

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ  
ЗВО “УКРАЇНСЬКИЙ КАТОЛИЦЬКИЙ УНІВЕРСИТЕТ”

Факультет суспільних наук  
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**Магістерська робота**

на тему: Creating smart assistant for coin and notes collectors

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Львів 2021

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## **1. INTRODUCTION**

### **1.1. Problem Overview**

There are millions of coin collectors in the US [1] and times more in the world. The collectibles market is pretty conservative. There were no disruptive innovations on it for ages. The only high-tech tool that people use widely is eBay that started 25 years ago [2]. We aim to use our experience and passion to change the lives of collectors. How looks a life of an average coin or note collector:

- They mostly use Excel files to maintain their catalogs;
- They visit coins shows with printed catalog and search items they don't have;
- They spend hours online searching for things they want to buy because the descriptions of items are not full or consistent.

The ultimate project goal is to create a universal catalog for the collectibles. We want to improve collectors' lives by bringing technology into their hobbies. This way, they can make their collections better and increase their value.

### **1.2 Company**

This work describes a business model of a future product IT company that helps collectors in the offline world. The company will be global as online removes any territorial restrictions. We plan to start from the US market as one that is well developed and researched. Later on, we plan to look at other English-speaking countries.

### **1.3 Role and motivation**

My role is to be a leader and project driver. My background is mainly technical, and I dedicated twenty years to the service business. This project is an opportunity to try something new in the area where business growth is not dependent on the number of people you hire.

While being a technical person, I have the right skills to do everything on my own at the beginning. However, with the growth of the project, the team needs to be extended.

#### **1.4 Literature**

The project contains business and technological parts.

The business model part uses Alexander Osterwalder's canvas[3]. Lean startup approach by Eric Ries [4]

The technological one uses the research of One-Short Learning [5, 6,7].

#### **1.5 Data**

The project describes the summaries of interviews with potential customers and the following steps once a prototype is built.

## 2. PROBLEM STATEMENT

### 2.1 Background

For ages, people collect different things: art, comics, knives, watches, and others. There are a lot of reasons why people collect something. A few of them are listed below [8]:

- Family and Emotional Meaning;
- To Connect to Their Childhood;
- Knowledge and Learning;

For most collectors, collecting is not just a hobby; it is a part of their life and even business. Many companies worldwide help hobbyists with their passion:

- stores/markets;
- auction houses;
- software products.

The list of industry players is available in Appendix A.

We aim to reach the following goals:

- Give people a smoother experience of collecting by getting more emotions;
- Help build better collections by predicting what they are looking for and providing purchase suggestions;
- Simplify purchase process;
- Provide additional means of keeping their collection in order and up to date.

### 2.2 Description

Collectors spend a lot of time with their collections, which reach hundreds and even thousands of items. The owners love to look at them, show them to their friends and family. A collectible item is a desired gift.

However, the supporting activity takes much more time than people want. Looking for new items takes hours that people spend online browsing tons of web

pages rather than with their families and friends. Friends often do not know what to present while they understand what collectors collect. The coins/notes collecting industry has poorly normalized paper catalogs, and so far, hi-tech is presented only in auctions.

### 2.3 Narrowing

While collecting has many directions, coins and stamps are collected more than anything else [9].

Focus is the crucial success factor in business. In the book Good to Great, Jim Collins calls this approach a Hedgehog Concept [10].

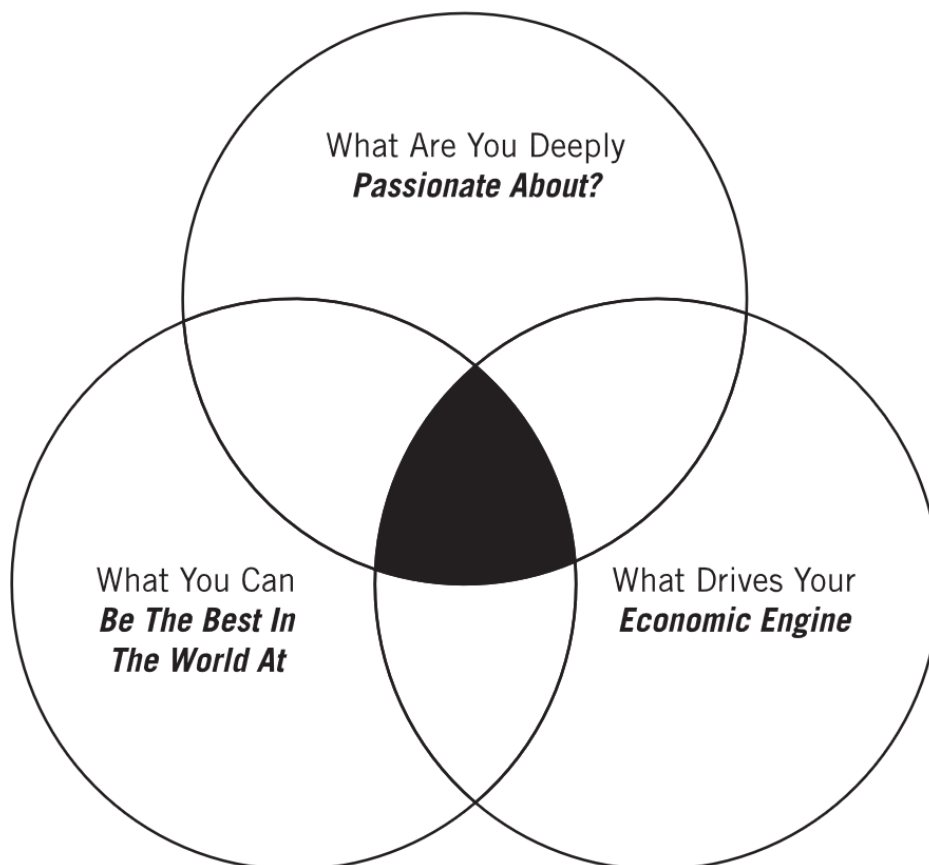


Figure 1.1 Three Circles of the Hedgehog Concept [11]

We have decided to focus on coins and paper money because of a few reasons:

- We have a lot of friends who can give feedback about the app;
- There is an enormous amount of information about coins collecting on the Internet;



- The market is slightly “red” [12], which means a need in this area. And we just need to adjust users’ behavior, so they use modern technology instead of a conventional approach.

However, it is still possible that targeting both coins and notes at the first stage is too much for us.

## **2.4 User behaviors overview and the initial plan**

User actions again collections usually limited with the following set:

- Managing and placing the collection in order;
- Adding and buying new items or upgrading existing ones;
- Selling items that are not needed anymore;
- Watching and showing to friends and family.

The technology could be applied to any of the listed activities.

Initially, we assumed that people do not like creating a catalog of coins and notes, and this activity takes a lot of time and is very dull. We planned to develop a mobile application that allows users to take a picture of a coin or note, identify it using computer vision technology and add it to our catalog.

The following section describes the journey of the idea development.

### 3. PROJECT IDEA TRANSFORMATION

#### 3.1 Before Interviews

As stated earlier, the initial idea was to create a catalog of collectible items. The plan was to use a phone camera to identify objects and add them to the catalog quickly. We wanted to start with the coins and switch to other collectibles (notes, mini bottles) later.

As the market, we chose the United States and planned to focus only on coins.

