unibz
Fakultät für Informatik
Facoltà di Scienze e Tecnologie informatiche
Faculty of Computer Science

INTRODUCTION TO DATABASE

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PROJECT

STICKEREST

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STICKEREST

Requirements:

It is asked to realize a platform, called STICKEREST, for selling and downloading stickers in different ways.

The users can be of two kinds, or even both at the same time: designers, those who create the digital artwork of the sticker and publish it; clients, those who use the platform to buy, download these artworks. The artworks published are called stickers and they are offered in packs. These sticker Packs are offered as 3 different products: pack of WhatsApp digital stickers*, downloadable and that can either be free or have a cost chosen by the creator; pack of real physique stickers, for which people can ask for shipping; pack of NFTs**, for which people can buy each NFT of the pack separately (but not on our platform). The creator of a sticker pack (who can be only one per each) can choose in which form this pack is going to be offered, but at least it will have to be a WhatsApp digital sticker pack, and optionally NFTs and/or physical pack. For each physical order, a shipping company may be assigned (depending on which one covers that territory part) in case the user chooses to receive the order at home. Alternatively, they can also choose to pick up the order in one of the local printing shops near to them, which are affiliated with STICKEREST. This is possible both to let the user receive the order at a pick-up point and to enhance the local shops and the small businesses. If the user decides to have it at home, also a printing company among those affiliated is chosen and that place is where the delivery would start.

There are such much information that we want to keep track of. Of WhatsApp sticker packs, we want to track the number of downloads and if it has a price, how much it costs (if it is free this is just set to 0.00), of NFT packs, we want to store the link that redirects the user to the Opensea marketplace where this NFT collection is currently being sold (because STICKEREST automatically for each artwork, that needs to be sold as NFT, uploads the image as NFT on an already known marketplace and then when sold, STICKEREST gives parts of the money back to the creator), of the physical sticker pack, we want the number of sold packs and the price set by the creator, but in a standard range set by the platform (STICKEREST will give part of the money earned with the pack back to the creator). More generally a sticker pack also has an ID that identifies it, a name and all the images of the stickers (that can be at least 1 and max 100) (of which we want to know the image file associated and the order, keeping in mind that in the same pack no stickers with the same image file exists) that compose that pack, when it has been uploaded and from whom. For each user we want to know their nickname (which cannot be equal among users), email and password (encrypted), if they are a client, also the address where they live (composed of city, cap, street, nation, province and each is unique only thanks to the street within the cap, province and nation) is needed, whereas if they are sticker designers also an email for PayPal payments is needed and one address for invoices. In the case of designers, we also want to know their VAT number if they own one, and additionally, a number (1 to 6) called “level” which is going to be used as an indicator of their performance on the website, so to give advantages to good creators. Users can therefore buy these packs making orders. Orders can contain multiple packs but these can only be of the same kind within the same order and for each, we want the identification number, the products to be sent and the date when this order was made. Moreover, it is wanted the place where it is going to be printed and the shipping company used, only if it contains physique packs. If it contains digital WhatsApp packs we manage it just like a normal download (priceless or not) with the fact that we kept track of who did it and when, in the case of NFTs we do not want to keep track of this, since the purchases are managed by another marketplace. For each shipping company we want to keep track of their identification acronym, which is inserted at their registration on the platform, the acronym of the countries where they operate, the fees asked for each shipping, their name.

For each printing “entity” we want to know their code (VAT number) for manufacturing invoices, their address, name, whether they are either a printing company or a local printing shop. For the firsts, we also want to know their pec email while for the seconds only a reachable phone number (since more direct contact is needed).

It is also important to take into consideration that when an order is analyzed often it is also important to see who made it. When the user searches for WhatsApp sticker packs, it needs to show also in which form it is offered (as NFT and/or physical), who made it and when it has been created. Lastly, it is important that accessing a printing entity allows also to know immediately also where it is located so that decisions can be taken by that.

Speaking on volumes of the platform, marketing estimations say that is likely to have for the first long period an amount of circa 10k users, 100 shipping companies and 800 among printing companies and local printing shops registered to the platform. It is estimated that, among users, for each designer, there will be 4,5 clients and ca. 1/10 of all users will be both. Moreover, on average, each designer creates 3 WhatsApp sticker packs and each of them is on average composed of 15 images. Additionally, among these WhatsApp sticker packs, more than 2/3 is also a physical sticker pack, as well as more than 2/3 is also a NFT pack. Estimations also say that for each client more than 1,5 orders are associated, among them the most is digital (ca 70 %) and the minority physical (ca 30%). Regarding the printing entity, there will be registered for each printing company ca. 3 local printing shops, so to cover the most possible part of territories. Another estimation says that in each order of WhatsApp sticker packs there are 1,8 Whatsapp sticker packs (on average many buy only one, but some of them more than 1), about physical orders instead it is 1,5 of physical sticker packs and more than 60% of them are asked to be shipped. About shippings, clients usually use their registered address to receive the orders, it is estimated that less than half of them use another address.

Speaking on actions it is also estimated that there will be 500 digital orders per day and users will look for information (included images) of WhatsApp sticker packs 1k a day. Physical orders should be much less, like 10 a day, and physical sticker packs will be of interest for 500 times a day by the users. Clients are also interested in seeing their past orders (500 a day) and in looking for the most downloaded packs, displayed in the homepage (10k times a day). It is also estimated that ca. 20 sticker packs are created every day.

*WhatsApp digital sticker = they are a type of file used by people on social networks like WhatsApp. These packs are downloadable as a unique file and importable automatically thanks to the software on the smartphone.

**NFTs = they are Non-Fungible Tokens, unique codes on a blockchain represented by a file (in this case the image also used for the sticker), traded between people. Each pack of stickers become a collection of NFTs and it is sold by the platform on an external market (like Opensea) on behalf of the designer.

STRUCTURED AND ORGANIZED REQUIREMENTS

General Statement:

It is asked to realize a platform, called STICKEREST, for selling and downloading stickers in different ways.

Statements Concerning Users:

The users can be of two kinds, or even both at the same time: designers, those who create the digital artwork of the sticker and publish it; clients, those who use the platform to buy, download these artworks. For each user we want to know their nickname (which cannot be equal among users), email and password (encrypted), if they are a client, also the address where they live (composed of city, cap, street, nation, province and each is unique only thanks to the street within the cap, province and nation) is needed, whereas if they are sticker designers also an email for PayPal payments is needed and one address for invoices. In the case of designers, we also want to know their VAT number if they own one, and additionally, a number (1 to 6) called “level” which is going to be used as an indicator of their performance on the website, so to give advantages to good creators. Users can therefore buy these packs making orders.

Speaking on volumes of the platform, marketing estimations say that is likely to have for the first long period an amount of circa 10k users, 100 shipping companies and 800 among printing companies and local printing shops registered to the platform. It is estimated that, among users, for each designer, there will be 4,5 clients and ca. 1/10 of all users will be both.

