ECE 355
Software Engineering

Tutorial: Assignment 5
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Problem Description

- You are to design the software for an automated teller machine (ATM). The ATMs are capable of only withdrawal of cash for this example. An ATM accepts a cash card, interacts with the user, verifies the PIN number provided, carries out the transaction, dispenses cash, and prints receipts. ATMs communicate with a central computer, which clears the transactions with the appropriate bank.
Problem Description

• To do
  • Draw a use case diagram for the ATM
  • Describe the use case
  • Draw a domain class diagram for the ATM
  • Draw a design-level sequence diagram to implement the use case
  • Draw the collaboration diagram corresponding to the sequence diagram
  • Draw a design-level class diagram of the ATM software
  • Draw state diagrams for active objects in your design
Use Case Diagram

ATM

Withdraw Cash

Customer 1

CentralComputer 1
Use Case Description

Primary Actor: Customer
Goal in context: Customer withdraws cash
Level: User Level
Stakeholders and Interests:
Customer: wants to withdraw cash
Bank: deducts money from customer's account

Preconditions:
ATM is ready, customer has a cash card

Trigger: Customer interacts with ATM by inserting a cash card

Frequency of use: several per day

Minimum guarantee:
Customer gets his card back and no money is deducted from customer's account

Success guarantees:
Customer gets requested amount of cash and receipt. Bank deducts the money from customer's account

Main Success Scenario:
1. Customer inserts cash card in the card reader
2. Customer enters the PIN
3. Customer enters the desired amount
4. ATM dispenses desired amount of cash
5. ATM prints a receipt
6. ATM returns customer's cash card

Extensions:
2a. The entered PIN is invalid – customer enters the PIN again
3a. insufficient money in cash tray – customer enters new amount
3b. insufficient money on customer's account – customer enters new amount
2b, 3c. Customer presses Cancel – ATM returns the cash card
2c, 3d. Customer does not enter anything for 30 seconds – ATM returns the cash card
**Authentication - Collaboration Diagram**

1. **CentralComputer**
   - 2.2a: \[[\text{cancel}] v.=\text{validate}(\text{acct}\#) \Rightarrow \text{pin}\]
   - 2.3a: \[[\text{cancel} \&\& v] \text{display}(\text{PIN OK})\]
   - 2.3b: \[[\text{cancel} \&\& !v] \text{display}(\text{Invalid PIN})\]

2. **CardReader**
   - \[\text{insertedCard}(\text{acct}\#) \Rightarrow \text{pin}\]
   - \[\text{readPin} \Rightarrow \text{enteredPIN}(\text{pin})\]
   - \[\leftarrow \text{cancel}\]

3. **ATMController**
   - \[\text{display}(\text{"Enter PIN"})\]

4. **DisplayPanel**

5. **Keyboard**
Transaction - Collaboration Diagram

1. **CentralComputer**
   - 3.5: \([s \& b]\) balance := deduce(acct\# , \(amnt\))
   - 3.4: \([s]\) balance := sufficientBalance(\(amnt\))

2. **ATMController**
   - 3.3: \([amnt \neq 0]\) \(s\) := sufficientCash(\(amnt\))
   - 3.6: \([s \& b]\) dispense(\(amnt\))
   - 3: [v] display("Enter Amount")
   - 4a: \([s \& b]\) display("Thank You")
   - 4b: [cancel] display("Operation Canceled")
   - 3.1: readAmount
   - 3.2a: enteredAmount(\(amnt\))
   - 3.2b: cancel
   - 5: removeCard

3. **CardReader**
   - 3.7: \([s \& b]\) printReceipt(acct\#, balance, \(amnt\))

4. **CashTray**
   - 3.3: \([amnt \neq 0]\) \(s\) := sufficientCash(\(amnt\))

5. **DisplayPanel**

6. **Printer**

7. **Keyboard**
Card Reader – State Diagram

- **Empty**
  - after: 20ms/ card:=readSensor()
  - removeCard / eject(),openSlot()
  - [card] / closeSlot(),acct#:readAcctNo(),insertedCard(acct#)

- **cardInserted**
Keyboard – State Diagram

- **Idle**
  - After 10ms[cancelPressed()]: cancel
  - After 30sec: cancel
  - ReadAmount / digitNo:=0

- **ReadAmount**
  - After 10ms[cancelPressed()]: cancel
  - ReadAmount / digitNo:=0

- **ReadPin**
  - After 10ms[cancelPressed()]: cancel
  - [digitNo=4]: enteredPIN(pin)
  - ReadPIN / digitNo:=0

- After 10ms[okPressed() & digitNo>0]: enteredAmount(amount)

- **Amount**
  - After 10ms[digitPressed()]: amount[digitNo]:=getKey(), digitNo++
ATM Controller – State Diagram

Idle

- insertedCard(acct#) / readPIN, display("Enter PIN")

WaitForPIN

- enteredPIN(pin)

- / display("Invalid PIN"), readPIN

- validate(acct, pin)

  - validate(acct, pin)

  - true / display("PIN OK"), display("Enter Amount"), readAmount

  - false / display("Insufficient cash in tray. Enter Amount"), readAmount

WaitForAmount

- enteredAmount(amount)

  - sufficientCash(amount)

    - sufficientCash(amount)

      - true

      - false / display("Insufficient balance. Enter Amount"), readAmount

  - false

  - sufficientBalance(acct#, amount)

    - sufficientBalance(acct#, amount)

      - true

      - false