Key features:

- Have own catalog;
- Snap to add;

Business Model:

- Freemium: limited scans, limited items in the catalog;
- Premium: 4.99 USD per month: more scans, more items in the catalog;

Problems to solve:

- Create a dataset to train a model;
- Create a mobile app;
- Create a catalog;
- Find enough users to make the app profitable;

The hypothesis to check:

- Do other people have similar problems as we do?
- Will we get a critical mass of users?
- Are they ready to pay for solving the problem?

#### 3.2 Interview Series #1 (November—December 2020)

We have interviewed more than ten coin collectors (friends and friends of friends) and got fascinating results:

- Respondents use mostly Excel and sometimes websites for tracking their collection;

- Some of the respondents are using <https://ucoin.net/> for coins and <https://colnect.com/> for banknotes;
- “Adding to catalog” is not the most tedious part of the hobby as they like to manage their collection;
- A lot of respondents are not ready to pay for a subscription while they’re spending more than 40—50 USD for coins monthly;
  - On the other hand, people were (ex-)Ukrainians, which probably caused this bias;
- A lot of people do not collect “the whole world” coins. They’re focused on something special. We call them subsets. For example:
  - All coins from a specific country or a continent;
  - Coins with a particular animal (e.g., owl) or coins dedicated to aviation;
- Duplicates in collections, in most cases, aren’t a problem. For collectors, the duplicates become a part of the swap.

Conclusion:

- We got a new hypothesis/idea: help searching missing items in the subsets on auctions;
- Business model: affiliate program at auctions/store, e.g., eBay;

### **3.3 Interview Series #2 (December 2020—January 2021)**

We’ve contacted Sev Onyshkevych (he was one of the mentors on the “New Technological Entrepreneurship” course). Sev is a notes collector and is the first vice president of the [International Bank Note Society](#). He posted a message on the internal organization forum with a link to an interview form. As a result, we got a new piece of valuable information.

New input:

- Banknote collectors also could be an attractive target;
- A lot of banknote collectors collect coins as well;

- They potentially dedicate more money to their hobby because collecting contemporary notes is more expensive than coins;
- There is no good resource for note collectors. [Colnect](#) doesn't allow private collections;
- Concern: a collection may cost a significant amount of money. Not everybody wants to show their collection to the public;

New customer problems:

- Sometimes customers want to know the cost of their collection or particular items;

Concerns:

- Colnect may easily add private collections to their product;
- While scanning auctions and other sources, it is possible to check the cost of the items;

New hypothesis:

- Will customers pay for auctions advanced search to know prices in their items?

### **3.4 WebEx Presentation**

On the 6th of Feb 2021, we made a WebEx Presentation to some members of the IBNS. About twenty members of the society were present at the event. The hour of discussion has confirmed a few assumptions and brought a few fresh thoughts.

What as confirmed:

- There is no standard toolkit among note collectors;
- The idea of identifying the missing items in subsets in catalogs looked interesting;

Our idea looked interesting, but we got controversial feedback:

- It is not clear if searching for the actual price is something that people need. There is an existing solution on the market:
  - a. <http://trackandprice.com/>
  - b. <http://www.trackandpricewpm.com/>

New input:

- There is an electronic book that is sold by subscription. The book's name is The Banknote Book. The author (Owen Linzmayer) updates it annually and sells it as the whole piece for 99.99 USD or 0.99 USD to 9.99 USD depending on the country or territory. The book owner can be a potential partner if he agrees to share the information about the notes on some conditions.

### **3.5 Other conversations and the final decision**

We confirmed that we're on the right track during the other conversations, and we need to continue testing our hypothesis. We have decided to create a demo tool to get feedback from the actual audience and make real sales.

### **3.6. Hypothesis definition**

Below we describe the final problem statements and the corresponding hypothesis to be tested using the prototype application.

#### **3.6.1 Problem #1: People spend hours online looking for missing pieces**

It appears that most of the collectors do not collect the whole world, i.e., they collect a subset of all possible coins or notes.

Subset examples:

- A country: Ukraine, UK, US, etc.;
- A continent: Africa, North America, Australia, etc.;
- Theme: aviation;
- Custom: UK coins with George VI;

We want to analyze their collection and recommend what items they need to buy and where.

#### **3.6.2 Problem #2: Unknown collection value**

Collecting is usually a lifetime hobby. People just buy and often do not track pricing changes because it is a very time-consuming process. Sometimes items

purchased years ago may become very expensive, so they are worth being sold. Another not obvious problem to collectors is estimating collection value for their heirs. When a collection contains thousands of items, it is hard to evaluate them one by one.

We want to analyze the market prices and recommend item costs based on actual market price: active and finished online and offline auctions.

### **3.6.3 Problem #3: Manual cataloging is boring**

The third problem is the one from which we started. We still think that this problem is real. However, it now has minor priority.

## 4. THE SOFTWARE ARCHITECTURE

We are using a Service-oriented architecture approach for the system. Each service is an independent module that can work in its environment, could be deployed and tested separately.

### 4.1 Service: Data Collector

The module's purpose is to grab information from 3rd party services. The list of services to take the information from:

- eBay;
- Heritage auctions;
- Stack & Bowers Auctions;
- SixBid;
- Great Collections;
- And others;

Not all data may be publicly available. We still need to research this information.

#### 4.1.1 eBay

eBay offers various APIs to access its data. All services nowadays are migrating to [Browse API](#).

For our needs, we need two endpoints:

- [search](#);
- [getItem](#);

The default limit for API usage is 5K requests per day. We got an extension to 100K.

eBay has a [tree-like catalog structure](#). For our needs, we need almost all items under [Coins & Paper Money](#). Initial research has shown that these categories contain approximately 2.8M items. With a 100K daily limit, we need almost a month to get detailed information about coins. Therefore we have a few options here:

- Reduce the number of items to work with;

- Talk to eBay about increasing the limit or get access to Feed API;
- Try to use only item summary (less attributes available here) and images;

Module Requirements:

- Iteratively grab information about all items from auctions;
- Get such details as:
  - Description;
  - Images;
  - Actual Price;
  - The item on sale or not;
- Save all items history;
- Provide access to data over API for internal clients;

#### 4.1.2 Other sites

The other sites do not offer any API for machine-to-machine communication. We will have to develop a parser for every site to extract the information we need periodically.

### 4.2 Service: Normalizer

The service purpose is to get unstructured data from Data Collector, make them structured, and put them into the Database. The structure of the service is outlined in Figure B.1

#### 4.2.1 Internal catalog

There are a few industry catalogs in this area. The most popular is [Krause](#). Krause catalog numbers are local to countries and have their specifics [13], compared to so that we need to use internal IDs.

Challenges:

- Find a normalized digital version of the Krause catalog, parse PDF for scanned versions, or get information from other online databases;
  - Check legal possibility of the information usage;



- Or spend time on building this catalog manually (calculate the cost of such work);

Problem to think about: we need to update our catalog with newly issued coins/notes regularly. This approach has to be much easier than editing a paper version of Krause.

The basic structure of the catalog will contain the following fields (with examples):

- Title: ¼ Dollar Washington Quarter
- Country: United States
- Year: 2005
- Value: 25 Cents
- Currency: Dollar
- Composition: Copper-nickel clad copper
- Weight: 5.67 g
- Diameter: 24.26 mm
- Thickness: 1.75 mm
- Shape: Round
- Orientation: Coin alignment ↑↓
- References (catalogs):
  - KM# 371
  - Schön# 371

The coin used as an example is ¼ Dollar "Washington Quarter" from [numista.com](http://numista.com).