Statements Concerning Sticker Packs:

The artworks published are called stickers and they are offered in packs. These sticker Packs are offered as 3 different products: pack of WhatsApp digital stickers*, downloadable and that can either be free or have a cost chosen by the creator; pack of real physique stickers, for which people can ask for shipping; pack of NFTs**, for which people can buy each NFT of the pack separately (but not on our platform). The creator of a sticker pack (who can be only one per each) can choose in which form this pack is going to be offered, but at least it will have to be a WhatsApp digital sticker pack, and optionally NFTs and/or physical pack. Of WhatsApp sticker packs, we want to track the number of downloads and if it has a price, how much it costs (if it is free this is just set to 0.00), of NFT packs, we want to store the link that redirects the user to the Opensea marketplace where this NFT collection is currently being sold (because STICKEREST automatically for each artwork, that needs to be sold as NFT, uploads the image as NFT on an already known marketplace and then when sold, STICKEREST gives parts of the money back to the creator), of the physical sticker pack, we want the number of sold packs and the price set by the creator, but in a standard range set by the platform (STICKEREST will give part of the money earned with the pack back to the creator). More generally a sticker pack also has an ID that identifies it, a name and all the images of the stickers (that can be at least 1 and max 100) (of which we want to know the image file associated and the order, keeping in mind that in the same pack no stickers with the same image file exists) that compose that pack, when it has been uploaded and from whom.

When the user searches for WhatsApp sticker packs, it needs to show also in which form it is offered (as NFT and/or physical), who made it and when it has been created. Moreover, on average, each designer creates 3 WhatsApp sticker packs and each of them is on average composed of 15 images. Additionally, among these WhatsApp Sticker Packs, more than 2/3 is also a physical sticker pack, as well as more than 2/3 is also a NFT pack. Another estimation says that in each order of WhatsApp

sticker packs there are 1,8 Whatsapp sticker packs (on average many buy only one, but some of them more than 1), about physical orders instead it is 1,5 of physical sticker packs and circa more than 60% of them are asked to be shipped. Speaking on actions it is also estimated that there will be 500 digital orders per day and users will look for information (included images) of WhatsApp sticker packs 1k a day. Physical orders should be much less, like 10 a day, and physical sticker packs will be of interest for 500 times a day by the users. Clients are also interested in seeing their past orders (500 a day) and in looking for the most downloaded packs, displayed in the homepage (10k times a day). It is also estimated that ca. 20 sticker packs are created every day.

Statements Concerning Orders:

For each physical order, a shipping company may be assigned (depending on which one covers that territory part) in case the user chooses to receive the order at home. Alternatively, they can also choose to pick up the order in one of the local printing shops near to them, which are affiliated with STICKEREST. This is possible both to let the user receive the order at a pick-up point and to enhance the local shops and the small businesses. If the user decides to have it at home, also a printing company among those affiliated is chosen and that place is where the delivery would start. Orders can contain multiple packs but these can only be of the same kind within the same order and for each, we want the identification number, the products to be sent and the date when this order was made. Moreover, it is wanted the place where it is going to be printed and the shipping company used, only if it contains physique packs. If it contains digital WhatsApp packs we manage it just like a normal download (priceless or not) with the fact that we kept track of who did it and when, in the case of NFTs we do not want to keep track of this, since the purchases are managed by another marketplace.

It is also important to take into consideration that when an order is analyzed often it is also important to see who made it. Estimations also say that for each client more than 1,5 orders are associated, among them the most is digital (ca 70 %) and the minority physical (ca 30%). Another estimation says that in each Order of WhatsApp Sticker Packs there are 1,8 Whatsapp Sticker Packs (on average many buy only one, but some of them more than 1), about Physical Orders instead it is 1,5 of Physical Sticker Packs and circa more than 60% of them are asked to be shipped. Speaking on actions it is also estimated that there will be 500 Digital Orders per day and users will look for information (included images) of WhatsApp Sticker Packs 1k a day. Physical Orders should be much less, like 10 a day, and physical sticker packs will be of interest for 500 times a day by the users. Clients are also interested in seeing their past orders (500 a day) and in looking for the most downloaded packs, displayed in the homepage (10k times a day).

Statements Concerning Printing Entities:

For each physical order, a shipping company may be assigned (depending on which one covers that territory part) in case the user chooses to receive the order at home. Alternatively, they can also choose to pick up the order in one of the local printing shops near to them. For each printing “entity” we want to know their code (VAT number) for manufacturing invoices, their address, name, whether they are either a printing company or a local printing shop. For the firsts, we also want to know their pec email while for the seconds only a reachable phone number (since more direct contact is needed).

Lastly, it is important that accessing a printing entity allows also to know immediately also where it is located so that decisions can be taken by that. Speaking on volumes of the platform, marketing estimations say that is likely to have for the first long period an amount of circa 10k users, 100 shipping companies and 800 among printing companies and local printing shops registered to the

platform. Regarding the printing entity, there will be registered for each printing company ca. 3 local printing shops, so to cover the most possible part of territories.

Statements Concerning Shipping Companies:

For each shipping company we want to keep track of their identification acronym, which is inserted at their registration on the platform, the acronym of the countries where they operate, the fees asked for each shipping, their name.

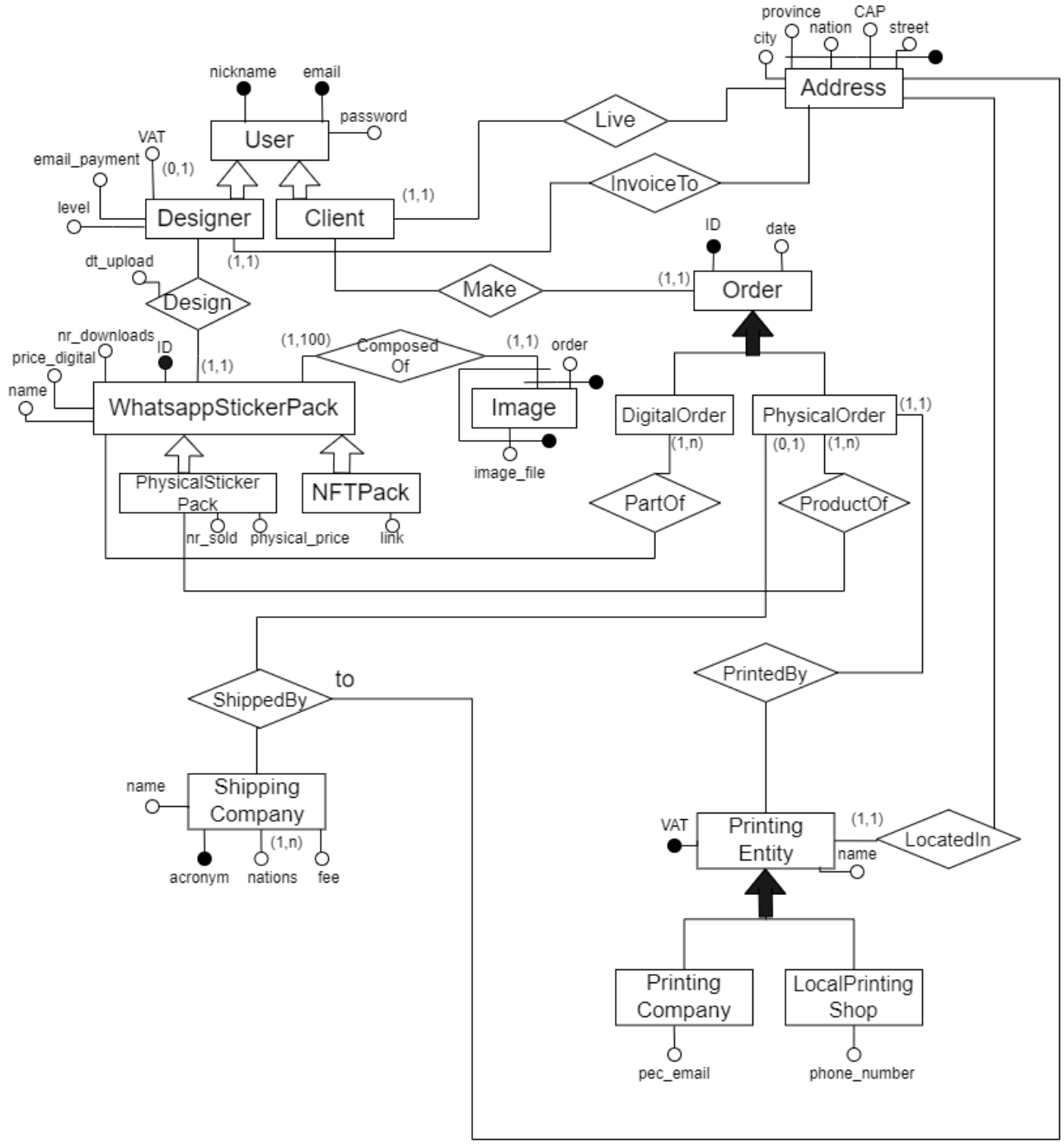
Speaking on volumes of the platform, marketing estimations say that is likely to have for the first long period an amount of circa 10k users, 100 shipping companies and 800 among printing companies and local printing shops registered to the platform.

