

VIETNAM NATIONAL UNIVERSITY - HO CHI MINH CITY
HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY
FACULTY OF COMPUTER SCIENCE AND ENGINEERING



DATABASE SYSTEM - SEMESTER 241

CELLPHONE SYSTEM MANAGING

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HO CHI MINH CITY, OCTOBER 2024



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1 Description

The selling mobile store keeps track of Device, Branch, Staff, Supply Store and transaction with customer

The store is divided into many branches that have unique ID, name and location

The database will also store the employee, which is compulsory to be Staff or Manager, but both share the same attributes: unique ID, Name (LName, FName), Date of Birth (Date, Month, Year), Gender and Address

All employees must work for exactly one branch, but branch must be worked by at least 1 employees, and each employee will have the working duration value along with a specific branch.

The employee must be a staff or a manager, and the manager must control at least one staff, and each staff must be controlled by exactly one manager.

The database keeps track of devices sold which contain unique device ID, Price, DType and Dname, each device must be a smartphone or accessory.

Each type of device can be provided the specific discount given by a branch through discount programs that contains attributes: unique name, unique ID and description, and the store must follow the start date and end date as well as percent discount.

The accessory (which is the subclass of device) must be divided into adapt all (which can connect with all types of smartphones) or specific (which is only available to specific types of smartphones). For specific entity type, it must adapt at least one smartphone, but a smartphone can do not suit with any specific accessories.

Branches can be supplied for many devices by many supply stores, which store unique ID, Location and name, and the time as well as quantity will be stored.

The information of customer, who contains unique Account_ID, Address, CusPoint, one or more phone numbers, Name (FName, MName, LName), DOB, Gender also be kept track.

Moreover, after each transaction information should be contained in Bill: unique ID, Exported date consisting Date (D_Num, Month, Year), Time (Hour, Minute), Total Price and PaymentMethod

Each customer can receive one or more bills can have extra discount, and a bill must be received by exactly one customer The bill must contain at least one device, and a device can contain in exactly one bill

The bill must be created by exactly one staff, but a staff can create many bills

The bill can be returned or exchanged by many branches, and a branch can receive many those, the information about return_date and amount of return and exchange will be stored