User fields (local for each coin added by a user):

- Grade: one of the standard [grades](#)
- Date Added
- Cost
- Comment
- Quantity
- Status: Have, Wish List, Swap

### 4.2.2 Mapper

The idea of the unit is unstructured data mapping, e.g., coin/note data extracting from eBay API to an Internal Catalog ID. The mapping engine is the most complex technical element of the system.

We are using the following attributes for mapping:

- title;
- short Description;
- image(s);

### 4.2.3 Recognizer

A recognizer is a system element that recognizes a coin/note that is located on a picture. Internally the module contains a Neural Network.

Internally the system uses the One-Shot Learning technique. Although there are a few approaches to the problem [6], we have chosen Siamese Networks.

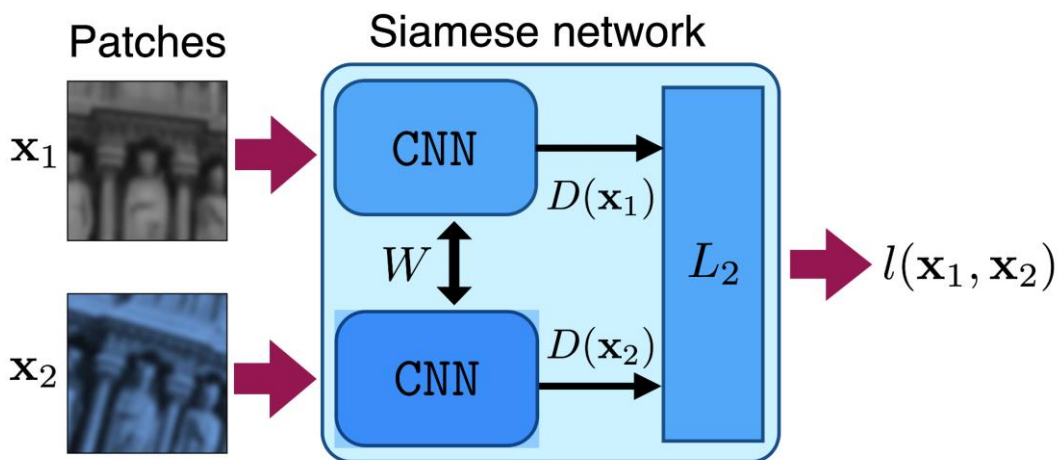


Figure 4.2 Schematic of a Siamese network [14]

A Siamese network contains two copies of the same Convolutional Neural Network [15, 16]. We are training it using data that we collected from existing online databases and other sources.

To train the network, we need:

- Receive data from online catalogs with pre-defined Krause ID;
- Manually map ambiguous data;

The advantage of this approach compared to CNN is that we do not need many examples of new items. We may train the system using an initial set and then just add new items to the system. As a result, if we train a network for coin detection, we need to retrain it for notes, mini-bottles, etc. [5].

As a technology, we're using open source Tensorflow + Keras [7] as one of the most popular solutions on the market.

As module input, we use:

- Image list annotated with catalog IDs;

As output:

- Return a catalog ID based on the image;

Note: Possible system usage can be using the mapping engine to map other objects based on closed catalog data.

#### **4.2.4 Textual Recognizer**

This area still needs to be researched. One of the directions of research is Recurrent Neural Networks.

#### **4.2.5 Updater**

After recognizing the new image, the mapping engine has to store a reference to a source element in the ItemDB. The system has to store pricing information derived from 3rd-party services along with the connection between links and items.

### **4.3 Service: Price Analyzer & Recommender**

The service's purpose is to recommend prices for users' items in the catalog.

Possible use cases:

- A user wants to run a search;
- A system recommends running a search on some items and recommends selling price;
- A system recommends the approximate total value of a collection;

Challenges:

- eBay API doesn't return price data. We need to research if receiving data over parsing pages is legal and accurate;
- Check how [Track & Price](#) work and compare our results;
- We have an idea of cooperating with Krause catalog owners for using their data. They provide valuations for five grades of coins:
  - VF-20 — Very Fine;
  - XF-40 — Extremely Fine;
  - MS-60 — Typical Mint State;
  - MS-63 — Choice Mint;
  - MS-65 — Gem Mint State.

For notes, usually three, but sometimes more:

- VG — Very Good;
- VF — Very Fine;
- UNC — Uncirculated.

#### **4.4 Service: Recommendation Engine**

The service is intended to recommend items to buy based on user preferences and existing items.

Another case: since you have this and this coin, you might be interested in this one

## 5. BUSINESS MODEL

More than two-thirds of startups never deliver a positive return to investors [17]. There is no silver bullet to avoid failure, but we can minimize money spent. Using the Lean Startup approach [4], we need to test all of our hypotheses at a minimal cost to ensure that the idea is scalable and will work out.

We used Alexander Osterwalder's business model canvas [3] to sketch our hypotheses (see Appendix C). Below we will go through each of the points and plan the validation steps.

### 5.1 Customers Segments

Our key audience at the first stages of product development are coins and note collectors. Various experts estimate different numbers:

- “About 7 million to 10 million [18] people in the U.S. are serious coin collectors”;
- “Ian Russell of GreatCollections estimated there are 10 million coin collectors in the U.S. on Larry King Now...” [1]
- “Results are the basis for a PNG estimate that the U.S. rare coin market was \$3.4 billion to \$3.8 billion.” [19]

Therefore we may just assume that the market is large enough to start working on it.

Customers are approximately split into the groups shown in table 5.1.

Customer Segments

Segment	Description
Inactive	Buy or sell once a year
Moderately active	Buy/sell every month, have a monthly budget
Serious collectors	They do a few purchases or selling per month, actively researching information about coins/notes.

We will start from serious collectors and use them as opinion-makers to expand our presence in other segments.

Another exciting aspect is geography. We plan to start from the United States as the most developed market. Low-hanging fruits will be other English-speaking countries such as the United Kingdom, Australia, and even India. This area will require some research. We need to target countries with sufficient numbers of collectors and those whose budgets are large enough.

We think that targeting both coins and note collectors is not defocusing but a wise decision. Coins and note collectors often are the same people. They visit the same places and websites. Interestingly, the amount of note collectors is 10 to 20 times less than coin collectors, but their budgets are more extensive (because the cost of a note is higher). Considering these numbers, we assume that the average annual income from coins and note collectors will be compatible.

The critical point of the first months of launch is to understand if coins and note collectors will use our platform. We need to reach the network effect [20] and add a social aspect into our system. If one of the customer groups is less active than the others, we might need to hold on with those features and focus only on the others.

### **5.1.1 Finding Early Adopters**

We have access to the International Bank Note Society (IBNS) via Sev Onyshkevych, who introduced us. After the February presentation, most participants were interested in the application, gave valuable feedback, and agreed to be the first beta testers.

We also participate in a few Facebook groups, Reddit communities and are in touch with a few YouTube channel owners. We plan to create an app and ask for feedback in those channels. Before, we came with the idea but didn't respond, likely because of the ambiguity of the messages.

## **5.2 Value Propositions**

As stated earlier, we came from the idea of automating a catalog for coins and notes to a system that helps collectors to buy and sell their items in a cost and time-saving manner.

The automated catalog is still a vital component of the system. We believe that saving time managing the catalog intensifies emotions received from the collecting process. The first key point of our plan in interacting with customers is to find a test group of 10–20 people and ask them to add their collections to the catalog. This way, we will test the user interface and make sure that the app is usable.

