
# ECEN 424 “Introduction to Database” Project Report By

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# I. Introduction

With e-commerce taking over the world, especially after COVID-19, it makes it a necessity to understand the backend process of developing e-commerce websites, and to understand their functionality. This report reflects the database development process for an e-commerce electronics store that will be called "NUElectronics". The phases included in this part are the requirements analysis, component design, and outlines for what will be done in the implementation phase. The overall target of the project is to design the database for the store (backend) and the store website (frontend), with a full-stack implementation.

## 1. User requirements

The given user requirements for the products of the store, which will also govern our entity identification and our database design are as follows:

- Product Name
- Product Category
- Manufacturer
- Technical Specs
- Price
- Status (New/Refurbished)
- Subcategories (if needed and could be further categorized)

## 2. Requirement analysis

Based on the given user requirements, the following tables represent the initial analysis for each of the given product requirements. Note that the accessories have no brands mentioned as it is a very broad and random category, and on most websites or platforms, even customers can have their own small businesses for accessories so it will be left open until the full stack development phase.

Also, not all brands are mentioned for each category. Assuming that this is a local-based website, not all brands nor all products would be available, and while diversity and accessibility are a better target for any platform, in this project, the database will not include huge amounts of products, brands, categories, … etc.

The rest of the given requirements (price, technical specs, status, and product name) have not been given by the user and thus will be identified and designed later on based on DB research and design relevant to other similar websites.

*Table 1. Products categories, subcategories, and manufacturers list.*

| **Product Category** | **Subcategory: sub-subcategory** | **Supplying Manufacturers** |
|---|---|---|
| Camera & Photo Products | Security Cameras | Blink mini, Simply safe, DECKO, ZOSI. |
| | Digital Cameras | Nikon, Kodak, Fujfilm, Canon, Sony, Panasonic, Polaroid. |
| | Mirrorless Cameras | |
| | Point & Shoot Cameras | |
| | Instant Cameras | Lecia, Fujifilm, Polaroid, Lomography. |
| | Tripods/Monopods | Manfrotto, Vanguard, Dolica, Induro, Bonfoto, Gitzo, Mefoto. Joby, Sirui, Magnus. |
| | Gimbals | FLYCAM ,Moza, Benro, Pilotfly, iKan, Feiyu ,Zhiyun, Glidecam, DJI |
| | Binoculars, Telescopes and Optics | Swarovski, Zeiss, Nikon, Leica, Vortex, Leupold, Steiner, Bushnell, Canon, Meopta, Celestron, Pentax, Fujinon, Vanguard, Burris, Minox, Alpen, Sony, Kowa, Olympus, Weaver, Apertura, Baader, Celestron, Zwo, QHY, Astronomik, Tele Vue, Starlight, Explore Scientific, Meade, iOptron, Atik, Coronado. |
| | Lenses | Canon, Nikon, Fujifilm, Leica, Sony, Olympus, Panasonic, Zeiss, Sigma, Tamron, Tokina, Samyang. |
| | Flashes, Lightning and Studio | Canon, Nikon, Hahnel, Yongnuo, Nissin, Kenko, Neewer, Metz, Phottix. |
| | Storage | Transcend, Samsung, Lexar, SanDisk, Sony. |
| | Accessories | - |
| Car & Vehicle Electronics | - | PPG, Kapci Coatings, BMW, Renault |
| Computers, Components & Accessories | **Laptops:** notebook, Ultrabook, Chromebook, MacBook, convertible, gaming. | Apple, HP, Lenovo, Dell, Acer, Asus, Huawei, Microsoft, Razer, Samsung, MSI, Alienware, Intel, LG, Toshiba |
| | Desktop/PC | |
| | PlayStations | Sony |
| | Games | Ninehertz, iTechArt, Zero Games Studio, Electronics Arts, Nintendo, Ubisoft, Sony, Activision Blizzard, Epic Games, Gameloft, Square Enix, Bungie Inc, Tencent, Microsoft, Take-Two Interactive, Bandai Namco, Nexon, Playtika, Naughty Dog, Platinum Games. |

