Dynamic Interaction Modeling

Reference: H. Gomaa, Chapters 9,11, 21 - *Software Modeling and Design*, Cambridge University Press,

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Dynamic Interaction Modeling

- Dynamic Interaction Modeling
  - Approach to determine how objects interact with each other to support use case
- Use cases realized in Dynamic Interaction Model
  - Show objects participating in each use case
- Determine how objects participate in use case
  - Use object structuring criteria to determine objects
    - Stereotype for each object structuring criterion
  - Shows sequence of object interactions in use case
    - Depict on
      - **communication diagram** or
      - **sequence diagram**
- State-dependent control objects
  - Modeled using statecharts

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Communication Diagram

- Graphically depicts objects interacting with each other
  - Show objects as boxes
  - Show their message interactions as arrows
  - Number sequence of messages

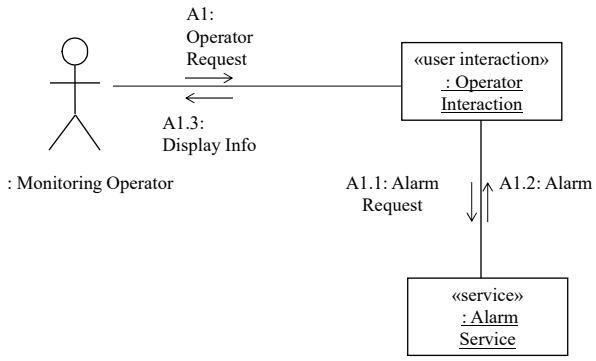

Figure 9.2 Communication diagram for View Alarms use case

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Sequence Diagram

- Shows sequence of object interactions
- Emphasis on messages passed between objects
  - Objects represented by vertical lines
  - Messages represented by labeled horizontal arrows
  - Sequence numbering is optional

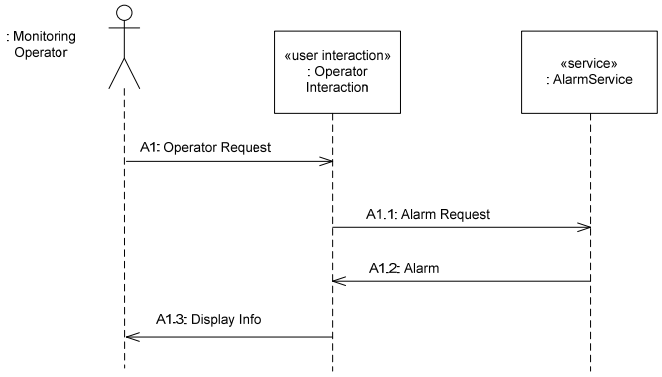

Figure 9.3 Sequence diagram for View Alarms use case

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Dynamic Interaction Modeling

- Determine how objects interact with each other to support use case
  - Start with external event from actor
  - Determine objects needed to support use case
  - Determine sequence of internal events following external event
  - Depict on communication diagram or sequence diagram
- Stateless (non-state-dependent) Dynamic Interaction Modeling
- State-dependent Dynamic Interaction Modeling

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Stateless Dynamic Interaction Modeling

- Start with use case
- Determine boundary objects
  - Receives external events from actor
- Determine internal objects
  - Receive messages from boundary objects
- Determine object interactions
  - Sequence of messages passed
- Develop main interaction sequence (scenario)
- Develop alternative sequences
  - For alternative branches of use case
  - E.g., for error handling or less frequently occurring conditions

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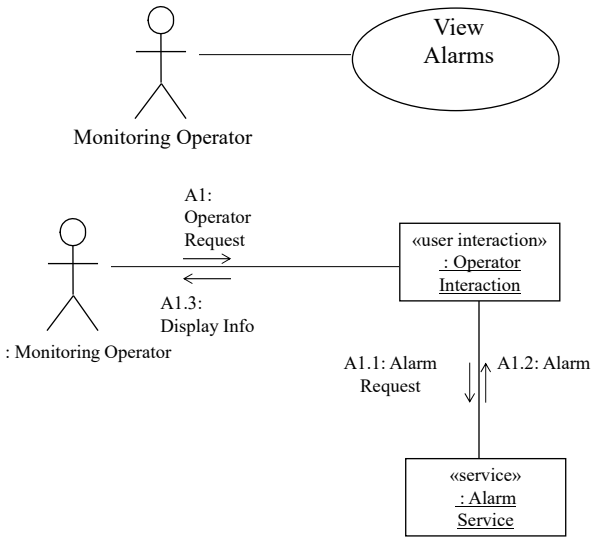
Example of Stateless Dynamic Interaction Modeling
Figure 9.2 Communication diagram for View Alarms use case