Another critical feature is migrating from existing systems like uCoin or ColNect. It is possible that having it, we will not be able to partner with online catalogs. Considering that many collectors still do not use online tools, we think importing from Excel will be enough at this stage.

Based on the catalog, we have these main value propositions for our customers.

### **5.2.1 Recommendation what to buy**

As we saw in our initial research, many people do not have the time and money resources to collect coins/notes from the whole world. Most collectors eventually focus on a subset of all possible items. The reasons why they stick to this

or that subset are outside of the scope of this work. Based on the interviews, we have found out that people spend hours online (we do not have information about their behavior before the pandemic) looking for the items they want to buy. It is still possible that they are shopaholics, and the process is more interesting to them than the result. But we think that this idea needs to be verified first.

To check this idea, we need to create the most obvious and common subsets automatically:

- Countries;
- Continents
- Periods;
- Keywords based on image elements;
- Combinations of the points above.

However, some of the subsets need to be created manually, but this functionality is less scalable.

Based on the elements of user collection, the chosen (by users) subsets, and available items on the Internet, our AI will recommend things to buy. The recommendations could be delivered over email or push notifications.

Possible risks:

- Not enough online places where items are sold;
- No affiliate programs;

### **5.2.2 Collection value**

For different reasons, collectors want to sell their items:

- They do not collect that category anymore;
- They did an upgrade and want to sell less valuable items;
- They just need money.

Very often not clear what is the reasonable price for a collectible. We want to build a system that analyses available sources on the Internet and recommends a sale price.

We need to check the following hypothesis:



- There are enough available sources of information;
- We may trust the information;
- We can get this information at no or low cost;

Risks:

- Auction shilling;
- We can not trust the information because of lack of normalization in the industry;

Another exciting use of information is estimating the total collection value for the owner's inheritors. Sometimes heirs sell collections very cheaply. Our technology may simplify the process of assessing the actual value.

### **5.2.3 Automating collection management**

Life is short. We believe that a human being exists for creative and non-standard things, things that evoke emotions. Everything else should be automated.

Collections often reach hundreds and even thousands of items. Solving problems described in points 1 and 2 of the value proposition section requires having a carefully filled catalog. Automation of adding items to collections is crucial.

We plan to offer two kinds of automation:

- Adding items using Computer Vision tool;
- Importing data from a structured Excel file.

Both tools will help save enormous amounts of time in management.

Things that still need to be taken into account:

- Some of the collectors do not consider adding items to a catalog boring;
- Nobody of interviewed people wanted to pay a significant amount of money (more than 1 USD) for this feature;

## 5.2.4 Existing solutions on the market

Table 5.2

### Competitors

Name / Description	Comment
<p>Maktun (<a href="https://www.maktun.com/">https://www.maktun.com/</a>), Mobile App, performs pretty similar to what we planned at the beginning. Completely free, unclear monetization scheme.</p>	<p>Pros:</p> <ul style="list-style-type: none"> <li>● Existing solution on the market</li> <li>● Completely free</li> </ul> <p>Cons:</p> <ul style="list-style-type: none"> <li>● Outdated UI (Then could easily change it).</li> <li>● It doesn't bring and value beyond storing items;</li> </ul>
<p>Collectgram (<a href="https://collectgram.com/">https://collectgram.com/</a>), Mobile App, operates on the Brazillian market. Has CV function in beta mode</p>	<p>Pros:</p> <ul style="list-style-type: none"> <li>● Nice UI;</li> <li>● Built-In Marketplace;</li> </ul> <p>Cons:</p> <ul style="list-style-type: none"> <li>● At the time of texting CV feature worked buggy;</li> <li>● Only in Brazil (but may go outside)</li> </ul>
<p>Numista (<a href="https://en.numista.com/">https://en.numista.com/</a>), WebSite.</p>	<p>Pros:</p> <ul style="list-style-type: none"> <li>● Large Database;</li> <li>● Provides value for a corresponding grade;</li> <li>● Supports coins and banknotes;</li> </ul> <p>Cons:</p> <ul style="list-style-type: none"> <li>● No mobile app;</li> <li>● No CV function;</li> </ul>
<p>uCoin (<a href="https://en.ucoin.net/">https://en.ucoin.net/</a>), WebSite.</p>	<p>Pros:</p> <ul style="list-style-type: none"> <li>● Large Database;</li> <li>● Provides value for a corresponding grade;</li> </ul> <p>Cons:</p> <ul style="list-style-type: none"> <li>● No mobile app;</li> <li>● No CV function;</li> <li>● Supports only coins.</li> </ul>
<p>Colnect (<a href="https://colnect.com/">https://colnect.com/</a>)</p>	<p>Pros:</p> <ul style="list-style-type: none"> <li>● Large Database;</li> <li>● Supports various types of collectibles;</li> </ul> <p>Cons:</p> <ul style="list-style-type: none"> <li>● No mobile app;</li> <li>● No CV function.</li> </ul>

It is stupid to assert that a startup doesn't have competitors on the market. Competitors always exist, if not direct but indirect. Coffee producers compete with mineral water producers on the soft-drink market, and Facebook competes with Netflix for users' free time.

While we don't know a product that contains all of the value propositions we plan to offer, table 5.2 includes a list of direct and indirect competitor analyses.

Overall concerns:

- Not clear why the pieces of our puzzle weren't put together by someone else. Probably the market is not large enough, or customers are too lazy.

### 5.3 Channels

We plan to have few sales-generating entry points:

- Mobile application. It will be a cross-platform solution for both iOS and Android users. There is no information about the split between platforms.
- Website. We have a registered name <https://collecto.ai/>. We plan to publish on it available information about all catalog items, blog posts. It will also contain online tools that help to import Excel files with user catalogs.
- Publications on:
  - Facebook Groups
  - Subreddits;
  - Contacting YouTube influencers;
- Less cost-efficient but worth trying:
  - Pay Per Click advertising (Google, Facebook);
  - Paid posts in various media;

According to Geoffrey Moore [21], customers split into the following groups:

- Innovators;
- Early Adopters;

- Early Majority;
- Late Majority;
- Laggards.

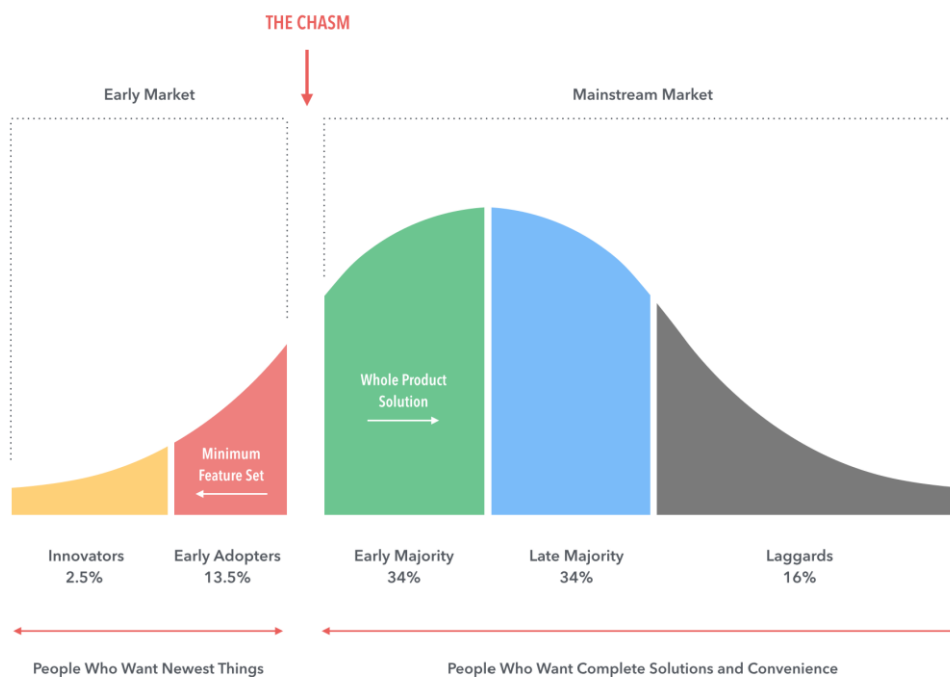


Figure 5.1 Geoffrey Moore's Chasm [22]