| | | |
|---|---|---|
| | **Printers:** Inkjet printers, laser printer, solid ink printers, LED printers, continuous ink printers. | HP, Epson, Lexmark, Xerox, Canon, Brother |
| | Storage | Kingston, SanDisk, Seagate, Toshiba, Western Digital, Samsung, ADATA |
| | Accessories | - |
| | Gaming Accessories | - |
| eBook Readers & Accessories | - | Amazon (Kindle), Kobo, Barnes & Nobels (Nook), Bookeen (Cybook), Onyx (BOOX), PocketBook, ReMarkable |
| Headphones, Earbuds & Accessories | Wired Headphones | Sony, Sennheiser, JBL, Beats, iBall, Bose, Logitech, Philips, Panasonic, Audio-Technica, Creative. |
| | Wireless/Bluetooth Headphones | Sony, JBL, SkullCandy, Beats, Senheiser, BOSE, Logitech, Panasonic, Ptron, BeyerDynamic, Jabra, Razer, SteelSeries, HyperX |
| | Wired Earphones/Earbuds | Plantronics, SkullCandy, Anker, Jaybird, Jabra, Beats, Sennheiser, Sony, Apple. |
| | Wireless Earphones/Earbuds | Plantronics, SkullCandy, Anker, Jaybird, Jabra, Beats, Sennheiser, Sony, Apple. |
| | Accessories | - |
| 100Home Audio & Theater Products | Sound Bars | Samsung, LG |
| | All-in-One Systems | Bose, Logitech, XZONE, Yamaha, Mediatech, Sony, ICONZ, |
| | Home Theater/Audio Systems | Yamaha, Logitech, JBL, Bose, Sonos, SVS, Bowers & Wilkins, Polk, Klipsch, Focal. |
| | Wireless Speakers | Sonons, UE, JBL, Bose, Anker, Sony, B&O, Urbanista, 1MORE. |
| | Subwoofers | Alpine, MTX, Kicker, Pioneer, QSC, Alto Professional, Electro-voice, JBL, Polk Audion, Klipsch, Yamaha. |
| | Receivers & Amplifiers | Denon, Onkyo, Sony, Marantz, Anthem, Yamaha, Integra, AudioControl, Pioneer, ARcam, Outklaw Audio. |
| | Accessories | - |
| Home Theater, TV & Video Products | Display (Screens/TVs) | Apple, LG, Samsung, Sony, Tornado, Toshiba, Sharp, Fresh, Haier, Vizio, TCL, Hisense, Panasonic, Philips. |
| | Projectors | Sony, Epson, Optoma, JVC, BenQ, Panasonic, LG, Philips. |
| | DVD and Blu-ray Players | Sony, LG, Panasonic, Pioneer. |
| | Streaming | |

| | | |
|---|---|---|
| | Remote Control Systems | Logitech, Caavo, Amazon, Sony, Inteset, Philips, Samsung, Toshiba, Roku, JVC. |
| | Accessories | - |
| Household Batteries & Chargers | Alkaline Batteries | Energizer, Panasonic, Duracell |
| | Lithium Batteries | Tesla, Panasonic, LG – Life's Good, Samsung SDI, CATL, BYD, Grepow. |
| | Rechargeable Batteries | Amazon, Energizer, EBL, Ponkor, PKCELL, Soluser. |
| | Special Batteries | Duracell, Energizer, CELEWELL, Batmax |
| | Phone Chargers | INIU, Anker, Poweradd, Ekrist, Miady. |
| | Portable Chargers | INIU, Anker, Poweradd, Ekrist, Miady. |
| | Wall Chargers | Anker, NekTeck, Apple, Spigen. |
| | Wireless Chargers | Belkin, Apple, Logitech, Nanami, Chotech, Anker, Yootechm google, Mophile, Native, OtterBox, Fonesalesman, Nomad, Moshi. |
| | Power Adapters | Epicka, Bonazza, Conair, Bestek, Newvanga, Pac2Go, Ceptics. |
| Mobile Phones & Communication Products | Android | Samsung, Huawei, Realme, Oppo, Xaiomi, Infinix, Nokia, Honor, Google, Sony, Microsoft |
| | IOS | Apple |
| | Accessories | - |
| Portable Sound & Vision Products | Portable Speakers | JBL, Dali, Tribit, Bang, Ultimate, Dynaudio, Audio, Naim, Amazon, Sonos. |
| | Gaming/VR Sets | Google, Homido, Zeiss, Gear, LG, Sony, Oculus, HTC. |
| | Digital Media Players | Roku, Kaleidscape, NVIDIA, Rocketfish, Amazon, TiVo. |
| | Radio | Panasonic, Jazmm, Powebear, Greadio, MAKSH, Magnavox, Sony, DreamSky, AOM. |
| | Accessories | - |
| Electrical Power Accessories | - | Fora, Gigamax, ADAX, AICO AIRMASTER, ANDA, Appleby, ARMEG, ASD Lighting, ATC, Aurora Enlite, B.E.G. Luxomat, Bell Lighting, BG Electric, Burco |
| GPS & Navigation Equipment | Vehicle GPS | ACR, Fusion, Garmin, Lowrance, Mareton, Marine Electronics, Seaview, Shakespeare, Sitex Marine, Standard Horizon |
| | Handheld GPS | Garmin, TwoNav, SkyGolf. |

| | | |
|---|---|---|
| | GPS tracker | Teltonika, Ruptela, ATrack, Tkstar, TrackingFox, GoSafe, Concox, Skypatrol, Meitrack, Quecklink, Tramigo, Galileosky. |
| | Item Finders | Apple, Tile, Samsung, Esky, Cube. |
| | Accessories | - |
| Computer Tablets | - | Huawei, Apple, Samsung, Lenovo, Microsoft, Asus, HTC |
| Telephones, VoIP & Accessories | Cordless Telephones | Logitech, Anker, Panasonic, Cisco |
| | Corded Telephones | AT&T, Future Call, Yealink, Crosley, Pansonic, Pyle, Cortelco, RCA, Conair, GE, Northwestern Bell, Clarity, CapTel, jWIN, Cisco, Polycom, Aastra, Nortel. |
| | VoIP | Polycom, Yealink, Grandstream, Cisco, Vtech. |
| | Telephone Accessories | - |
| Wearable Technology | Smart Watches | Fitbit, Garmin, Amazon, Samsung, Amazfit, Apple, Huawei, Xiaomi, Honor, Oura, Withings, Oppo, Infinix, Realme, Lenovo. |
| | Smart Bands | |
| | Fitness Trackers | |

## 3. Business rules

Business rules are ones that identify what should be done/not done on the website, based on the client's preferences. The given business rules could be summed in:

### *3.1.Stock state:*

The product could have 3 states:

- ***Standard:*** sufficient available quantity.
- ***Running out:*** limited quantity available.
- ***Not Available:*** no stock/quantities available for the product.