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Message Sequence Numbering

- Form of message sequence number
  - [first optional letter sequence][numeric sequence] [second optional letter sequence]
- First optional letter sequence - use case id
- Numeric sequence
  - Message sequence starting with external event
  - A1, A2, A3
- Interactive System
  - Whole number for external event
    - A1, A2
  - Decimal number for subsequent internal events
    - A1.1, A1.2, A1.3, …, A2, A2.1, A2.2,…
- Second optional letter sequence
  - Concurrent event sequences
    - A3, A3a
  - Alternative message sequences
    - D1[Normal], D1A[Error]

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Message Sequence Description

- Describes sequence of object interactions
  - Narrative description
  - Corresponds to Communication Diagram or Sequence Diagram
- Description corresponds to message sequence numbering on diagrams
  - Describe what object does on receiving message
  - E.g., every time an object interacts with an entity object
    - Identify attributes referenced

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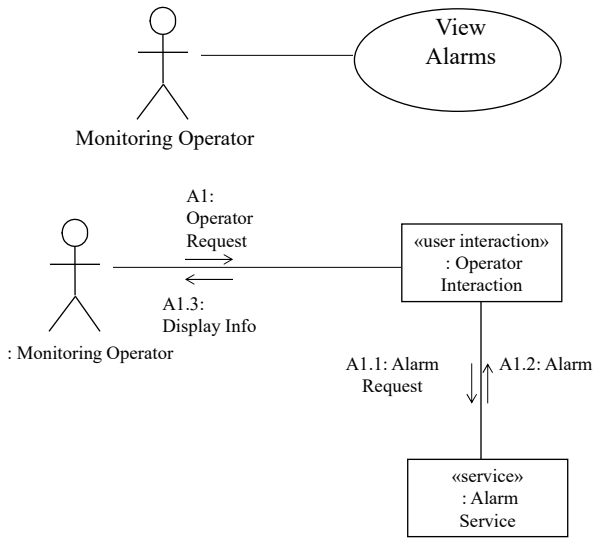
Example of Stateless Dynamic Interaction Modeling
Figure 9.2 Communication diagram for View Alarms use case



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Message Sequence Description - View Alarms

A1: The operator requests to view one or more alarms—for example, to view the status of a factory workstation.

A1.1: `Operator Interaction` object sends an alarm request to the `Alarm Service`.

A1.2: `Alarm Service` responds—for example, with information about the requested alarm: name, description, location, severity.

A1.3: `Operator Interaction` object formats and displays the alarm information to the operator.

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Make Order Request use case description

Use case name: Make Order Request

Summary: Customer enters an order request to purchase catalog items. The customer's credit card is checked for validity and sufficient credit to pay for the requested catalog items.

Actor: Customer, Bank

Precondition: Customer has selected one or more catalog items

Main sequence:

1. Customer provides order request and customer account Id to pay for purchase.
2. System retrieves customer account information, including the customer's credit card details.
3. System requests to a bank checking the customer's credit card for the purchase amount and, if approved, creates a credit card purchase authorization number.
4. System creates a delivery order containing order details, customer Id, and credit card authorization number.
5. System confirms approval of purchase and displays order information to customer.
6. System sends email confirmation to customer.

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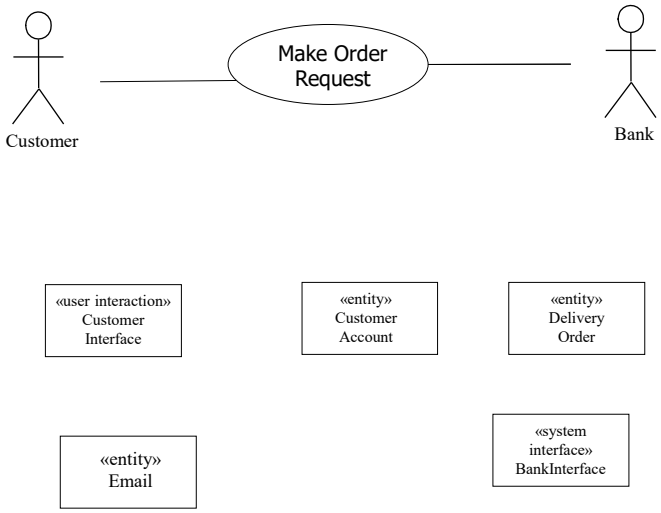
Classes for Make Order Request use case



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Application Logic Objects

- Business Logic Object
  - Defines business specific application logic (rules) for processing a client request
  - Use to access more than one entity object