The scheme that approximately shows the quantity of each group of users is shown in figure 5.1. Innovators and early adopters form the early market, and the rest is the mainstream. There is a gap between the early and the mainstream so-called The Chasm. The Chasm is a pause in growth between the early adopters and the early majority. The art of business is to “jump” over this gap.

We hope to get the first users (innovators and early adopters) via obvious channels like:

- Friends;
- Friends of friends;
- Social networks and other societies;
- Posts to Reddit;
- Contacting YouTube influencers.

To make the user growth consistent, we need to find other sales channels. The trick is to make them as cheap as possible. The obvious solution is to use

Google/Facebook or different kinds of Pay-per-click or Pay-per action advertising. Less obvious is to make a viral effect and make application owners ambassadors of our brand. I.e., reach network effect.

One of the options is to offer users a bonus for recommending the application.

The most probable risks:

- Early adopters are not happy with the solution;
- We can not identify who is our early majority.

#### **5.4 Customer Relationships**

Our business goal is to bring new emotions to customers' lives continuously.

The key performance indicators here are:

- Customers' lifetime;
- Average earning per-user per month/year;

By managing these two KPIs, we may make our business more substantial and more profitable. We need to think about the following aspects:

- UI quality, FAQs, Video Tutorials, Customer support over chat and if necessary via phone;
- Customer notifications via push notification and email.

The difference in behavior depending on customer segment:

- Inactive:
  - We should not bother them often. These users are not ready to buy frequently. Our goal is to move them to a moderately active group by sending exciting offers;
- Moderately active:
  - They like where they are. Maybe some of the users will become serious collectors. Our goal is to send them as much information as they need. Theoretically, we may provide them not only informational services but also partner with real-life things providers and have discounts on albums, holders, capsules;

- We need to create and maintain community so that these users bring and support other similar to them;
- Serious collectors:
  - They spend every day with their hobby and know a lot about it.
  - Unlikely, we give them general information they don't know, but we need to provide them with good tools and make them our brand ambassadors. They could be opinion leaders, and they may earn additional money on bringing new users to the system;
  - Since this group contains fewer people, we need to consider talking to them on a personal basis.
  - They may become community moderators and country managers;

## **5.5 Revenue Streams**

Initially, the only revenue stream of the application was a subscription. We believe that a subscription is a better model for customers because they do not need to invest in one-time software purchases but instead pay a small amount month to month and cancel anytime. However, initial research showed that while collectors spend a significant amount of money purchasing new items, they are unlikely to pay for the subscription. The app's novelty probably causes it, or the value is not clear for them.

After changing the model and the approach, we reviewed the revenue sources. They are described below.

### **5.5.1 Commission fee of affiliate program**

At the moment, we're members of the eBay Partner Program only. We consider this as one of the critical revenue streams. The fundamental hypothesis is that we need to check if eBay has enough lots, and we may route enough traffic to eBay to run the business.

Currently, eBay offers 3% of Sales with a Cap of 550 USD for items in the Collectibles categories [23]. Detailed calculations on many sales we need to be profitable will be placed in the financial model section.

### **5.5.2 One-time payments for estimating values of items**

The idea came from one of the interviews with an expert. The problem itself is described in point [5.2.2 Collection Value](#). However, we plan to have free only a few searches per account or month and charge for the furthers.

Possible options:

- Package of 50 searches for 50 USD;
- One-time search for 3 USD;
- Subscription for 9.99 USD per month. Annual commitment, with a limit of 100 searches per month).

Interesting that we may experiment with different models for different user groups (not segments) and choose a model that works better.

Groups could be split:

- by age;
- by country;
- by occupancy (discount for students);
- etc.

### **5.5.3 Subscriptions for storing collection items**

It is the initial revenue source. Users still need to store user items in the collection. We can make it free for most of them but probably may charge for useful features like using the Computer Vision tool (let's call it Snap-to-Add) for adding items to the collection. While doing that, we may provide three free scans per month to show how to use the tool and charge for the rest.

Possible models to try:

- Storing 100 items for free and subscription (4.99 USD per month) for additional;
- Three free scans per month and subscription for the other;
- Refer a friend to get free scans;
- Add a new item to the global catalog to get more storage;
- Etc.;

### 5.5.4 Other ideas

Once critical mass is reached, we plan to launch an internal marketplace and auctions.

## 5.6. Key Resources

To function our company requires a few groups of resources.

### 5.6.1 Information about coins/notes

Having a Global Items Database is crucial to start the work. We promise a simple adding process. To operate, we need to either buy this data or create our own. Table 5.3 shows an analysis of every approach.

Table 5.3

Comparison of approaches

Method	Pros	Cons
3rd-party data	<ul style="list-style-type: none"> <li>● Fast start</li> <li>● A lot of data</li> </ul>	<ul style="list-style-type: none"> <li>● It may be costly in the long run;</li> <li>● Data Source may consider us as a competitor</li> <li>● Risk of poorly normalized data</li> </ul>
Building our own	<ul style="list-style-type: none"> <li>● Cheaper in the long run;</li> <li>● We manage data quality;</li> </ul>	<ul style="list-style-type: none"> <li>● Slow start;</li> <li>● Lot of manual work;</li> <li>● Chance of stealing the data;</li> </ul>

Our perception that we need to start by buying a database or partnering with one of the database owners and then creating our own. The time factor is critical here.

### 5.6.2 Technology

Technology is our unfair advantage. It is the crucial difference between our competitors who have a user base and data about the coins. Creating a mobile application is not a big deal itself.



The critical risk here is that if the market becomes attractive with investing a certain amount of money, the competitors could copy the technology. The only solution here is to go beyond the market and continuously innovate. This way, the competitors will copy what we have instead of what we build and release in the future.

While it is not possible to patent software, the methods we are using could be patented. It is another level of protection.

### **5.6.3 Customer Loyalty**

Trust takes years to build, seconds to break, and forever to repair  
(Anonymous)

The last but not least key resource is the loyalty of our customers. It is built daily by providing quality service, customer support. The brand that we are building will help offer other services beyond just providing the information.

## **5.7 Key Activities**

Every business has a massive amount of tasks to be done daily. Without proper prioritizing available money could end, and we will not achieve desirable results.

Below we describe three key activities to which we need to pay attention.

### **5.7.1 Marketing and branding**

The technology itself is just a technology. Every software application is just coded if it is not used. To be used, potential customers need to be convinced that our product is worth trying and could solve their problems.

The technology building process should not be separated from customer research and receiving feedback.