CONSTRUCTION OF THE GLOSSARY

Term	Description	Synonyms	Connections
User	A user of the platform. They can be Designer and/or Client	-	Sticker Pack, Order
Sticker Pack	It is the product that the platform sells. It is a WhatsApp sticker pack and can be also an NFT sticker pack and/or physical sticker pack.	-	User, Order
Order	It represents the transition of a sticker pack instance given to the user. It can be digital or physical, depending on in which form is the product sold/downloaded	-	User, Sticker Pack, Printing Entity, Shipping Company
Printing Entity	Company that prints sticker packs. They may be local shops or alternatively real printing companies	-	Order
Shipping Company	Company that ships orders of physical sticker packs.	-	Order

DIAGRAM OF THE CONCEPTUAL SCHEMA

E/R Conceptual Schema



DATA DICTIONARIES

Data Dictionary: Entities

Entity	Description	Attributes	Identifiers
User	User of the platform	nickname email password	{ nickname } { email }
Designer	User as Designer, who designs artwork	nickname email password VAT email_payment level	{ nickname } { email }
Client	User as Client, who buys products	nickname email password	{ nickname } { email }
Address	Address information	street CAP nation province city	{ street, CAP, nation, province}
Order	Representation of a group of products ordered by a client	ID date	{ ID }
DigitalOrder	Order of digital stickers	ID date	{ ID }
PhysicalOrder	Order of physical stickers	ID date	{ ID }
WhatsAppSticker Pack	Pack of WhatsApp stickers	ID name digital_price nr_downloads	{ ID }
PhysicalStickerPack	Pack of WhatsApp stickers being sold also as physical	ID name digital_price nr_downloads physical_price nr_sold	{ ID }
NFTPack	Pack of WhatsApp stickers being sold also as NFT	ID name digital_price nr downloads link	{ ID }
Image	Image of stickers	Image_file order	{ order, WhatsAppStickerPack } { image file, WhatsAppStickerPack }

PrintingEntity	Entity that prints physically stickers	VAT name	{ VAT}
PrintingCompany	Printing entity that is a company	VAT name pec email	{ VAT}
LocalPrintingShop	Printing entity that is a local shop	VAT name phone number	{ VAT}
ShippingCompany	Company that ships orders	acronym name nations fee	{ acronym }

Data Dictionary: Relationships

Relationship	Description	Components	Attributes	Identifiers
Live	Where the client currently live	Client, Address		
InvoiceTo	Address for a designer for invoices	Designer, Address		
Design	Sticker packs made by a designer	Designer, WhatsappStickerPack	dt_upload	
Make	Orders made by a client	Client, Order		
PartOf	Stickers that compose a digital order	WhatsappStickerPack, DigitalOrder		
ProductOf	Physical stickers that compose the physical order	PhysicalStickerPack, PhysicalOrder		
ComposedOf	Images that compose the sticker pack	WhatsappStickerPack, Image		
ShippedBy (to)	Where the shipping ends (address of the client)	PhysicalOrder, ShippingCompany, Address		
PrintedBy	The company enrolled in printing the pack of stickers	PhysicalOrder, PrintingEntity		
LocatedIn	Where the printing entity is located	PrintingEntity, Address		

Data Dictionary: Attributes

Attribute	Entity/Relationship	Domain	Description
nickname	User	Varchar	Nickname of the user
email	User	Varchar	Email of the user
password	User	Varchar	Password of the user (encrypted)
VAT	Designer	Varchar	Number of characters is different for nations
email_payment	Designer	Varchar	Email of the designer used to be paid
level	Designer	Integer [1:6]	Level of the designer
dt_upload	Design	Date	Date of upload of a sticker pack
street	Address	Varchar	Street
CAP	Address	Varchar(10)	CAP (10 because it is different across the world)
nation	Address	Varchar	Nation
province	Address	Varchar(7)	Province (7 because it is different across the world)
city	Address	Varchar	City
ID	Order	Integer	Unique identifier of the order
date	Order	Date	Date when the order has been made
ID	WhatsappStickerPack	Integer	Unique identifier of the sticker pack
name	WhatsappStickerPack	Varchar	Name of the sticker pack
price_digital	WhatsappStickerPack	Decimal	Price of the digital sticker pack (0 if free)
nr_downloads	WhatsappStickerPack	Integer	Number of times it has been downloaded/bought
order	Image	Integer	Cardinal order of the images inside the pack
image_file	Image	Varchar	Names of the file of the images
nr_sold	PhysicalStickerPack	Integer	Number of times it has been sold
physical_price	PhysicalStickerPack	Decimal	Price of the physical sticker pack

link	NFTPack	Varchar	Link to the marketplace where this NFT is currently sold
acronym	ShippingCompany	Varchar	Acronym which identifies the shipping company
name	ShippingCompany	Varchar	Extended name of the shipping company
nations	ShippingCompany	Char(2)	Nations in which the company operate
fee	ShippingCompany	Decimal	Fee asked for shipping by the company
VAT	PrintingEntity	Varchar	VAT number of the printing entity
name	PrintingEntity	Varchar	Name of the printing entity
pec_email	PrintingCompany	Varchar	Pec Email of the printing company
phone_number	LocalPrintingShop	Varchar	Phone number of the local printing shop

Data Dictionary: External Constraints

External Integrity Constraints	
1	For each instance (PhysicalOrder: v, PrintingEntity: u) of PrintedBy, if u is an instance of PrintingCompany then v participates to ShippedBy, otherwise if u is an instance of Local PrintingShop then v does not participate to ShippedBy.
2	Attribute “level” has a range of [1, 6].
3	Attribute “nr_downloads” of a certain v instance of WhatsappStickerPack is equal to the number of instances of PartOf in which v participates.
4	Attribute “nr_sold” of a certain v instance of PhysicalStickerPack is equal to the number of instances of ProductOf in which v participates.
5	For each v in User, it also has to be instance of Designer, Client or both.