For the running out state, since the user did not specify his requirement for this part, this state will be set to appear when the quantity of a product is less than 10.

### *3.2.Product status:*

There are two states for the products, which are illustrated below:

- ***New:*** First time to be bought by the user/ First time distributed from the vendor. If the product is returned before 15 days of the purchase, it is still classified as new. The product will be resold at the original price
- ***Refurbished:*** Has been previously bought and returned to the vendor for considering reasons. If the product is returned between 15 – 30 days, it is classified as refurbished. The product will be resold with a 10% discount from the original price.

### *3.3.Order Status:*

Each customer has multiple orders, and each order contains multiple purchases. Each order has its own status, which are:

- ***Ordered:*** The order has been submitted and is being processed.
- ***Shipped:*** The order has been shipped from the vendor and is to be received by the distributor.
- ***Out for Delivery:*** Order has been acquired by the delivery and is soon to be delivered to the customer.
- ***Cancelled:*** The order has been cancelled by the customer before receiving.
- ***Delivered:*** The order has been delivered and payment is complete.
- ***Payment Ongoing:*** Order has been delivered and received by the customer, but installments are still ongoing.
- ***Return Requested:*** The customer has requested a return and is waiting for the item to be picked up.
- ***Refund Complete:*** The refund has been completed for the returned item after it has been acquired by the delivery.

### *3.4.Payments:*

There are three 3 different payment techniques, based on the customer's choice:

- ***Cash:*** customer pays the delivery person when the order is received in person.
- ***Visa:*** accessibility is checked by withdrawing 1 pound from the customer's card.
- ***Installments:*** monthly payments for one year – fixed – and has a 20% interest rate on the original price.

### *3.5.Return Policies:*

The chosen return policies are:

- No returns are allowed after 30 days of receiving the product.
- Returns are allowed for cash-paid products only.
- Full funding for products returned less than 15 days of purchase.
- 85% funding for products returned between 15 and 30 days of purchase.
- The customer must provide reasons for the return request, and the causes are to e reviewed by the admins before proceeding with the refund.

# II. Database Design

Based on the requirements analysis, the following section discusses the data model and component design. Before defining the used entities, the main functions of the website should be pointed out to make it more clear what objects would focus on. The main functions and steps of the website – with respect to the given business rules – are:

- The customer creates an account and inputs his/her data
- The customer adds their address, with the option of adding more than one address.
- The customer is allowed to search for products (i.e. products are viewed on the website based on the requirements and categories mentioned earlier).
- The customer can add/remove items to his cart.
- The customer can add/remove and chose his payment method.
- The customer makes a purchase, where cart items are saved as an order.
- The customer can request refunds and returns.
- The customer can check his balance, pay, and follow up with orders.

## 1. Entities

With the given info, the first part of the designing phase is specifying the objects of interest for developing the website while meeting the criteria. The chosen initial entities – further discussed in detail – for the design are identified in the table below. For each entity, it is identified if it is weak/strong, ID dependent/ non-ID dependent, and if there are any associative entities.

*Table 2. Entities' specifications.*

| Entity | Weak/Strong | General Dependency | ID Dependency | Remarks |
|---|---|---|---|---|
| Customer | Strong | Independent | Non-ID dependent | |
| Admins | Strong | Independent | Non-ID dependent | |
| Product | Strong | Existence-dependent | Non-ID dependent | |
| Categories | Strong | Independent | Non-ID dependent | |
| Subcategories | Strong | Independent | Non-ID dependent | |
| Brands | Strong | Independent | Non-ID dependent | |
| Payment Methods | Strong | Independent | Non-ID dependent | |
| Cart | Weak | Existence-dependent | Non-ID dependent | |
| Cart Items | Weak | Existence-dependent | Non-ID dependent | |
| Invoices | Weak | Existence-dependent | Non-ID dependent | |
| Installments | Weak | Existence-dependent | Non-ID dependent | |
| Brands Categories | Weak | Existence-dependent | ID Dependent | Associative Entity |
| Customer Orders | Weak | Existence-dependent | ID Dependent | Associative Entity |

## 2. ER Diagram

An initial ER diagram was constructed to be able to visualize the relations between the entities and to verify the chosen ones as well. The diagram was hand sketched and does not represent all the updates done, but rather an early designing sketch for further illustration.

### 3. Database Relational Design Diagram

The database was constructed using MySQL (see the appendix). The MySQL shell provides an option of showcasing the relation design diagram once the DB's structure is done and written using the reverse engineer option. The relational design diagram is further revised and is shown in Figure 2. Note that there are no recursive relations for any of the entities. Also, the MySQL does not showcase the optional relations, it considers all tables and relations mandatory. Figure (1) represents an very early version of the ERD, as an initial sketch. The relational model could be further broke-down and discussed in the table below.