Marketing involves the following subactivities:

- Writing content to the website, social media, Quora, Reddit;
- Preparing videos for YouTube;
- Interviewing existing customers;

- Interviewing potential customers;

The vital part of the approach is making hypotheses and measuring the results. The resulting speed will depend on several theories and their quality.

### **5.7.2 Technology development**

Say that the speed of technology development is fast is to say nothing. Once the market sees that the model works, competitors will try to copy and adapt it. Or even steal.

The only way to protect ourselves from “being eaten” by the rivals is a constant improvement and being beyond the market.

The technology development includes the following sub-activities:

- Development of the mobile application;
- Development of the back-end and AI part;
- Testing / Deploying;
- Security analysis / Data Protection;
- Competitor technologies analysis;
- Researching alternative ways of solving problems;
- Researching potential partners to shortcut the solution delivery;

### **5.7.3 Information management**

Since we do not have an item database, we have to create it ourselves. Yes, it is possible that at the first stages of company life, we will use 3rd-party information. However, it is unlikely that our data providers will be happy that we’re starting to eat their lunch. The most tricky part here is to make the switching between data sources smoothly.

Therefore we need to do the following manual activities:

- Create and manage own products database;
- Moderate user-created content;
- Create and manage subsets;
- Annotate data for training neural network;

## **5.8 Key Partners**

One man, no man (Proverb)

Technically our business model can be categorized as B2B2C. That means we take information from business processes and sell it to single customers. Our company acts as a glue between various pieces.

Below are described different groups of our partners and their roles.

### **5.8.1 Auctions and marketplaces.**

The critical element of our business existence are places where people can buy something online. Another essential piece is that these places need an affiliate program to refer to them and earn a commission.

### **5.8.2 Opinion leaders**

These partners will help us to promote. It is not possible physically to reach each customer individually. As a result, we need to put out advertisements to places which our audience visits. These places could include YouTubers, Facebook group admins, etc.

### **5.8.3 Information database owners**

As stated a few times before, we need to get somewhere info to build our business on in the beginning. At the moment, we're in contact with a few owners.

### **5.8.4 Technology partners**

Having extensive staff is expensive. From our experience, the successful model of a startup team is an in-house CTO and probably a few key members and an outsourced team. The company could never outsource core competencies. Lack of communication and coordination will just burn the budget and do not provide any significant value.

We consider outsourcing the following activities:

- Mobile app development;
- UI/UX design;

- Customer support (on later stages);
- Data annotating;

Another group of technology partners is hosting companies. At the moment, we're looking at either AWS as a leader or Linode. DigitalOcean can be only an option if they offer GPU-based droplets.

## 5.9 Cost Structure

While the majority of costs and their nature will be described in the Financial model section here we outline the essential elements:

- Team salaries;
- Commissions to partners;
- Payment for advertisement;
- Fees for technology development.

## 5.10 Experiments

We think about each statement in the canvas as a hypothesis. Until the model is stable and scalable (never), an experiment is a crucial element of our life.

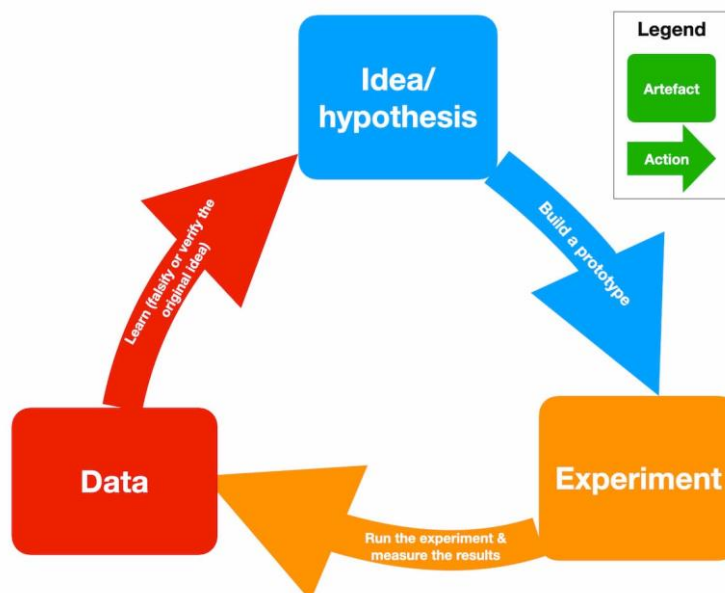


Figure 5.2 Lean Startup Cycle [24]

## 6. FINANCIAL MODEL

While planning, we split the things we know and don't know. What we know for sure we note; what we don't know, we just percept.

### 6.1 Revenue Streams

#### 6.1.1 Commission fee of affiliate program

In our model, we made a few assumptions:

- The average sale cost is 10 USD — taken from interviews. The number needs to be refined with more discussions. We got 10 USD from a calculation of monthly budget of 40 USD and 3-5 purchases per month;
- Number of active users per year — perception/projection;
- Number of purchases per year — we assume that a user will do four purchases per month and half of them through our system;
- 3% for referral program is a known piece;

Table 6.1 shows the sales projection in the revenue stream that is built using the assumptions.

Table 6.1

Commission fee of affiliate program data

	2021	2022	2023	2024	2025
Number of active users	1K	20K	50K	100K	200K
Number of purchases per user	18	24	24	24	24
Total purchases made per year	18K	480K	1200K	2400K	4800K
Average sales cost, USD	10	10	10	10	10
Total value of purchased items, USD	180K	4800K	12000K	24000K	48000K
Referral commission, %	3.00%	3.00%	3.00%	3.00%	3.00%
<b>Stream Revenue</b>	<b>5.4K</b>	<b>144K</b>	<b>360K</b>	<b>720K</b>	<b>1440K</b>

A concern:

- It is not clear if eBay may generate 4.8M sales per year in absolute values. The category we're working with contains 2.8M items, and we haven't found statistics on how often those items are sold. It is the next step for the research.

### 6.1.2 One-time payments for estimating values of items

Assumptions:

- The average number of items per user is 500.
  - The number is taken by dividing the number of coins in uCoin.net (38M) by the number of collectors (80K) at the moment of preparing this work;
- 20% of all items worth being rated (assumption);
- 5% of all recommendation will become a paid search;
- In calculations, we suppose that the price per search is 1.00 USD.

Table 6.2

One-time payments for estimating values of items data

	2021	2022	2023	2024	2025
Number of active users	1K	20K	50K	100K	200K
Average number of items per user	500	500	500	500	500
Number of items in catalog	500K	10000K	25000K	50000K	100000K
old/rare/searchable items in catalog, %	20%	20%	20%	20%	20%
Amount of recommendations	100K	2000K	5000K	10000K	20000K
Paid searches, %	5%	5%	5%	5%	5%
Paid searches	5K	100K	250K	500K	1000K
Price per search, USD	\$1.00	\$1.00	\$1.00	\$1.00	\$1.00

<b>Stream revenue</b>	<b>5K</b>	<b>100K</b>	<b>250K</b>	<b>500K</b>	<b>1000K</b>
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### 6.1.3 Subscriptions for storing collection items

We still want this feature even though we got initial negative feedback that users will pay for storing items in the catalog. We assume that 2% of all users will purchase a subscription.