COST EVALUATION

Table of Volumes

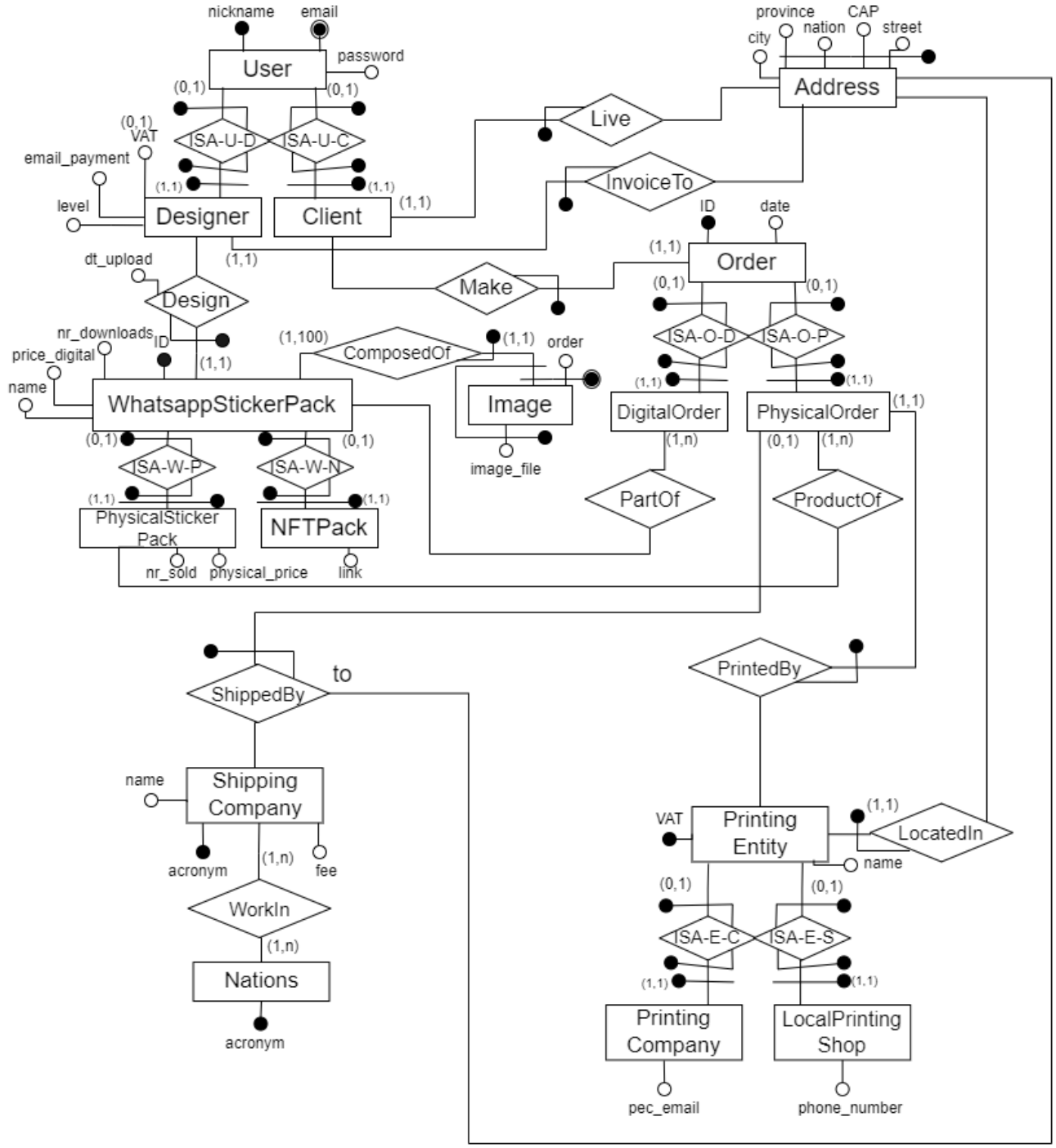
Concept	Construct	Volume
User	Entity	10 000 (2 000 + 9 000 – 1000 (both))
Designer	Entity	2 000
Client	Entity	9 000 (4,5 x 2000)
Address	Entity	9 000 (Clients) + 2 000 (Designer) + 800 (PrintingEntities) + 1000 (< 50% of ShippedBy, because most of Clients use their registered address) = 12 800
WhatsappStickerPack	Entity	6 000 (2 000 * 3)
Image	Entity	90 000 (6 000 * 15)
PhysicalStickerPack	Entity	4 000 (2/3 * 6000)
NFTPack	Entity	4 000 (2/3 * 6000)
Order	Entity	14 000 (> 9 000 * 1,5)
DigitalOrder	Entity	10 000 (~ 70% of 14 000)
PhysicalOrder	Entity	4 000 (~ 30% of 14 000)
ShippingCompany	Entity	100
PrintingEntity	Entity	800
PrintingCompany	Entity	200
LocalPrintingShop	Entity	600 (200 * 3)
Design	Relationship	6 000
InvoiceTo	Relationship	2 000
Live	Relationship	9 000
Make	Relationship	14 000
ComposedOf	Relationship	90 000
PartOf	Relationship	18 000 (10 000 * 1,8)
ProductOf	Relationship	6 000 (4 000 * 1,5)
ShippedBy	Relationship	2 500 (> 60% of 4 000)
PrintedBy	Relationship	4 000
LocatedIn	Relationship	800

Table of Operations

Operation	Type	Frequency
1. Client displays their past orders	Interactive	500 / day
2. Client/Designer searches most downloaded packs	Interactive	10k / day
3. Client/Designer wants to display all images of a WhatsappStickerPack	Interactive	1k / day
4. Client makes a new DigitalOrder	Interactive	500 / day
5. Client changes his/her address	Interactive	10 / day

DIAGRAM OF THE RESTRUCTURED CONCEPTUAL SCHEMA

E/R Conceptual Schema Restructured



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Data Dictionary: Entities

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Client	User as Client, who buys products	nickname email password	{ nickname } { email }
Address	Address information	street CAP nation province city	{ street, CAP, nation, province}
Order	Representation of a group of products ordered by a client	ID date	{ ID }
DigitalOrder	Order of digital stickers	ID date	{ ID }
PhysicalOrder	Order of physical stickers	ID date	{ ID }
WhatsAppSticker Pack	Pack of WhatsApp stickers	ID name digital_price nr_downloads	{ ID }
PhysicalStickerPack	Pack of WhatsApp stickers being sold also as physical	ID name digital_price nr_downloads physical_price nr_sold	{ ID }
NFTPack	Pack of WhatsApp stickers being sold also as NFT	ID name digital_price nr downloads link	{ ID }
Image	Image of stickers	image_file order	{ order, WhatsAppStickerPack } { image file, WhatsAppStickerPack }

PrintingEntity	Entity that prints physically stickers	VAT name	{ VAT }
PrintingCompany	Printing entity that is a company	VAT name pec email	{ VAT }
LocalPrintingShop	Printing entity that is a local shop	VAT name phone number	{ VAT }
ShippingCompany	Company that ships orders	acronym name fee	{ acronym }
Nations	Nations in which shipping companies operate	acronym	{ acronym }