*Table 3. Entities-relationships description.*

| First Entity | Second Entity | Relationship | Type |
|---|---|---|---|
| Products | Cart Items | 1:N | Non-identifying relationship |
| Products | Product Category | 1:N | Identifying relationship |
| Categories | Product Category | 1:N | Identifying relationship |
| Subcategories | Product Category | 1:N | Non-identifying relationship |
| Brands | Product Category | 1:N | Non-identifying relationship |
| Cart | Cart Items | 1:N | Non-identifying relationship |
| Customers | Cart Items | 1:N | Non-identifying relationship |
| Customers | Cart | 1:N | Non-identifying relationship |
| Customers | Installments | 1:N | Non-identifying relationship |
| Customers | Customer Orders | 1:N | Identifying relationship |
| Customers | Invoices | 1:N | Non-identifying relationship |
| Payment Methods | Invoices | 1:N | Non-identifying relationship |
| Cart | Invoices | 1:N | Non-identifying relationship |
| Invoices | Customer Orders | 1:N | Identifying relationship |
| Invoices | Installments | 1:N | Non-identifying relationship |

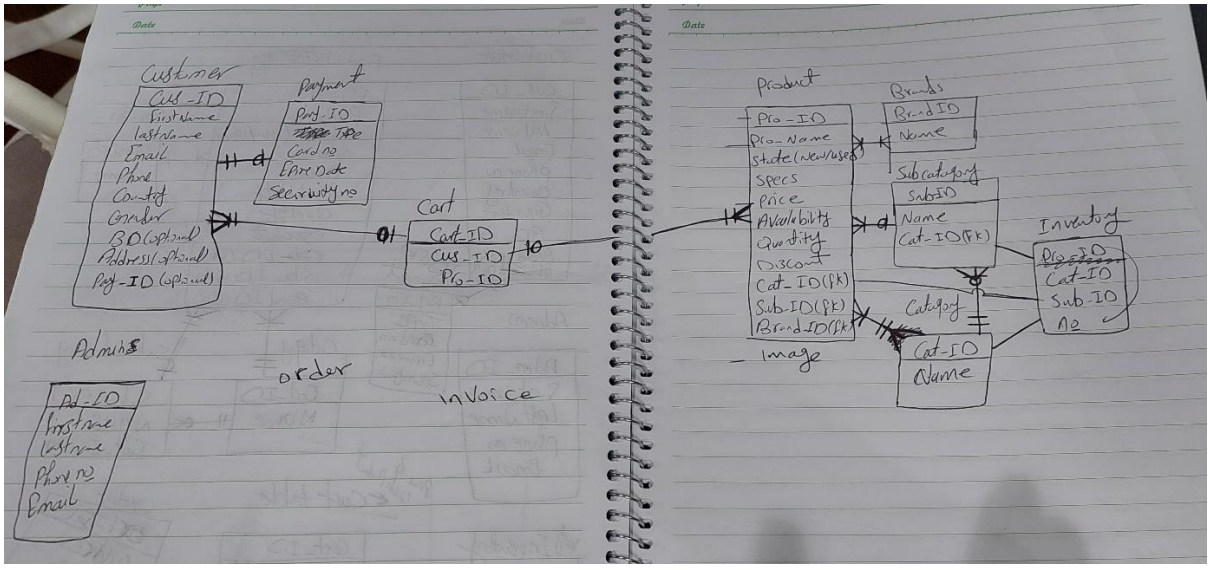


*Figure 1. Initial ERD Sketch*

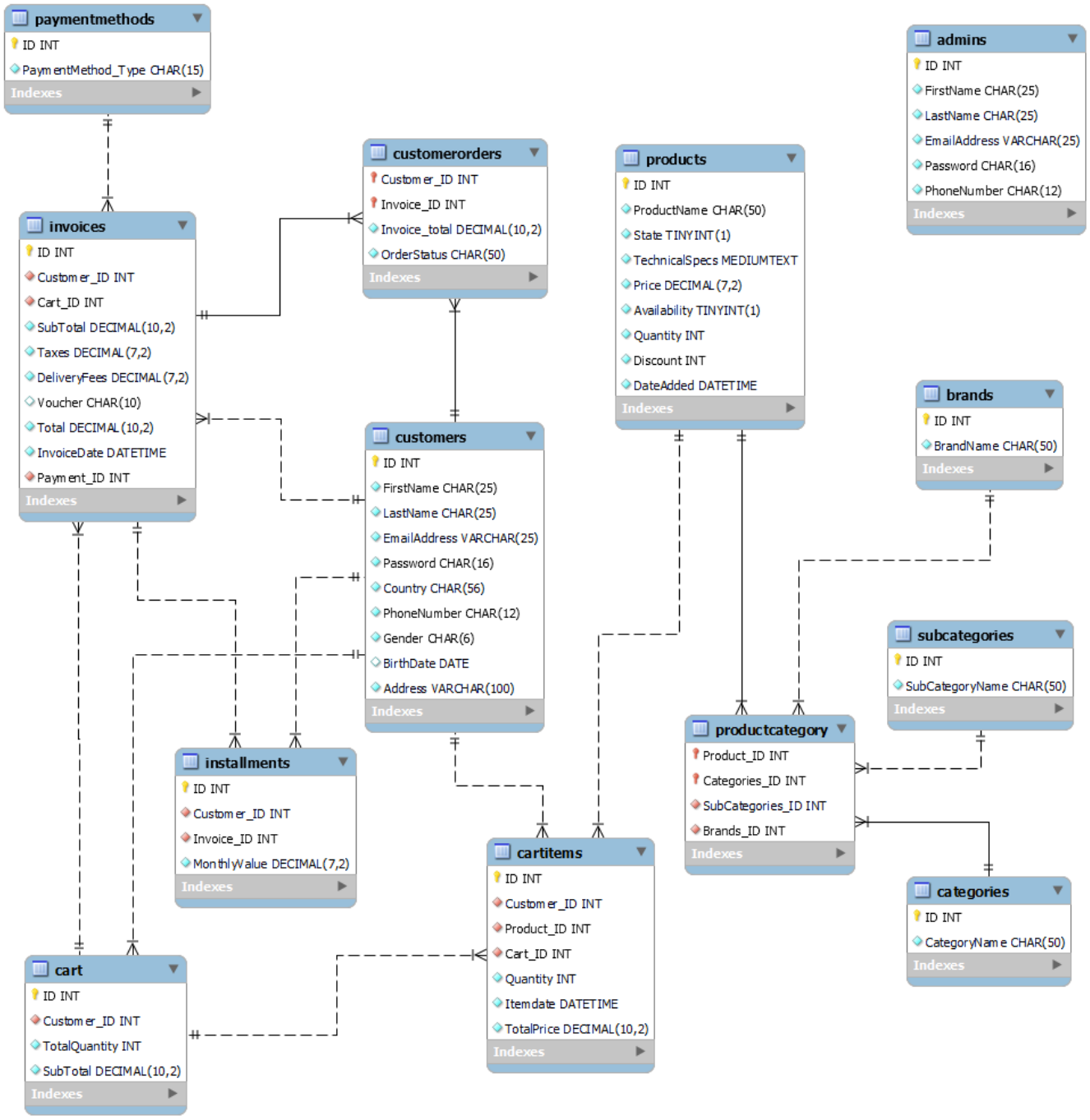


*Figure 2. Relational Model for NUElectronics*

## 4. Columns Specification

The below tables are further clarification to the structure of each of the above-mentioned entities/tables. The column specification tables help break down the data model for the implementation phase. For the sizing of the datatype for some columns, research was done to identify the right size, with the assumption starting from average to the longest value that could be provided.

*Table 4. Customers entity column specifications.*

| Column Name | Data Type | Key | Required | Default Value | Remarks |
|---|---|---|---|---|---|
| ID | Int | PK | Yes | DBMS supplied | Initial value = 1<br>Increment = 1 |
| FirstName | Char(25) | No | Yes | None | |
| LastName | Char(25) | No | Yes | None | |
| EmailAddress | VarChar(25) | No | Yes | None | |
| Password | Char(16) | No | Yes | None | |
| PhoneNumber | Char(15) | No | Yes | None | |
| Country | Char(56) | No | Yes | None | |
| Gender | Char(6) | No | Yes | None | |
| BirthDate | Date | No | Optional | None | Format: yyyy-mm-dd |
| Address | VarChar(100) | No | Yes | None | |

*Table 5. Admins entity column specifications.*