Table 6.3

Subscriptions for storing collection items data

	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>
Number of active users	1,000	20,000	50,000	100,000	200,000
Users who purchased a subscription, %	2%	2%	2%	2%	2%
Users who purchased a subscription	20	400	1,000	2,000	4,000
Annual subscription cost, USD	\$99	\$99	\$99	\$99	\$99
<b>Stream revenue</b>	<b>1.98K</b>	<b>39.6K</b>	<b>99K</b>	<b>198K</b>	<b>396K</b>

### 6.1.4 Other

There are a lot of other possibilities in revenue generation. However, for a startup, the most important is to grow the user base. Having users that consider the app valuable, it is possible to pay with other sources.

## 6.2 Cost of Sales

We assume that we will not have many variable expenses. Some commissions may apply since money is not free, so we suppose we will have transactional costs in 3% of revenue (The adjusted fee from Stripe).

Another possible cost is the AppStore fee from 15% to 30% [25]. This cost is not included in the model.

### 6.3. Technical Team

The first technical hire should be a team CTO. His or her primary responsibility will be hiring the other technical team members. The tricky moment here is that the team eventually will not be extensive, and the CTO needs to be also a collector with passion.

In the table below, we do not split between in-house and outsourcing team members. Hiring people in partner companies will be more expensive, but other advantages apply then.

Table 6.4

	Technical team				
	2021	2022	2023	2024	2025
Average team member cost, USD	5K	5K	5K	5K	5K
Product Manager				1	1
Technical Lead / Back-End	1	1	1	1	1
Back-End / DevOps			1	2	2
UI/UX	0.5	0.5	0.5	1	1
Mobile	0.5	1	1	2	2
QA	0.5	1	1	2	2
Months	6	12	12	12	12
<b>Technical Team Cost</b>	<b>75K</b>	<b>210K</b>	<b>270K</b>	<b>480K</b>	<b>480K</b>

### 6.4 Business Team

The business team is as important as the technical one. Since we have a technical B2B2C, product marketing is a crucial part of the sales-driving process. The critical hire here is a Chief Marketing Officer.



Table 5.6

## Business Team

	2021	2022	2023	2024	2025
CMO		3K	3K	3K	3K
Marketing Team, Average cost		2K	2K	2K	2K
Number		1	2	2	3
Customer Support, Average cost		1K	1K	1K	1K
Number		1	2	3	5
Data Processing, Average Cost	1K	1K	1K	1K	1K
Number	1	5	5	5	5
Months	6	12	12	12	12
CEO	\$1.00	\$1.00	\$1.00	\$1.00	\$1.00
<b>Business Team Cost</b>	<b>6K</b>	<b>132K</b>	<b>108K</b>	<b>120K</b>	<b>168K</b>

### 6.5. Profit and Loss Statement

Putting all the above data together, we may build the resulting P&L. It looks somewhat optimistic, but it could lead us in the right direction and be a base of further calculations.

## Profit &amp; Loss Statement

	2021	2022	2023	2024	2025
Sales:					
- Commission fee of affiliate program	5.4K	144K	360K	720K	1440K
- Pay per Search	2K	39.6K	99K	198K	396K
- Subscriptions for storing collection items	2K	39.6K	99K	198K	396K
Total Sales	9.4K	223.2K	558K	1116K	2232K
Cost of Sales:					
- Transaction Expenses	0.3K	6.696K	16.74K	33.48K	66.96K
Gross Margin	9.1K	216.5K	541.3K	1082.5K	2165K
SG&A:					
- Development Team	75K	210K	270K	480K	480K
- Business Team	6K	132K	108K	120K	168K
- Advertizement	5K	22.3K	55.8K	111.6K	223.2K
- Equipment / Office	20K	20K	20K	20K	20K
- Hosting & Software	6K	24K	48K	48K	48K
- Consulting (Accountants, Lawyers)	24K	28.8K	34.6K	41.5K	49.8K
Total SG&A	136K	437.1K	536.4K	821.1K	989K
<b>EBITDA</b>	<b>-126.9K</b>	<b>-220.6K</b>	<b>4.9K</b>	<b>261.4K</b>	<b>1176.1K</b>

## **6.6 Investment needed**

The project's minimal needed investment includes the first four years of SG&A +30% reserve and equal to 1.5M USD. It is possible to start with smaller, but the number of experiments to do will be less.

## 7. ROADMAP

To continue work on the project, we need to create a PoC (Proof of concept) with a minimal set of features. Its functions are described below:

- Money/Coins of one country: e.g., Ukraine or US;
- Minimal catalog front-end/back-end will take about two months for API and simple front-end;
- We can't start without data. To start, we need to take a country and one category only. Manual creation for a selected subset will take 2-3 weeks, and we could potentially delegate this work. Possible options for the subset are placed in table 7.1;
- While it is possible to start without a Computer Vision model, we will not distinguish ourselves from competitors. So we need to create it, and it will be the most time-consuming task: our estimation is 2–3 months based on previous tries.

Table 7.1

Subsets for prototype

Type	URL
Bullion	<a href="https://www.ebay.com/b/Bullion/39482/bn_1642568">https://www.ebay.com/b/Bullion/39482/bn_1642568</a>
UK Coins	<a href="https://www.ebay.com/b/UK-Coins/3394/bn_16566229">https://www.ebay.com/b/UK-Coins/3394/bn_16566229</a>
UK Notes	<a href="https://www.ebay.com/b/UK-Paper-Money/47398/bn_16566241">https://www.ebay.com/b/UK-Paper-Money/47398/bn_16566241</a>
Ukraine Coins	<a href="https://www.ebay.com/b/Ukraine-Coins/77528/bn_16566247">https://www.ebay.com/b/Ukraine-Coins/77528/bn_16566247</a>
Ukraine Notes	<a href="https://www.ebay.com/b/Ukrainian-Paper-Money/162232/bn_16566248">https://www.ebay.com/b/Ukrainian-Paper-Money/162232/bn_16566248</a>
US Quarters	<a href="https://www.ebay.com/b/US-Quarters/11962/bn_2313681">https://www.ebay.com/b/US-Quarters/11962/bn_2313681</a>

It is hard and pointless to include all possible variants of the project development. In table 7.2, we have placed the optimistic flow.

Table 7.2

## Project Roadmap

Period	Description
2020Q4	Initial Idea: Catalog with Computer Vision capabilities
2021Q1	Pivot: Purchase Assistant Data Collecting
2021Q2	Data Analysis
2021Q3	PoC Creation
2021Q4	PoC Creation and Start of getting feedback for the first hundred users. The users are received from IBNS.
2022Q1	If positive feedback, get data from other countries/categories. Probably we need to partner with a catalog to speed up the process. If negative feedback, we stop here, rethink the concept, and probably shut down.
2022Q2	Closing technical debt. Soft-launch in the US. Promoting in FB/Reddit

We do not plan to add other markets or collectibles in 2022. We need to create a great app and a smooth user experience at this stage. Further steps could be:

- Other countries;
- Other collectibles.

## **8. PERSPECTIVES**

### **8.1 Other markets**

Our unfair advantage is the technology that we are working on. It performs three main functions:

- Analyzing data at open platforms;
- Extracting information (item identification) from unstructured data (based on the predefined database);
- Recommendation system based on user information.

At the moment, the created algorithms are intended to perform only in a very narrow field. The algorithms could easily extend them for other collectibles:

- Mini Bottles
- Stamps
- Bierdeckels (German);
- Bottle Crowns;
- Etc.

### **8.2 Extending Technology**

One of the enormous unsolved problems in coin and note collecting is grading. For old and potentially valuable items, the collectors pay a significant amount of money to certified graders that assess a state and seal the item.