Data Dictionary: Relationships

Relationship	Description	Components	Attributes	Identifiers
ISA-U-D	Keeps track of users who are designers	User, Designer		{ User } { Designer }
ISA-U-C	Keeps track of users who are clients	User, Client		{ User } { Designer }
Live	Where the client currently live	Client, Address		{ Client }
InvoiceTo	Address for a designer for invoices	Designer, Address		{ Client }
Design	Sticker packs made by a designer	Designer, WhatsappStickerPack	dt_upload	{ WhatsapStickerPack }
Make	Orders made by a client	Client, Order		{ Order }
ISA-W-P	Keeps track of whatsapp sticker packs which are also physical sticker packs	WhatsappStickerPack, PhysicalStickerPack		{ WhatsappStickerPack } { PhysicalStickerPack }
ISA-W-N	Keeps track of whatsapp sticker packs which are also NFT packs	WhatsappStickerPack, NFTPack		{ WhatsappStickerPack } { NFTPack }
PartOf	Stickers that compose a digital order	WhatsappStickerPack, DigitalOrder		

ProductOf	Physical stickers that compose the physical order	PhysicalStickerPack, PhysicalOrder		
ISA-O-D	Keeps track of orders that are digital orders	Order, DigitalOrder		{ Order } { DigitalOrder }
ISA-O-P	Keeps track of orders that are physical orders	Order, PhysicalOrder		{ Order } { PhysicalOrder }
ComposedOf	Images that compose the sticker pack	WhatsappStickerPack, Image		{ Image }
ShippedBy (to)	Where the shipping ends (address of the client)	PhysicalOrder, ShippingCompany, Address		{ PhysicalOrder }
PrintedBy	The company enrolled in printing the pack of stickers	PhysicalOrder, PrintingEntity		{ PhysicalOrder }
LocatedIn	Where the printing entity is located	PrintingEntity, Address		{ PrintingEntity }
ISA-E-C	Keeps track of printing entities that are printing companies	PrintingEntity, PrintingCompany		{ PrintingEntity } { PrintingCompany }
ISA-E-S	Keeps track of printing entities that are local printing shops	PrintingEntity, LocalPrintingShop		{ PrintingEntity } { LocalPrintingShop }
WorkIn	Keeps track of which shipping company works in which nation	Shipping Company, Nations		

Data Dictionary: Attributes

Attribute	Entity/Relationship	Domain	Description
nickname	User	Varchar	Nickname of the user
email	User	Varchar	Email of the user
password	User	Varchar	Password of the user (encrypted)

VAT	Designer	Varchar	Number of characters is different for nations
email_payment	Designer	Varchar	Email of the designer used to be paid
level	Designer	Integer [1:6]	Level of the designer
dt_upload	Design	Date	Date of upload of a sticker pack
street	Address	Varchar	Street
CAP	Address	Varchar(10)	CAP
nation	Address	Varchar	Nation
province	Address	Varchar(7)	Province
city	Address	Varchar	City
ID	Order	Integer	Unique identifier of the order
date	Order	Date	Date when the order has been made
ID	WhatsappStickerPack	Integer	Unique identifier of the sticker pack
name	WhatsappStickerPack	Varchar	Name of the sticker pack
price_digital	WhatsappStickerPack	Decimal	Price of the digital sticker pack (0 if free)
nr_downloads	WhatsappStickerPack	Integer	Number of times it has been downloaded/bought
order	Image	Integer	Cardinal order of the images inside the pack
image_file	Image	Varchar	Names of the file of the images
nr_sold	PhysicalStickerPack	Integer	Number of times it has been sold
physical_price	PhysicalStickerPack	Decimal	Price of the physical sticker pack
link	NFTPack	Varchar	Link to the marketplace where this NFT is currently sold
acronym	ShippingCompany	Varchar	Acronym which identifies the shipping company
name	ShippingCompany	Varchar	Extended name of the shipping company

fee	ShippingCompany	Decimal	Fee asked for shipping by the company
acronym	Nations	Char(2)	Acronym which identifies the nation (e.g. IT)
VAT	PrintingEntity	Varchar	VAT number of the printing entity
name	PrintingEntity	Varchar	Name of the printing entity
pec_email	PrintingCompany	Varchar	Pec Email of the printing company
phone_number	LocalPrintingShop	Varchar	Phone number of the local printing shop

Data Dictionary: External Constraints

External Integrity Constraints	
1	Each instance of Order participates to ISA-O-D and to ISA-O-P, but not to both.
2	Each instance of PrintingEntity participates both to ISA-E-C and to ISA-E-S, but not to both.
3	For each instance (PhysicalOrder: v, PrintingEntity: u) of PrintedBy, if u participates to ISA-E-C then v participates to ShippedBy, otherwise if u participates to ISA-E-S then v does not participate to ShippedBy.
4	Attribute “level” has a range of [1, 6].
5	Attribute “nr_downloads” of a certain v instance of WhatsappStickerPack is equal to the number of instances of part of in which v participates.
6	Attribute “nr_sold” of a certain v instance of PhysicalStickerPack is equal to the number of instances of ProductOf in which v participates.
7	Each instance of User participates to ISA-U-D or ISA-U-C, or both.

COST EVALUATION

Table of Volumes

Concept	Construct	Volume
User	Entity	10 000
Designer	Entity	2 000
Client	Entity	9 000
Address	Entity	12 800
WhatsappStickerPack	Entity	6 000
Image	Entity	90 000
PhysicalStickerPack	Entity	4 000
NFTPack	Entity	4 000
Order	Entity	14 000
DigitalOrder	Entity	10 000
PhysicalOrder	Entity	4 000
ShippingCompany	Entity	100
Nations	Entity	~ 200 (there are 195 countries in the world)
PrintingEntity	Entity	800
PrintingCompany	Entity	200
LocalPrintingShop	Entity	600
ISA-U-D	Relationship	2 000
ISA-U-C	Relationship	9 000
Design	Relationship	6 000
InvoiceTo	Relationship	2 000
Live	Relationship	9 000
Make	Relationship	14 000
ComposedOf	Relationship	90 000
ISA-W-P	Relationship	4 000
ISA-W-N	Relationship	4 000
PartOf	Relationship	18 000
ProductOf	Relationship	6 000
ISA-O-D	Relationship	10 000
ISA-O-P	Relationship	4 000
ShippedBy	Relationship	2 500
WorkIn	Relationship	>= 100
PrintedBy	Relationship	4 000
LocatedIn	Relationship	800
ISA-E-C	Relationship	200
ISA-E-S	Relationship	600