| Column Name | Data Type | Key | Required | Default Value | Remarks |
|---|---|---|---|---|---|
| ID | Int | PK | Yes | DBMS supplied | Initial value = 1<br>Increment = 1 |
| FirstName | Char(25) | No | Yes | None | |
| LastName | Char(25) | No | Yes | None | |
| EmailAddress | VarChar(25) | No | Yes | None | |
| Password | Char(16) | No | Yes | None | |
| PhoneNumber | Char(12) | No | Yes | None | |

*Table 6. Products entity column specifications.*

| Column Name | Data Type | Key | Required | Default Value | Remarks |
|---|---|---|---|---|---|
| ID | Int | PK | Yes | DBMS supplied | Initial value = 1<br>Increment = 1 |
| ProductName | Char(50) | No | Yes | None | |
| State | Boolean | No | Yes | None | Boolean: if True then it’s New else it’s Refurbished |
| TechnicalSpecs | MediumText | No | Yes | None | |
| Price | Decimal(7,2) | No | Yes | None | Number is a decimal with 7 digits and 2 decimal points. |
| Availability | Boolean | No | Yes | None | Boolean: if True then it’s available else it’s not available |
| Quantity | Int | No | Yes | None | |
| Discount | Int | No | Yes | 0 | |
| DateAdded | Datetime | No | Yes | Current Timestamp | YYYY-MM-DD HH:MM:SS |

Based on the market research done,the prices are not expected to overpass 7 digits, as in table (6).

*Table 7. Categories entity column specifications.*

| Column Name | Data Type | Key | Required | Default Value | Remarks |
|---|---|---|---|---|---|
| ID | Int | PK | Yes | DBMS supplied | Initial value = 1<br>Increment = 1 |
| Name | Char(50) | No | Yes | None | |

*Table 8. Sub-categories entity column specifications.*

| Column Name | Data Type | Key | Required | Default Value | Remarks |
|---|---|---|---|---|---|
| ID | Int | PK | Yes | DBMS supplied | Initial value = 1<br>Increment = 1 |
| Name | Char(50) | No | Yes | None | |

*Table 9. Brands entity column specifications.*

| Column Name | Data Type | Key | Required | Default Value | Remarks |
|---|---|---|---|---|---|
| ID | Int | PK | Yes | DBMS supplied | Initial value = 1<br>Increment = 1 |
| Name | Char(50) | No | Yes | None | |

*Table 10. Payment methods entity column specifications.*

| Column Name | Data Type | Key | Required | Default Value | Remarks |
|---|---|---|---|---|---|
| ID | Int | PK | Yes | DBSM supplied | Initial value = 1<br>Increment = 1 |
| Type | Char(15) | None | Yes | None | |