2 Diagram

2.1 ERD

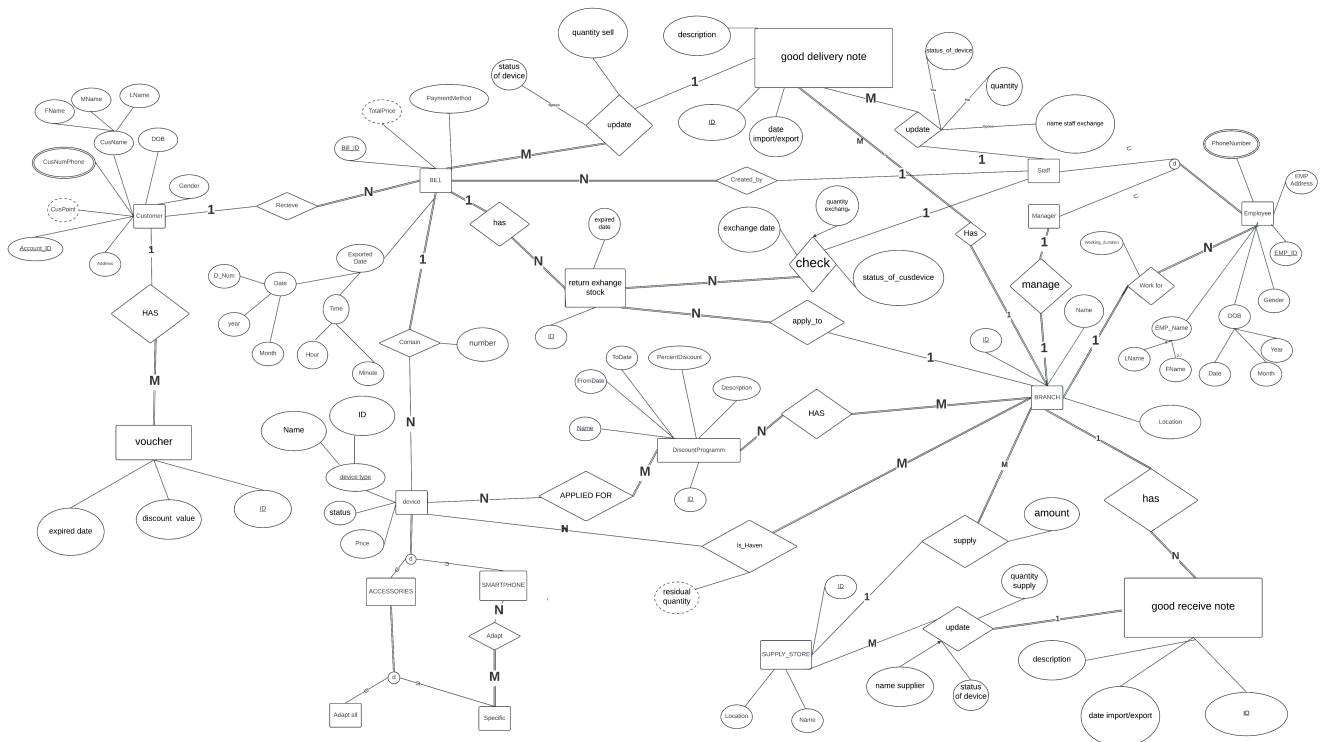


Figure 1: Cellphone store ERD

2.2 Schema Mapping

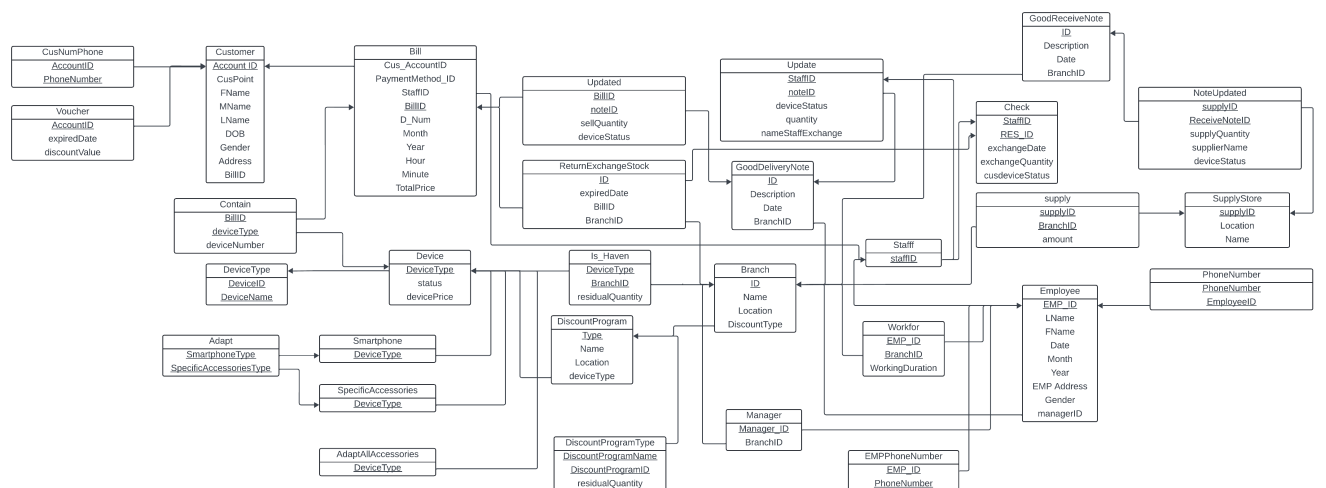


Figure 2: The schema mapping

3 Requirement

3.1 Queries

3.1.1 Show all customer who has voucher

$$\pi_{\text{voucherCustomer}} \left(\left(\text{Customer} \bowtie_{\text{Customer.CusNumPhone} = \text{HAS.Customer_ID}} \text{HAS} \right) \bowtie_{\text{HAS.Voucher_ID} = \text{Voucher.ID}} \text{Voucher} \right)$$

- **VoucherCustomer:** Customer.FName, Customer.MName, Customer.LName, Customer.CusNumPhone, Customer.CusPoint, Voucher.discount_value, Voucher.expired_date.

3.1.2 Show all employee who work under a specific manager

$$A = \left(\text{Employee} \bowtie_{\text{Employee.EMP_ID} = \text{MANAGE.Employee_ID}} \text{MANAGE} \right) \bowtie_{\text{MANAGE.Branch_ID} = \text{Branch.ID}} \text{Branch}$$

$$RES = \pi_{\text{EMPInfo}} \left(\sigma_{\text{Manager.Name} = \text{'Manager_Name'} \& \text{Branch.Location} = \text{'Location_Name'}} \bowtie_{\text{MANAGE.Branch_ID} = \text{Branch.ID}} \text{Branch} (A) \right)$$

- **EMPInfo:** Employee.FName, Employee.LName, Employee.PHONE_NUMBER, Branch.Name \rightarrow BranchName.