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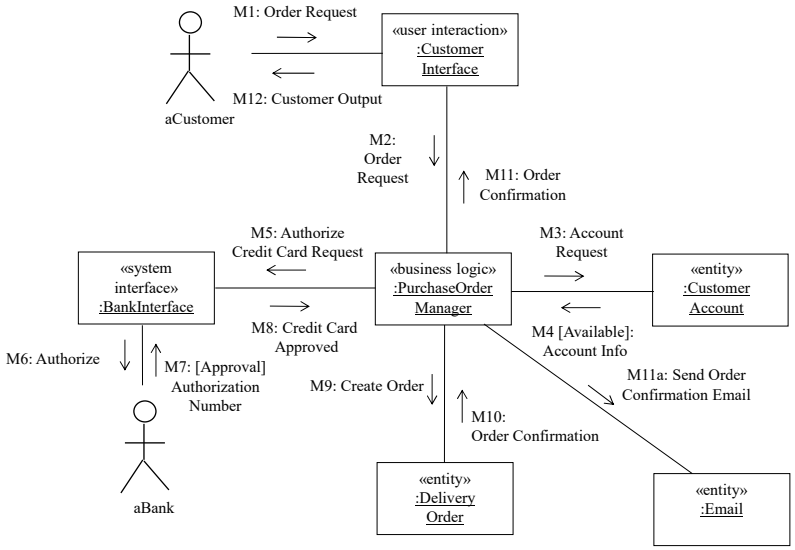
Main Sequence for Make Order Request use case



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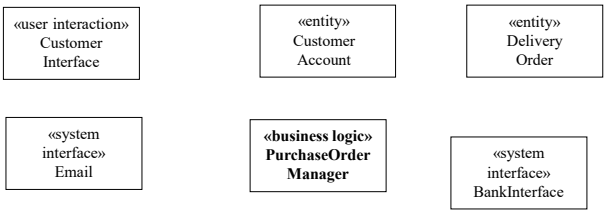
Classes for Make Order Request use case



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State Dependent Dynamic Interaction Modeling

- Object interaction controlled by statechart(s)
  - Control object
    - Executes statechart
    - Activates/deactivates other objects
- For each use case
  - Determine objects participating in use case
  - Determine sequence of object communication
  - Develop statechart for control object
- For each event that arrives at control object
  - Determine state transition from current state to next state
  - Determine actions to be executed
  - Determine objects required to perform actions

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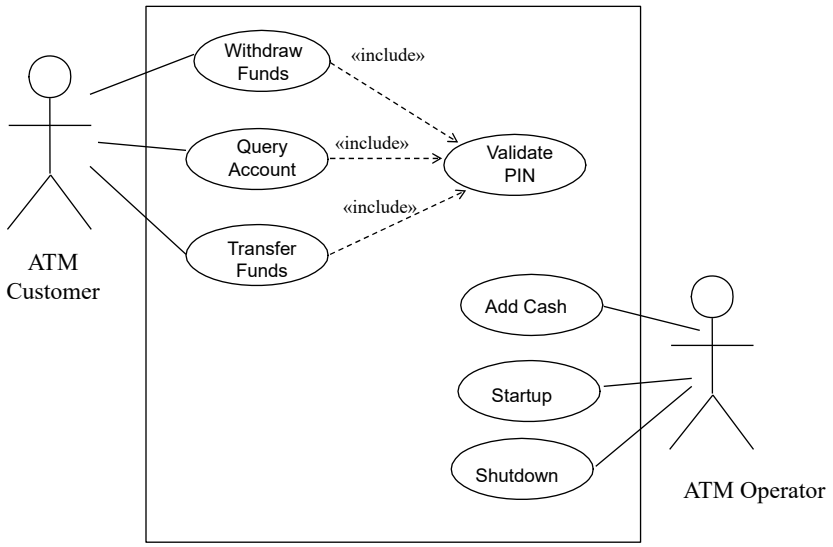
Figure 21.1 Banking System use case model



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Use Case Name: Validate PIN
Summary: System validates customer PIN.
Actor: ATM Customer
Precondition: ATM is idle displaying a Welcome message.
Description:

- Customer inserts the ATM Card into the Card Reader.
- If the system recognizes the card, it reads the card number.
- System prompts customer for PIN number.
- Customer enters PIN.
- System checks the expiration date and whether the card is lost or stolen
- If card is valid, the system then checks if the user entered PIN matches the card PIN maintained by the system.
- If the PIN numbers match, the system checks what accounts are accessible with the ATM Card.
- System displays customer accounts and prompts customer for transaction type: Withdrawal, Query or Transfer.