*Table 11. Cart items entity column specifications.*

| Column Name | Data Type | Key | Required | Default Value | Remarks |
|---|---|---|---|---|---|
| ID | Int | PK | Yes | DBMS supplied | Initial value = 1<br>Increment = 1 |
| CustomerID | Int | FK | Yes | None | REF: Customers |
| ProductID | Int | FK | Yes | None | REF: Products |
| CartID | Int | FK | Yes | None | |
| Quantity | Int | No | Yes | None | |
| ItemDate | datetime | No | Yes | Current Timestamp | YYYY-MM-DD<br>HH:MM:SS |
| TotalPrice | Decimal(10,2) | No | Yes | None | |

*Table 12. Cart entity column specifications.*

| Column Name | Data Type | Key | Required | Default Value | Remarks |
|---|---|---|---|---|---|
| ID | Int | PK | Yes | DBMS supplied | Initial value = 1<br>Increment = 1 |
| CustomerID | Int | FK | Yes | None | REF: Customers |
| TotalQuantity | Int | No | Yes | None | |
| Subtotal | Decimal(10,2) | No | Yes | None | |

*Table 13. Invoices entity column specifications.*

| Column Name | Data Type | Key | Required | Default Value | Remarks |
|---|---|---|---|---|---|
| ID | Int | PK | Yes | DBMS supplied | Initial value = 1<br>Increment = 1 |
| CustomerID | Int | FK | Yes | None | REF: Customers |
| CartID | Int | FK | Yes | None | REF: Cart |
| Subtotal | Decimal(10,2) | No | Yes | None | REF: Cart |
| Taxes | Decimal(7,2) | No | Yes | 0 | |
| DeliveryFees | Decimal(7,2) | No | Yes | 0 | |
| Voucher | Char(10) | No | Optional | None | |
| Total | Decimal(10,2) | No | Yes | None | |
| InvoiceDate | datetime | No | Yes | Current Timestamp | YYYY-MM-DD<br>HH:MM:SS |
| PaymentID | Int | FK | Yes | None | |

*Table 14. Installments entity columns specifications.*

| Column Name | Data Type | Key | Required | Default Value | Remarks |
|---|---|---|---|---|---|
| ID | Int | PK | Yes | DBMS supplied | Initial value = 1<br>Increment = 1 |
| CustomerID | Int | FK | Yes | None | REF: Customers |
| InvoiceID | Int | FK | Yes | None | REF: Invoices |
| MonthlyValue | Decimal(7,2) | No | Yes | None | |

Other provided entities are associative entities. They are used to resolve many-to-many issues and for further illustration and direct accessibility while using the DB. They consist mainly of primary keys of two or more other entities, referenced as foreign keys, and the associative entity's PK itself is in most cases a composite key of these two or more referenced keys. The tables below show the specifications of the associative entities used.

*Table 15. Customer orders entity column specifications.*

| Column Name | Data Type | Key | | Required | Default Value | Remarks |
|---|---|---|---|---|---|---|
| CustomerID | Int | FK | Composite PK | Yes | None | REF: Customers |
| InvoiceID | Int | FK | | Yes | None | REF: Invoices |
| OrderStatus | Char(50) | No | | Yes | None | |

*Table 16. Product Categroy entity column specifications.*

| Column Name | Data Type | Key | | Required | Default Value | Remarks |
|---|---|---|---|---|---|---|
| ProductID | Int | FK | Composite PK | Yes | None | REF: Products |
| CategoryID | Int | FK | | Yes | None | REF: Categories |
| SubCategoryID | Int | FK | | Yes | None | REF: SubCategories |
| BrandsID | Int | FK | | Yes | None | REF: Brands |

## 5. Referential Integrity Constraints

As per the guidelines given to us, the table below shows all the referential integrity constraints between the entities, representing each foreign key created, and the actions taken dependent on it (deletion and updating). Note that all entities are not cascaded on deletion, as it is very crucial to keep track and save the history of every purchase and process, even if it has been changed or deleted.

As for updating, it makes sense to not use the ON UPDATE CASCADE with most of the used FK as they all reflect IDs that are DBSM supplied, meaning a unique value that supposedly should never be changed nor edited.

There is an option of using ON CASCADE RESTRICT and ONE DELETE RESTRICT. The RESTRICT option prevents the deletion of the updating in any parent key if it has a child. However, based on the MySQL official manual, using the RESTRICT option is equivalent to omitting the sage of ON CASCADE and ON DELETE in general, and thus they are not used.

*Table 17. Referential Integrity Constraints for all the foreign keys used in all entities.*

| **Relationship** | | **Referential Integrity Constraint** | **Behavior** | |
|---|---|---|---|---|
| **Parent** | **Child** | | **On Update** | **On Delete** |
| Categories | Products | CategoryID in PRODUCTS must exist in ID in CATEGORIES | None | None |
| Sub-Categories | Products | SubCategoryID in PRODUCTS must exist in ID in SUBCATEGORIES | None | None |
| Brands | Products | BrandID in PRODUCTS must exist in ID in BRANDS | None | None |
| Customers | Cart | CustomerID in CART must exist in ID in CUSTOMERS | None | None |
| Customers | Cart Items | CustomerID in CART ITEMS must exist in ID in CUSTOMERS | None | None |
| Products | Cart Items | ProductID in CART ITEMS must exist in ID in PRODUCTS | None | None |
| Cart | Cart Items | CartID in CART ITEMS must exist in ID in CART | None | None |
| Customers | Invoices | CustomerID in INVOICES must exist in ID in CUSTOMERS | None | None |
| Cart | Invoices | CartID in INVOICES must exist in ID in CART | None | None |
| Payment Methods | Invoices | PaymentID in INVOICES must exist in ID in PAYMENT METHODS | None | None |
| Customer | Installments | CustomerID in INSTALLMENTS must exist in ID in CUSTOMERS | None | None |
| Invoices | Installments | InvoiceID in INSTALLMENTS must exist in ID in INVOICES | None | None |