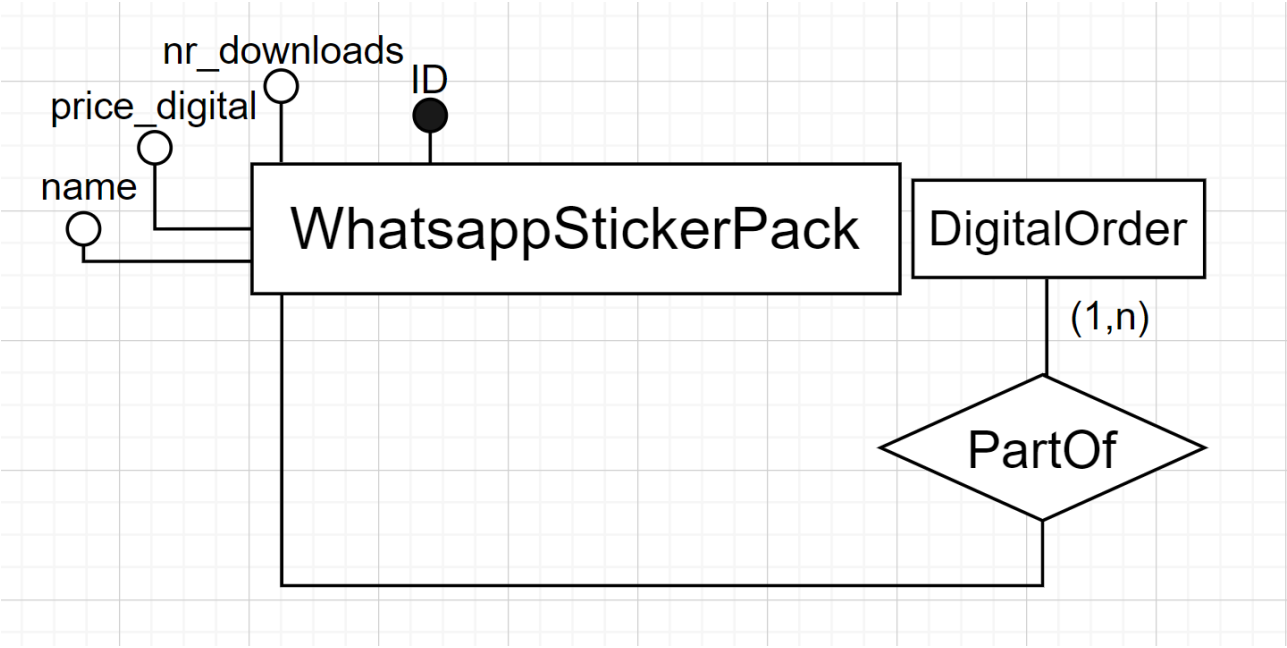
Table of Operations

Operation	Type	Frequency
1. Client displays their past orders	Interactive	500 / day
2. Client/Designer searches most downloaded packs	Interactive	10k / day
3. Client/Designer wants to display all images of a WhatsappStickerPack	Interactive	1k / day
4. Client makes a new DigitalOrder	Interactive	500 / day

5. Client changes his/her address	Interactive	10 / day

REDUNDANCY ANALYSIS

Concepts Interested



Redundancy: nr_downloads

From Table Of Volumes

Concept	Construct	Volume
WhatsappStickerPack	Entity	6 000
DigitalOrder	Entity	10 000
PartOf	Relationship	18 000

Operations

Operation	Type	Frequency
1. A new digital order is made, composed of Whatsapp sticker packs	Interactive	500 / day
2. Shows the user all the information of the Whatsapp sticker pack, including its nr of downloads	Interactive	1k / day

Access Tables & Cost WITHOUT REDUNDANCY

Operation	Concept	Construct	Accesses	Type
1	DigitalOrder	Entity	1	W
1	PartOf	Relationship	1.8 (18 000 / 10 000)	W
2	WhatsappStickerPack	Entity	1	R

2	PartOf	Relationship	3 (18 000 / 6 000)	R

Costs:
- OP1: 1 400 write a day
- OP2: 4 000 read a day

Assuming that a W cost is like two R,
TOTAL: 6 800 accesses per day

Access Tables & Cost WITH REDUNDANCY

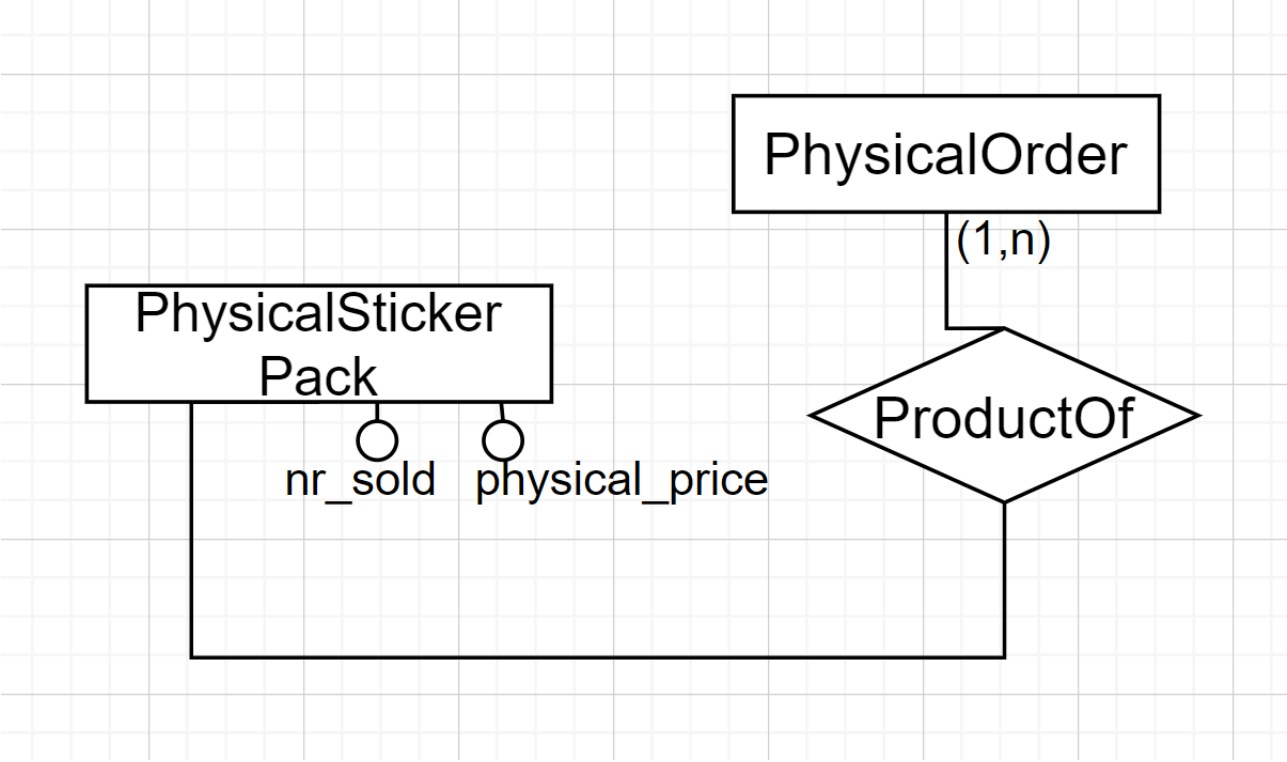
Operation	Concept	Construct	Accesses	Type
1	DigitalOrder	Entity	1	W
1	WhatsappStickerPack	Entity	1.8 (like PartOf because circa 1.8 sticker packs for each order)	W
1	PartOf	Relationship	1.8 (18 000 / 10 000)	W
2	WhatsappStickerPack	Entity	1	R

Costs:
- OP1: 2 300 write a day
- OP2: 1 000 read a day

Assuming that a W cost is like two R,
TOTAL: 5 600 accesses per day

⇨ **Redundancy of “nr_downloads” is kept**

Concepts Interested



Redundancy: nr_sold

From Table Of Volumes

Concept	Construct	Volume
PhysicalStickerPack	Entity	4 000
PhysicalOrder	Entity	4 000
ProductOf	Relationship	6 000

Operations

Operation	Type	Frequency
1. A new Physical Order is made, composed of Physical Sticker Packs	Interactive	10 / day
2. Shows the user all the information of the Physical sticker pack, including its nr of pack sold	Interactive	500 / day