Alternatives:
a) If the system does not recognize the card, the card is ejected.
b) If the system determines that the card date has expired, the card is confiscated.
c) If the system determines that the card has been reported lost or stolen, the card is confiscated.
d) If the user entered PIN does not match the PIN number for this card, then the system re-prompts for the PIN.
e) If the user enters the incorrect PIN three times, then the system confiscates the card.
Postcondition: Customer PIN has been validated.

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Example of Dynamic Interaction Modeling Banking System - Validate PIN Use Case

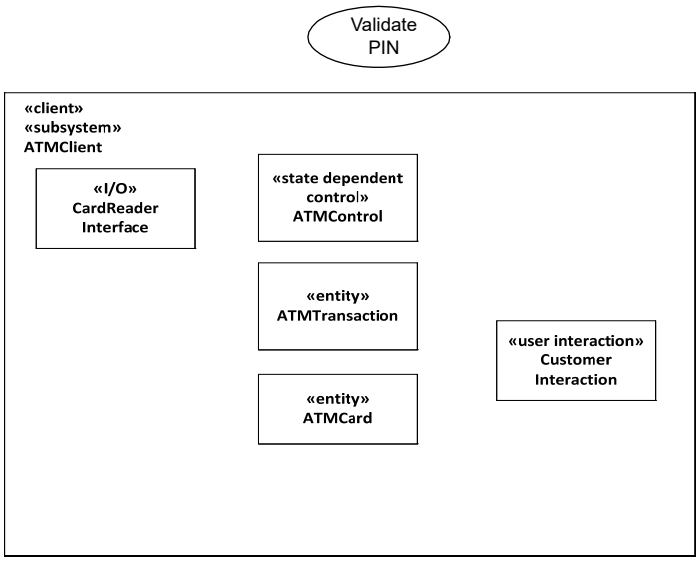

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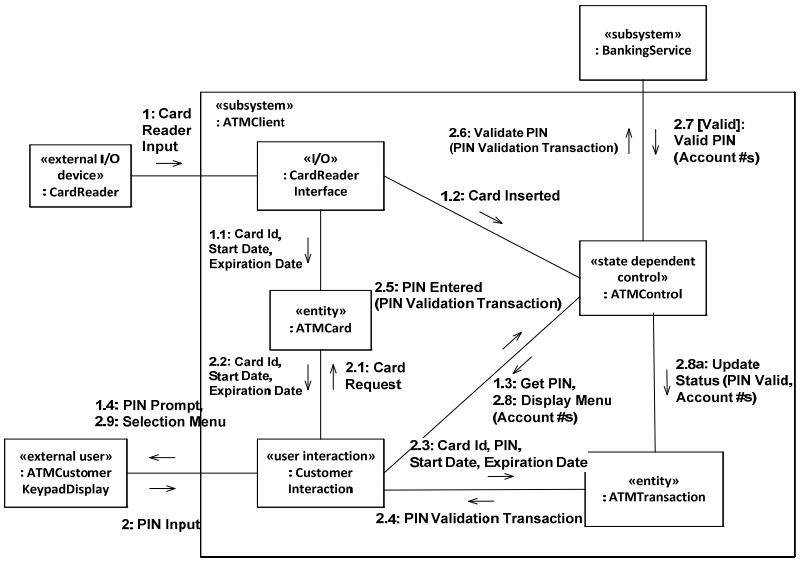
Figure 11.1 Communication diagram: ATM Client – Validate PIN use case – Valid Pin



PIN Validation Transaction = {transactionId, transactionType, cardId, PIN, startDate, expirationDate}

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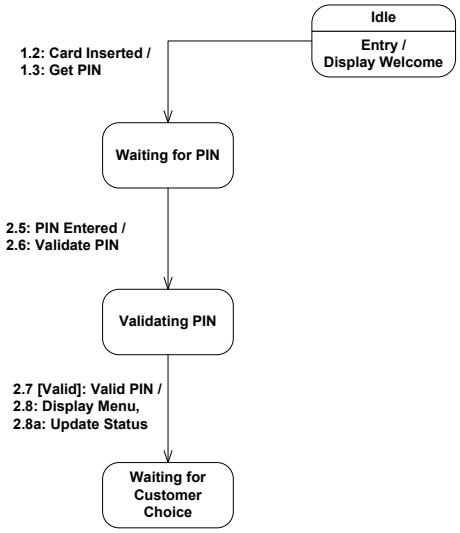
Figure 11.3 Validate PIN Statechart – Valid Pin



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