## III. Website Design

The designed website was made using PHP, CSS, Bootstrap, and JavaScript. The website was connected to the MySQL database using PHP through Apache server. This project has two side one for the user and other is for the admin. The user side can view product categories and add products to cart and proceed for checkout. The admin side they can view sales, number of products, users, daily sales report, add product and categories.

Admin has full control of the system, they can view daily or monthly sales report for each year, manage existing users, add, view, edit, delete products and categories. While adding products, the admin must provide Product's name, select category, price, upload product's photo and write a description. Adding a product category is simple, the admin just must provide Category name. The system redirects to PayPal for checkout.

Features:

1. Admin Panel
2. Login/Sign Up
3. Product Cart
4. Checkout using PayPal
5. Add, Edit, Remove and View Products
6. User Management
7. View daily or monthly sales

# Appendix: MySQL Initial code

```
drop database if exists NUElectronics;
create database NUElectronics;
use NUElectronics;

/* DEFAULT CHARACTER SET utf8 COLLATE utf8_unicode_ci; */

/*creating tables*/
/*Table 1 customer*/
create table Customers (
        ID int not null AUTO_INCREMENT, FirstName char(25) not null, LastName char(25) not null,
        EmailAddress Varchar(25) not null, Password Char(16) not null, Country char(56) not null,
        PhoneNumber char(12) not null, Gender char(6) not null, BirthDate date, Address Varchar(100) not null,
        Primary Key (ID)
  );

/*Table 2 Admins*/
create table Admins (
        ID int not null AUTO_INCREMENT, FirstName char(25) not null, LastName char(25) not null,
        EmailAddress Varchar(25) not null, Password Char(16) not null, PhoneNumber char(12) not null,
        Primary Key (ID)
  );

/*Table 3 Categories*/
create table Categories (
        ID int not null AUTO_INCREMENT, CategoryName char(50) not null,
        Primary Key (ID)
  );

/*Table 4 Sub-Categories*/
create table SubCategories (
        ID int not null AUTO_INCREMENT, SubCategoryName char(50) not null,
        Primary Key (ID)
  );

/*Table 5 Brands*/
create table Brands (
        ID int not null AUTO_INCREMENT, BrandName char(50) not null,
        Primary Key (ID)
  );

/*Table 6 Payment Methods*/
create table PaymentMethods (
        ID int not null AUTO_INCREMENT, PaymentMethod_Type char(15) not null,
        Primary Key (ID)
  );
```

```
/*Table 7 Products*/
create table Products (
        ID int not null AUTO_INCREMENT, ProductName char(50) not null,
        State boolean not null /*True = New, False = Refurbished*/,
        TechnicalSpecs MediumText not null, Price decimal(7,2) not null,
        Availability boolean not null /*True = In Stock, False = Out of Stock*/,
        Quantity int not null, Discount int not null default 0,
        DateAdded datetime not null DEFAULT current_timestamp,
        Primary key (ID)
        );

/*Visa Cards*/
/*create table CARDS (
        ID int not null AUTO_INCREMENT, CardNumber varchar(16) not null,
   ExpireDate Date not null, SecurityNumber smallint not null,
        CONSTRAINT cards_PK Primary Key (ID),
   );*/

/*Table 8 Cart */
create table Cart (
        ID int not null AUTO_INCREMENT, Customer_ID int not null,
        TotalQuantity int not null, SubTotal decimal(10,2) not null,
        Primary Key (ID),
        CONSTRAINT cartCustomer_FK Foreign Key (Customer_ID) References Customers(ID)
        );

/*Table 9 Cart items*/
create table CartItems(
        ID int not null AUTO_INCREMENT, Customer_ID int not null, Product_ID int not null,
        Cart_ID int not null, Quantity int not null, Itemdate datetime not null DEFAULT current_timestamp,
        TotalPrice decimal(10,2) not null,
        Primary Key (ID),
        CONSTRAINT itemCustomer_FK Foreign Key (Customer_ID) References Customers(ID),
        CONSTRAINT itemProduct_FK Foreign Key (Product_ID) References Products(ID),
        CONSTRAINT itemCart_FK Foreign Key (Cart_ID) References Cart(ID)
   );

/*Table 10 Orders */
create table Invoices (
        ID int not null AUTO_INCREMENT, Customer_ID int not null, Cart_ID int not null,
        SubTotal decimal(10,2) not null, Taxes decimal(7,2) not null default 0,
        DeliveryFees decimal(7,2) not null default 0, Voucher char(10), Total decimal(10,2) not null,
        InvoiceDate datetime not null DEFAULT current_timestamp, Payment_ID int not null,