Access Tables & Cost WITHOUT REDUNDANCY

Operation	Concept	Construct	Accesses	Type

1	PhysicalOrder	Entity	1	W
1	ProductOf	Relationship	1.5 (6 000 / 4 000)	W
2	PhysicalStickerPack	Entity	1	R
2	ProductOf	Relationship	1,5 (6 000 / 4 000)	R

Costs:
- OP1: 25 write a day
- OP2: 1 250 read a day

Assuming that a W cost is like two R,
TOTAL: 1 300 accesses per day

Access Tables & Cost WITH REDUNDANCY

Operation	Concept	Construct	Accesses	Type
1	PhysicalOrder	Entity	1	W
1	PhysicalStickerPack	Entity	1.5 (like ProductOf because circa 1.5 sticker packs for each order)	W
1	ProductOf	Relationship	1.5 (6 000 / 4 000)	W
2	PhysicalStickerPack	Entity	1	R

Costs:
- OP1: 40 write a day
- OP2: 500 read a day

Assuming that a W cost is like two R,
TOTAL: 580 accesses per day

⇨ **Redundancy of “nr_sold” is kept**

DIRECT TRANSLATION TO THE RELATIONAL MODEL

Relational Schema

User(email, nickname, password)
key: nickname

Designer(email, email_payment, level, VAT*)
fk: Designer[email] ⊆ User[email]
fk: Designer[email] ⊆ InvoiceTo[Designer]

Client(email)
fk: Client[email] ⊆ User[email]
fk: Client[email] ⊆ Live[Client]

InvoiceTo (Designer, province, nation, CAP, street)
fk: InvoiceTo[Designer] ⊆ Designer[email]
fk: InvoiceTo[province, nation, CAP, street] ⊆ Address[province, nation, CAP, street]

Live(Client, province, nation, CAP, street)
fk: Live[Client] ⊆ Client[email]
fk: Live[province, nation, CAP, street] ⊆ Address[province, nation, CAP, street]

Address(province, nation, CAP, street, city)

Design(WhatsappStickerPack, Designer, dt_upload)
fk: Design[WhatsappStickerPack] ⊆ WhatsappStickerPack[ID]
fk: Design[Designer] ⊆ Designer[email]

Make(Order, Client)
fk: Make[Order] ⊆ Order[ID]
fk: Make[Client] ⊆ Client[email]

WhatsappStickerPack (ID, nr_downloads, price_digital, name)
fk: WhatsappStickerPack[ID] ⊆ Design[WhatsappStickerPack]
inclusion: WhatsappStickerPack[ID] ⊆ Image[ID]

Image(ID, order, image_file)
fk: Image[ID] ⊆ WhatsappStickerPack[ID]
key: {ID, image_file}

PhysicalStickerPack(ID, nr_sold, physical_price)
fk: PhysicalStickerPack [ID] ⊆ WhatsappStickerPack[ID]

NFTPack(ID, link)
fk: NFTPack[ID] ⊆ WhatsappStickerPack[ID]

Order(ID, date)
fk: Order[ID] ⊆ Make[Order]

DigitalOrder(ID)
fk: DigitalOrder[ID] ⊆ Order[id]
inclusion: DigitalOrder[ID] ⊆ PartOf[DigitalOrder]

PhysicalOrder(ID)
fk: PhysicalOrder[ID] ⊆ Order[ID]
fk: PhysicalOrder[ID] ⊆ ProductOf[PhysicalOrder]

PartOf(DigitalOrder, WhatsappStickerPack)
fk: PartOf[DigitalOrder] ⊆ DigitalOrder[ID]
fk: PartOf[WhatsappStickerPack] ⊆ WhatsappStickerPack[ID]

ProductOf(PhysicalOrder, PhysicalStickerPack)
fk: ProductOf[PhysicalOrder] ⊆ PhysicalOrder[ID]
fk: ProductOf[PhysicalStickerPack] ⊆ PhysicalStickerPack[ID]

ShippedBy(PhysicalOrder, province, nation, CAP, street, ShippingCompany)
fk: ShippedBy[PhysicalOrder] ⊆ PhysicalOrder[ID]
fk: ShippedBy[province, nation, CAP, street] ⊆ Address[province, nation, CAP, street]
fk: ShippedBy[ShippingCompany] ⊆ ShippingCompany[acronym]

ShippingCompany(acronym, name, fee)
inclusion: ShippingCompany[acronym] ⊆ WorkIn[ShippingCompany]

WorkIn(ShippingCompany, Nations)
fk: WorkIn[ShippingCompany] ⊆ ShippingCompany[acronym]
fk: WorkIn[Nations] ⊆ Nations[acronym]

Nations(acronym)
inclusion: Nations[acronym] ⊆ WorkIn[Nations]

PrintedBy(PhysicalOrder, PrintingEntity)
fk: PrintedBy[PhysicalOrder] ⊆ PhysicalOrder[ID]
fk: PrintedBy[PrintingEntity] ⊆ PrintingEntity[VAT]

PrintingEntity(VAT, name)
fk: PrintingEntity[VAT] ⊆ LocatedIn[PrintingEntity]

PrintingCompany(VAT, pec_email)
fk: PrintingCompany[VAT] ⊆ PrintingEntity[VAT]

LocalPrintingShop (VAT, phone_number)
fk: LocalPrintingShop[VAT] ⊆ PrintingEntity[VAT]

LocatedIn(PrintingEntity, province, nation, CAP, street)
fk: LocatedIn[PrintingEntity] ⊆ PrintingEntity[VAT]
fk: LocatedIn[province, nation, CAP, street] ⊆ Address[province, nation, CAP, street]

External Constraints

- DigitalOrder[ID] ∩ PhysicalOrder[ID] = Ø
  Order[ID] ⊆ DigitalOrder[ID] ∪ PhysicalOrder[ID]

- PrintingCompany[VAT] ∩ LocalPrintingShop[VAT] = Ø
  PrintingEntity[VAT] ⊆ PrintingCompany [VAT] ∪ LocalPrintingShop[VAT]

- ∀ (x,y) ∈ PrintedBy, if y ∈ PrintingCompany[VAT] then x ∈ ShippedBy[PhysicalOrder]

- Attribute “level” has a range [1,6]

- ∀ (i,n) ∈ WhatsappStickerPack[ID,nr_downloads], n is equal to the number of tuples (d,w) ∈ PartOf such that w = i.

- ∀ (i,n) ∈ PhysicalStickerPack[ID,nr_sold], n is equal to the number of tuples (d,w) ∈ ProductOf such that w = i.

- User[email] ⊆ Client[email] ∪ Designer[email]

- ∀ x ∈ WhatsappStickerPack[ID], there can be at most 100 tuples (id,o,if) ∈ Image such that id=x.

