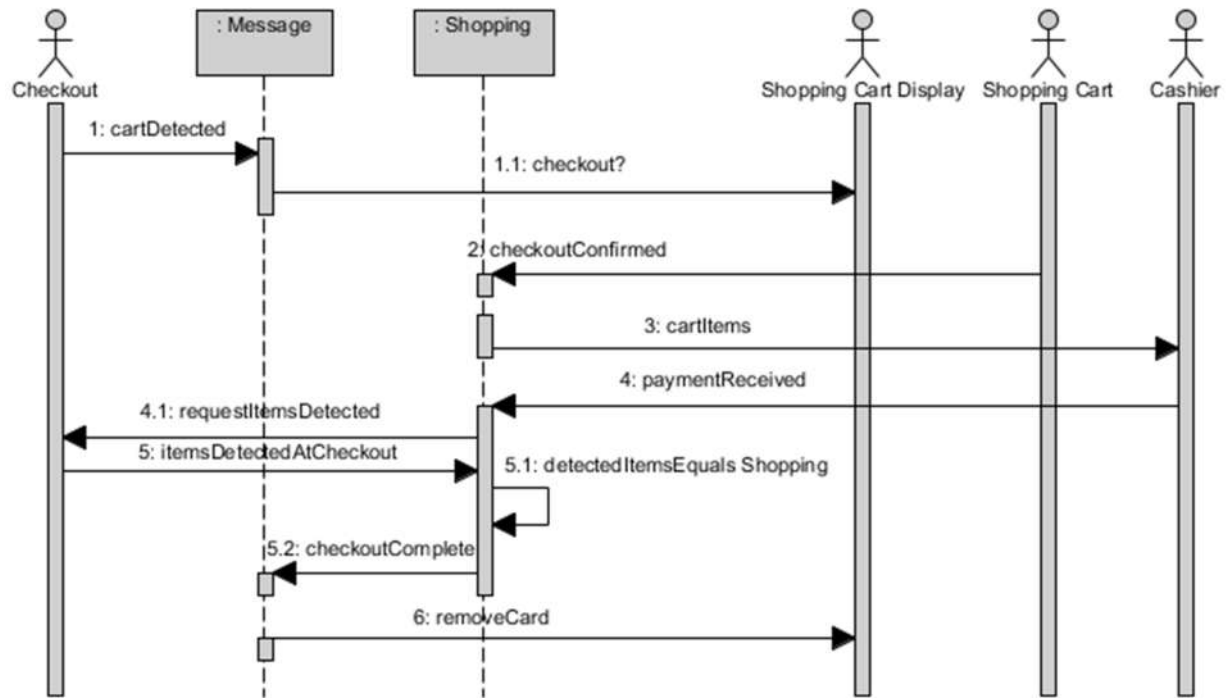
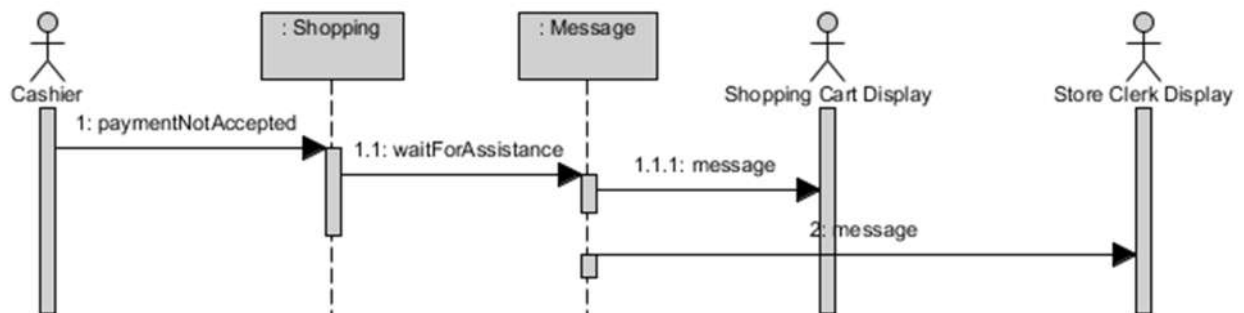Figure 19:   Cart Detected At Checkout
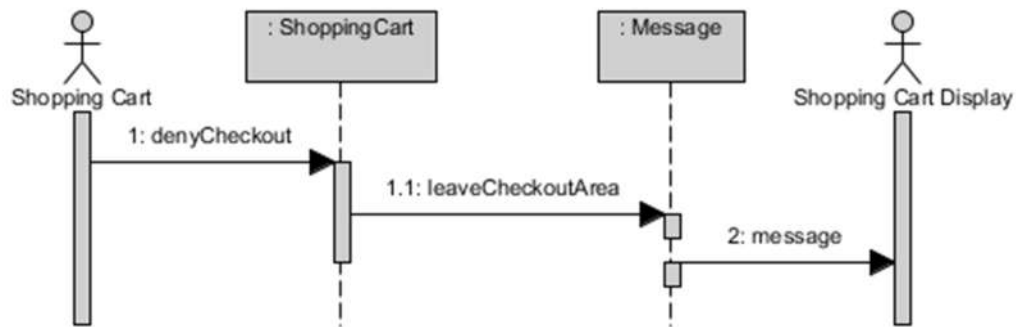
Figure 20:   Checkout Denied