        Primary Key (ID),
        CONSTRAINT invoiceCustomer_FK Foreign Key (Customer_ID) References Customers (ID),
        CONSTRAINT invoiceCart_FK Foreign Key (Cart_ID) References Cart (ID),
        CONSTRAINT invoicePayMethod_FK Foreign Key (Payment_ID) References PaymentMethods (ID)
        );
```

```
/*Table 11 Installments  */
create table Installments (
        ID int not null AUTO_INCREMENT, Customer_ID int not null,
        Invoice_ID int not null, MonthlyValue decimal(7,2) not null,
        Primary Key (ID),
        CONSTRAINT instalCustomer_FK Foreign Key (Customer_ID) References Customers (ID),
        CONSTRAINT instalOrder_FK Foreign Key (Invoice_ID) References Invoices (ID)
        );

/*Table 12 Customer Orders Associative Entity */
create table CustomerOrders (
        Customer_ID int not null, Invoice_ID int not null,
        Invoice_total decimal(10,2) not null, OrderStatus char(50) not null,
        CONSTRAINT CustomerOrders_PK Primary Key (Customer_ID, Invoice_ID),
        CONSTRAINT CustomerOrders1_FK Foreign Key (Customer_ID) References Customers (ID),
        CONSTRAINT CustomerOrders2_FK Foreign Key (Invoice_ID) References Invoices (ID)
        );

/*Table 13 Product's Categories Associative Entity */
create table ProductCategory (
        Product_ID int not null, Categories_ID int not null, SubCategories_ID int not null,
        Brands_ID int not null,
        Primary Key (product_ID, Categories_ID),
        CONSTRAINT Product_FK Foreign Key (Product_ID) References Products (ID),
        CONSTRAINT Category_FK Foreign Key (Categories_ID) References Categories (ID),
        CONSTRAINT Subcategory_FK Foreign Key (SubCategories_ID) References SubCategories (ID),
        CONSTRAINT Brand_FK Foreign Key (Brands_ID) References Brands (ID)
        );

insert into Categories (CategoryName) values
('Camera & Photo Products'),
('Car & Vehicle Electronics'),
('Computers, Components & Accessories'),
('eBook Readers & Accessories'),
('Headphones, Earbuds & Accessories'),
('Home Audio & Theatercategoriescategories Products'),
('Home Theater, TV & Video Products'),
('Household Batteries & Chargers') ,
('Mobile Phones & Communication Products') ,
('Portable Sound & Vision Products') ,
('Electrical Power Accessories'),
('GPS & Navigation Equipment') ,
('Computer Tablets') ,
('Telephones, VoIP & Accessories') ,
('Wearable Technology' );
```

```
insert into SubCategories (SubCategoryName) values
('Security Cameras'), ('Digital Cameras'), ('Mirrorless Cameras'), ('Point & Shoot Cameras'),
('Instant Cameras'), ('Tripods/Monopods'), ('Gimbals'), ('Binoculars, Telescopes and Optics'), ('Lenses'), ('Flashes,
Lightning and Studio'),
('Storage'), ('Accessories'),
('Laptops'), /*notebook, Ultrabook, Chromebook, MacBook, convertible, gaming*/
('Desktop/PC'), ('PlayStations'), ('Games'),
('Printers'), /*Inkjet printers, laser printer, solid ink printers, LED printers, continuous ink printers*/
('Storage'), ('Accessories'), ('Gaming Accessories'), ('Wired Headphones'), ('Wireless/Bluetooth Headphones'),
('Wired Earphones/Earbuds'), ('Wireless Earphones/Earbuds'), ('Accessories'),
('Sound Bars'), ('All-in-One Systems'), ('Home Theater/Audio Systems'), ('Wireless Speakers'),
('Subwoofers'), ('Receivers & Amplifiers'), ('Accessories'),
('Display (Screens/TVs)'), ('Projectors'), ('DVD and Blu-ray Players'), ('Streaming'),
('Remote Control Systems'), ('Accessories'), ('Alkaline Batteries'), ('Lithium Batteries'),
('Rechargeable Batteries'), ('Special Batteries'), ('Phone Chargers'), ('Portable Chargers'),
('Wall Chargers'), ('Wireless Chargers'), ('Power Adapters'), ('Android'), ('IOS'), ('Accessories'),
('Portable Speakers'), ('Gaming/VR Sets'), ('Digital Media Players'), ('Radio'), ('Accessories'),
('Vehicle GPS'), ('Handheld GPS'), ('GPS tracker'), ('Item Finders'), ('Accessories'),
('Cordless Telephones'), ('Corded Telephones'), ('VoIP'), ('Telephone Accessories'), ('Smart Watches'),
('Smart Bands'),('Fitness Trackers');

insert into Brands (BrandName) values
('Apple'), ('HP'), ('Lenovo'), ('Dell'), ('Acer'), ('Asus'), ('Huawei'), ('Microsoft'), ('Razer'),
('Samsung'), ('MSI'), ('Alienware'), ('Intel'), ('LG'), ('Toshiba'),
('Samsung'), ('Realme'), ('Oppo'), ('Xaiomi'), ('Infinix'), ('Nokia'), ('Honor'), ('Google'), ('Sony'),
('Kingston'), ('SanDisk'), ('Seagate'), ('Western Digital'), ('ADATA');

/*customers without pass view*/
/*create view CustomersView as
select (ID, concat(FirstName, " ",LastName), emailaddress, country, phonenumber, gender)
from Customers;*/
```