APPLICATION LOAD

Table of Volumes

Relation	Volume
User	10 000
Designer	2 000
Client	9 000
Address	12 800
WhatsappStickerPack	6 000
Image	90 000
PhysicalStickerPack	4 000
NFTPack	4 000
Order	14 000
DigitalOrder	10 000
PhysicalOrder	4 000
ShippingCompany	100
Nations	~ 200
PrintingEntity	800
PrintingCompany	200
LocalPrintingShop	600
Design	6 000
InvoiceTo	2 000
Live	9 000
Make	14 000
PartOf	18 000
ProductOf	6 000
ShippedBy	2 500
WorkIn	>= 100
PrintedBy	4 000
LocatedIn	800

Table of Operations

Operation	Type	Frequency
1. Client displays their past orders	Interactive	500 / day
2. Client/Designer searches most downloaded WhatsappStickerPacks	Interactive	10k / day
3. Client/Designer wants to display all images of a WhatsappStickerPack	Interactive	1k / day
4. Client makes a new DigitalOrder	Interactive	500 / day
5. Client changes his/her address	Interactive	10 / day

Frequent Accesses

a. When we access an order, we often want to know who made this order
b. When we access a WhatsappStickerPack, we often want to know if it is available also as

Physical and/or NFTpack
c. When we access a WhatsappStickerPack we often want to know its designer and the date when it has been created (uploaded)
d. When we access a PrintingEntity we often want to know where it is located

RESTRUCTURING OF THE RELATIONAL SCHEMA

From Application Load

a. When we access an order, we often want to know who made this order
b. When we access a WhatsappStickerPack, we often want to know if it is available also as Physical and/or NFTpack
c. When we access a WhatsappStickerPack we often want to know its designer and the date when it has been created (uploaded)
d. When we access a PrintingEntity we often want to know where it is located

Taking into account those statements, the followings have been performed:

1. Due to (a) we merge Make into Order
2. Due to (b) we merge NFTPack into WhatsappStickerPack as the attribute 'link' which can be null and is null if no NFTPack corresponds or contains the link of NFTPack if there's one. Moreover, we merge also PhysicalStickerPack into WhatsappStickerPack as the attributes 'nr_sold' and 'physical_price' that are both null if no PhysicalStickerPack corresponds or they are both non null if instead there's a PhysicalStickerPack associated.
3. Due to (c) we merge Design into WhatsappStickerPack
4. Due to (d) we merge LocatedIn into PrintingEntity
5. We remove Client because it is a useless relation, but we rename Live again as Client because it is more meaningful, renaming also its primary key as 'email'.
6. We remove Nations since it is a useless relation.
7. We remove DigitalOrder because it is a useless relation.
8. We remove PhysicalOrder because it is a useless relation.

Restructured Relational Schema

User(<u>email</u>, nickname, password)
key: nickname

Designer(<u>email</u>, email_payment, level, VAT*)
fk: Designer[email] ⊆ User[email]
fk: Designer[email] ⊆ InvoiceTo[Designer]

InvoiceTo (<u>Designer</u>, province, nation, CAP, street)
fk: InvoiceTo[Designer] ⊆ Designer[email]
fk: InvoiceTo[province, nation, CAP, street] ⊆ Address[province, nation, CAP, street]

Client(<u>email</u>, province, nation, CAP, street)
fk: Client[email] ⊆ User[email]
fk: Client[province, nation, CAP, street] ⊆ Address[province, nation, CAP, street]

Address(<u>province, nation, CAP, street</u>, city)

WhatsappStickerPack (ID, nr_downloads, price_digital, name, Designer, dt_upload, nr_sold*, physical_price*, link*)
fk: WhatsappStickerPack[Designer] ⊆ Designer[email]
inclusion: WhatsappStickerPack[ID] ⊆ Image[ID]

Image(ID, order, image_file)
fk: Image[ID] ⊆ WhatsappStickerPack[ID]
key: {ID, image_file}

Order(ID, date, Client)
fk: Order[Client] ⊆ Client[email]

PartOf(DigitalOrder, WhatsappStickerPack)
fk: PartOf[DigitalOrder] ⊆ Order[ID]
fk: PartOf[WhatsappStickerPack] ⊆ WhatsappStickerPack[ID]

ProductOf(PhysicalOrder, PhysicalStickerPack)
fk: ProductOf[PhysicalOrder] ⊆ PrintedBy[PhysicalOrder]
fk: ProductOf[PhysicalStickerPack] ⊆ WhatsappStickerPack[ID]

ShippedBy(PhysicalOrder, province, nation, CAP, street, ShippingCompany)
fk: ShippedBy[PhysicalOrder] ⊆ PrintedBy[PhysicalOrder]
fk: ShippedBy[province, nation, CAP, street] ⊆ Address[province, nation, CAP, street]
fk: ShippedBy[ShippingCompany] ⊆ ShippingCompany[acronym]

ShippingCompany(acronym, name, fee)
inclusion: ShippingCompany[acronym] ⊆ WorkIn[ShippingCompany]

WorkIn (ShippingCompany, Nations)
fk: WorkIn[ShippingCompany] ⊆ ShippingCompany[acronym]

PrintedBy(PhysicalOrder, PrintingEntity)
fk: PrintedBy[PhysicalOrder] ⊆ Order[ID]
fk: PrintedBy[PrintingEntity] ⊆ PrintingEntity[VAT]

PrintingEntity(VAT, name, province, nation, CAP, street)
fk: PrintingEntity[province, nation, CAP, street] ⊆ Address[province, nation, CAP, street]

PrintingCompany(VAT, pec_email)
fk: PrintingCompany[VAT] ⊆ PrintingEntity[VAT]

LocalPrintingShop (VAT, phone_number)
fk: LocalPrintingShop[VAT] ⊆ PrintingEntity[VAT]

External Constraints

- PartOf[DigitalOrder] ∩ PrintedBy[PhysicalOrder] = Ø
  Order[ID] ⊆ PartOf[DigitalOrder] ∪ ProductOf[PhysicalOrder].

- PrintingCompany[VAT] ∩ LocalPrintingShop[VAT] = Ø
  PrintingEntity[VAT] ⊆ PrintingCompany [VAT] ∪ LocalPrintingShop[VAT].

- ∀ (x,y) ∈ PrintedBy, if y ∈ PrintingCompany[VAT] then x ∈ ShippedBy[PhysicalOrder].

- Attribute “level” has a range [1,6].

- ∀ (i,n) ∈ WhatsappStickerPack[ID,nr_downloads], n is equal to the number of tuples (d,w) ∈ PartOf such that w = i.

- ∀ (i,n) ∈ WhatsappStickerPack[ID,nr_sold], n is equal to the number of tuples (d,w) ∈ ProductOf such that w = i.

- User[email] ⊆ Client[email] ∪ Designer[email].

- ∀ (a,b) ∈ WhatsappStickerPack[nr_sold, physical_price], a is NULL iff b is NULL.

- ∀ x ∈ WhatsappStickerPack[ID], there can be at most 100 tuples (id,o,if) ∈ Image such that id=x.

APPLICATION LOAD

Table of Volumes

Relation	Volume
User	10 000
Designer	2 000
Client	9 000
Address	12 800
WhatsappStickerPack	6 000
Image	90 000
Order	14 000
ShippingCompany	100
PrintingEntity	800
PrintingCompany	200
LocalPrintingShop	600
InvoiceTo	2 000
PartOf	18 000
ProductOf	6 000
ShippedBy	2 500
WorkIn	>= 100
PrintedBy	4 000

Table of Operations

Operation	Type	Frequency
1. Client displays their past orders	Interactive	500 / day
2. Client/Designer searches most downloaded WhatsappStickerPacks	Interactive	10k / day
3. Client/Designer wants to display all images of a WhatsappStickerPack	Interactive	1k / day
4. Client makes a new Order of WhatsappStickerPacks	Interactive	500 / day
5. Client changes his/her address	Interactive	10 / day