Figure 21:   Payment Not Approved
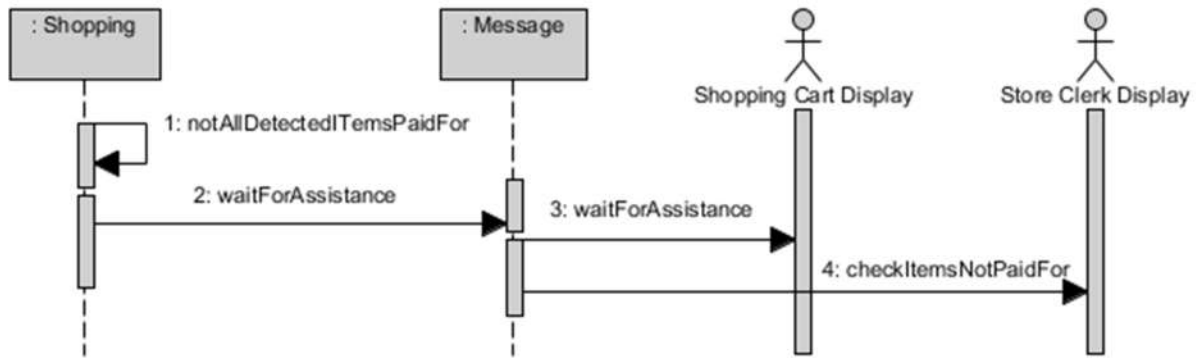
Figure 22:   Not All Items Paid For

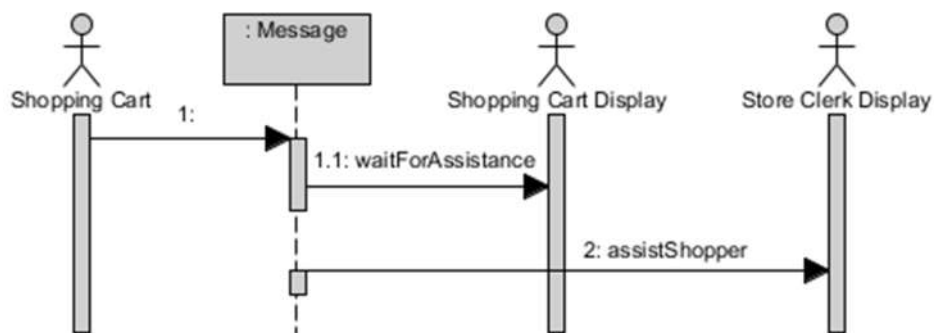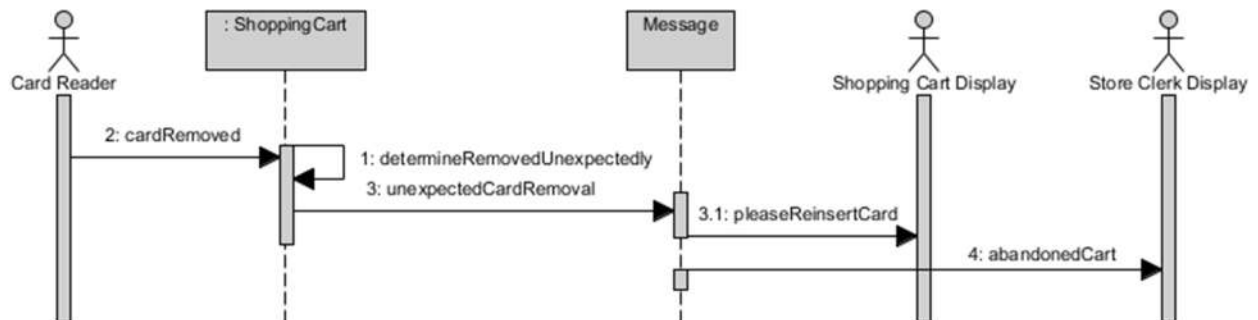### 4.1.4 Assist Shopper

Figure 23:   Assist Shopper

4.1.5 Unexpected Card Removal

Figure 24:   Unexpected Card Removal