3.1.3 Check Best-Selling Product (by Branch or Price Range)

$$A = \left(\gamma_{\text{ProductID}, \text{ProductName} \rightarrow \text{SUM(quantity_sell)}} \text{ProductSales} \right) \bowtie \left(\gamma_{\text{ProductID} \rightarrow \text{SUM(quantity_sell)} \rightarrow \text{TotalSales}} \text{ProductSales} \right)$$

$$RES = \pi_{\text{ProductID}, \text{ProductName}, \text{SUM(quantity_sell)} \rightarrow \text{TotalSales}} \left(\sigma_{\text{SUM(quantity_sell)} = \text{MAX(SalesTotals.TotalSales)}} (A) \right)$$

3.1.4 Show all discount can be applied in a specific device

$$RES1 = \left(\text{Device} \bowtie_{\text{Device.ID} = \text{APPLIED_FOR.Device_ID}} \text{APPLIED_FOR} \right)$$

$$RES0 = RES1 \bowtie_{\text{APPLIED_FOR.DiscountProgram_ID} = \text{DiscountProgram.ID}} \text{DiscountProgram}$$

$$RES = \pi_{\text{Device.Name} \rightarrow \text{DeviceName}, \text{DiscountProgram.Name} \rightarrow \text{DiscountName}, \text{DiscountProgram.PercentDiscount}} (RES1)$$

3.1.5 Find the bill with returned device

$$RES1 = \left(\text{BILL} \bowtie_{\text{BILL.Bill_ID} = \text{ReturnExchangeStock.Bill_ID}} \text{ReturnExchangeStock} \right)$$

$$RES0 = \sigma_{\text{ReturnExchangeStock.quantity_exchange} > 0} \left(RES1 \bowtie_{\text{ReturnExchangeStock.Device_ID} = \text{Device.ID}} \text{Device} \right)$$

$$RESULT = \pi_{\text{BILL.Bill_ID}, \text{BILL.Date}, \text{Device.Name}, \text{ReturnExchangeStock.quantity_exchange}} (RES0)$$

3.1.6 Check Returned Products at a Branch

$$\pi_{\text{ReexchangeInfo}} (\sigma_{\text{BranchID}='desired_branch'}(\text{ReexchangeInfo}))$$

- **ReexchangeInfo:** BranchID, BillID, Exported_date, CusAccountID, CusName, DeviceID, DeviceName, DeviceType, Return_date.

3.1.7 List the devices and matched accessories

$$RES0 = (\text{Device} \bowtie_{\text{Device.ID} = \text{ADOPT.Device_ID}} \text{ADOPT}) \bowtie_{\text{ADOPT.Accessory_ID} = \text{Accessories.ID}} \text{Accessories}$$

$$RESULT = \pi_{\text{Device.Name} \rightarrow \text{DeviceName}, \text{Accessories.Name} \rightarrow \text{AccessoryName}} (RES0)$$

3.1.8 Searching for staff information worked for the corresponding manager

$$RESULT = \sigma_{\text{Manager_ID}=123} (\text{Manager} \bowtie_{\text{Manager_ID}=\text{ManagerID}} \text{Staff})$$

3.1.9 Searching for customer's information

$$\begin{aligned} RES &= \text{CusNumPhone} \\ &\bowtie_{\text{CusNumPhone.AccountID}=\text{AccountID}} (\text{Customer} \\ &\bowtie_{\text{AccountID}=\text{Cus_AccountID}} (\text{Bill} \\ &\bowtie_{\text{Bill.StaffID}=\text{Staff.StaffID}} \text{Staff})) \end{aligned}$$

$$RESULT = \sigma_{\text{AccountID}='123456789'} (\pi_{\text{CusInfo}} (RES))$$

- **CusInfo:** Account_ID, FName || ' ' || MName || ' ' || LName, DOB, Gender, Address, PhoneNumber, CusPoint, Staff_ID, Staff.LName || ' ' || Staff.FName, BillID, D_Num || '/' || Month || '/' || Year, Hour || ':' || Minute, TotalPrice, PaymentMethod_ID, extra_discount.

3.1.10 Searching for corresponding branch's information

$$\text{Res} = \text{Manager} \bowtie_{\text{BranchID}=\text{ID}} (\text{Branch} \bowtie_{\text{ID}=\text{BranchID}} (\text{Supply} \bowtie_{\text{Supply.DeviceID}=\text{Device.DeviceID}} \text{Device}))$$

$$RESULT = \sigma_{\text{Branch.Name}='ABC' \text{ AND } \text{Branch.Location}='BinhThanh'} (\pi_{\text{BranchInfo}} (\text{Res}))$$

- **CusInfo:** Branch.Name, Branch.Location, Branch.ID, Manager_ID, LName || ' ' || FName, Device.Name, Device.Type, Device.Price

3.2 Identify all constraints not shown in your (E)ER diagram

- The bill and return exchange stock will be only available if and only if the account of the customer exists (is created and is not deleted).
- The customer only has the right to return or exchange when the bill is produced by the staff working in the local store which creates the bill.
- The ID of the bill will increase depending on the number of the customers.
- The manager cannot manage themselves.
- The customer only receives the discount when all the requirements in the description are satisfied.
- In a branch, $5 \leq \text{Num (Staff)} \leq 10$.
- The location of the employee and the branch must have the same city name.
- The customer point will be the sum of points of all bills received by the customer.
- If the customer returns the devices, the customer points will decrease depending on the price of the products.
- Any device entity associated with a bill and having a residual quantity of 0 will have a status of “unavailable.” When a product is successfully returned and the residual quantity is 0, the status will also be “unavailable.” The residual quantity will decrease by the quantity sold or exchanged. Update the staff name in the description of the delivery note.
- When a product is supplied, the status of the device will be “available.” The residual quantity will increase by the supply quantity. Update the supplier’s name in the description of the receipt note.
- If the return period is still valid, the customer’s device condition is due to a technical issue, and the residual quantity of the product is greater than 0, it can be exchanged; otherwise, it cannot be exchanged.
- Payment Method $\in \{\text{Cash, Credit Card, Debit Card, Momo, Internet Banking}\}$, unit of price is VND.
- Date Range: The FromDate and ToDate fields in the Discount Program entity should maintain logical date ranges (ToDate must be later than FromDate).
- If the customer returns the devices, the money they receive will depend on the price after being discounted, not on the original price.
- The manager: work experience ≥ 5 years and must have been a staff member.
- ID Employee: $\overline{s_1 s_2}$
 - If $\overline{s_1 s_2} = \text{“ST”}$ $\Rightarrow \text{Employee} = \text{Staff}$.
 - If $\overline{s_1 s_2} = \text{“MN”}$ $\Rightarrow \text{Employee} = \text{Manager}$.
- The account ID: $\overline{s_1 s_2 n_1 n_2 n_3 n_4 n_5 n_6 n_7 n_8 n_9}$, where:
 - $\overline{s_1 s_2} \in \{\text{copper (CP), silver (SV), gold (GO), diamond (DM)}\}$.
 - $\overline{n_1 n_2 n_3 n_4 n_5 n_6 n_7 n_8 n_9}$: random 9-digit number.

- The Bill ID: $\overline{c_1c_2n_1n_2n_3n_4n_5n_6b_1b_2b_3}$, where:
 - $\overline{c_1c_2}$: Customer status.
 - $\overline{n_1n_2n_3n_4n_5n_6}$: Unique numbers.
 - $\overline{b_1b_2b_3}$: Number of bills.
- Warehouse must consist $\{\geq 100 \text{ new devices}, \geq 50 \text{ old devices}\}$.
- The ID of each device will start with the first 2 digits: Old (OL), New (NE). If the production date is less than 1 year from the present, it is considered new; otherwise, it is old, followed by 9 unique numbers.
- ID device: $\overline{s_1s_2n_1n_2n_3n_4n_5n_6n_7n_8n_9}$, where:
 - $\overline{s_1s_2} \in \{\text{Old (OL), New (NE)}\}$.
 - $\overline{n_1n_2n_3n_4n_5n_6n_7n_8n_9}$: random 9-digit number.

Note:

- If: present date – produced date $> 1 \text{ year} \Rightarrow \text{Old}$.
- If: present date – produced date $\leq 1 \text{ year} \Rightarrow \text{New}$.
- Phone number: valid format: $\overline{0n_1n_2n_3n_4n_5n_6n_7n_8n_9}$.
- Customer Date of Birth (DoB): valid format: dd/mm/yyyy, and Customer age ≥ 18 years old.
- Gender $\in \{\text{Male, Female, Unknown}\}$.
- Customer Points ≥ 0 .
- Device Price > 0 .
- Working Duration > 0 .
- Manager Age > 21 years old.
- Percent Discount: The discount values in the Discount Program or Return Exchange should be between 0 and 100.
- Percent Discount: $0\% \leq \text{discount value} \in \{\text{Discount Program, Return Exchange}\} \leq 100\%$.
- Voucher ID: $(\overline{n_1n_2n_3n_4n_5n_6n_7n_8n_9})$: random 9 digital numbers