The current level of hardware development doesn't allow the creation of a mass tool for coin or note grading. However, we hope that soon cameras will take better pictures, LiDARs will be present in everyone's phones and be more precise.

### **8.3 Above and beyond**

We believe that people will not use physical money in the future. But it doesn't mean that the technology will be useless. People will collect them as antiques, and our tool will be more valuable.

On the other hand, we see a few other extensions of the business and the application of created AI:

- Creating own online platform for selling collectibles;
- Creating a trusted network for selling and exchanging the collectibles;
- Using a tool to detect fake coins or notes (theoretically, a computer may note insignificant differences from originals);
- Assistant for picking items in grocery stores (along with Apple Glasses, Hololens, or similar device);
- Going for digital NFT collectibles;

## 9. CONCLUSIONS

### 9.1 Project Idea Evolution

Validation of the idea has completely changed it. We went from just a smart catalog to a collection assistant that targets three problems:

- helps to purchase items;
- estimates the value of the collection;
- and organizes the collections.

Customer interviews added valuable information regarding the needs and problems they face. In addition, some of the problems we targeted initially are not the problems at all. The key function (Computer Vision) became only a supporting tool on the new platform.

### 9.2. Implementation Plan

The next plan in our work is to start working on PoC. We plan to implement it at our own cost. Hopefully, this process will take from three to six months. Having the PoC, it will be easier to get more feedback and get investment. We have contacts that could introduce us to large players like Heritage Auctions as an investment target.

Another thing that required research is analyzing datasets from eBay and other auctions to understand that we could have enough referred sales online. We need to find out how often items are sold and how often new positions appear on auctions.

### 9.3 Limitations of a one-person company

The initial project idea was about the creation of a relatively simple catalog of items. That project could be created and managed by one person from both technical and business perspectives. Once the idea is changed, the project's technical part (hidden under the hood) became our core competitive advantage. It became evident that the technical team must be much broader as long as the amount of manual work is much larger than planned, even in the early product stages.



#### **9.4 The final decision**

The market for collectibles looks very promising. It is not well automated, and it is worth trying to enter. However, changing a user's habits is a tricky thing. There we think that if the PoC that we are building doesn't get good feedback. I.e., the user will not start using it, ask for new features but admit that idea is not worthy of the future time and money spent.

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## APPENDIX A. INDUSTRY PLAYERS

Table A.1

### Industry players

Company Name	Description
Numista <a href="https://en.numista.com/">https://en.numista.com/</a>	Online catalog of world coins and banknotes
uCoin <a href="https://en.ucoin.net/">https://en.ucoin.net/</a>	Coin Catalog
Colnect <a href="https://en.ucoin.net/">https://en.ucoin.net/</a>	Colnect (collect + connect ==> Colnect) is a comprehensive online solution for collectors of mass-produced collectibles (stamps, coins, phone cards, and so many more)
Numiscorner <a href="https://www.numiscorner.com/">https://www.numiscorner.com/</a>	Numismatic store
eBay <a href="https://www.ebay.com/">https://www.ebay.com/</a>	The largest online auction
Heritage Auctions <a href="https://www.ha.com/">https://www.ha.com/</a>	Heritage Auctions is an American multi-national auction house based in Dallas, Texas
Track and Price <a href="http://www.trackandpricewpm.com/">http://www.trackandpricewpm.com/</a>	A tool that grabs historical results of eBay and other auctions
Paper Money Guaranty (PMG) <a href="https://www.pmgnotes.com/">https://www.pmgnotes.com/</a>	Paper Money Guaranty (PMG) is the world's largest and most trusted third-party grading service for paper money

<p>The Banknote Book  <a href="https://banknotebook.contentshelf.com/">https://banknotebook.contentshelf.com/</a></p>	<p>A catalog of world paper and polymer money</p>
<p>Coin Appraiser by Stacks-Bowers Numismatics  <a href="https://coinappraiser.com/">https://coinappraiser.com/</a></p>	<p>Find Values And Sell Your Rare Old Coins</p>
<p>Stack's Bowers Galleries  <a href="http://stacksbowers.com">stacksbowers.com</a></p>	<p>Stack's Bowers Galleries has been conducting live, Internet, and specialized auctions of rare U.S., World, and Ancient Coins and Currency since 1933.</p>
<p>SixBid  <a href="https://www.sixbid.com/en/">https://www.sixbid.com/en/</a></p>	<p>Sixbid is the most crucial online auction platform for coins &amp; medals and other valuables and features auctions of all significant numismatic firms worldwide.</p>
<p>Great Collections  <a href="https://www.greatcollections.com/">https://www.greatcollections.com/</a></p>	<p>The Fastest Growing Coin Auction House in the United States. Over \$400 million sold, over 900,000 certified coins and currency auctioned.</p>

### APPENDIX B. NORMALIZER

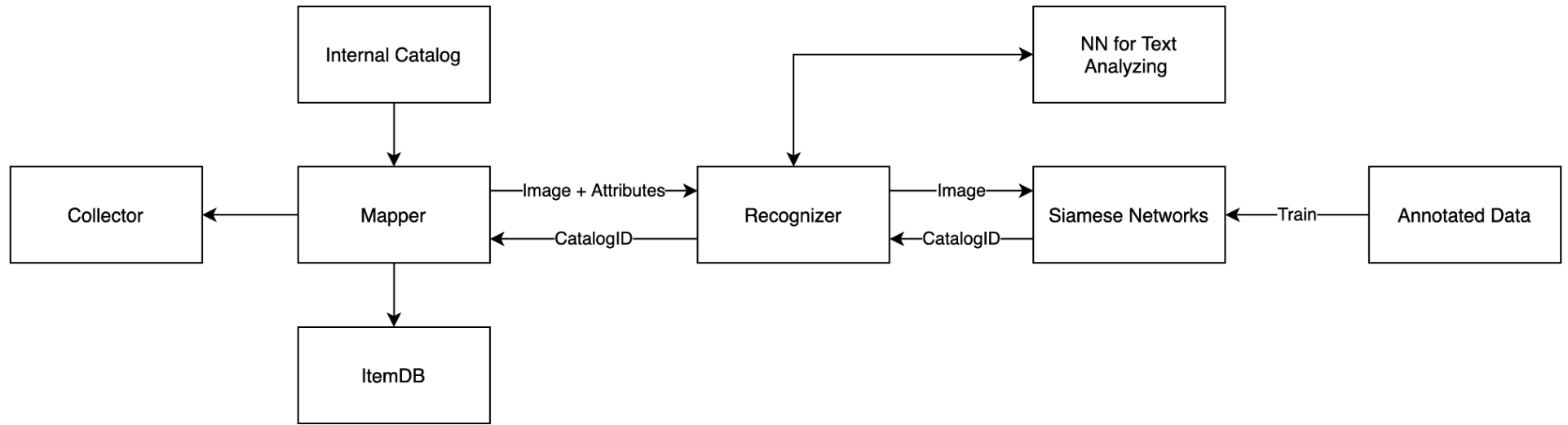


Figure B.1 The structure of Normalizer Service

### APPENDIX C. THE BUSINESS MODEL CANVAS

(8) Key Partners	(7) Key Activities	(2) Value Propositions	(4) Customer Relationships	(1) Customer Segments
<ul style="list-style-type: none"> <li>● Online auctions, auction houses, numismatic stores;</li> <li>● Opinion leaders in the community;</li> <li>● Information database owners;</li> <li>● Technology partners;</li> </ul>	<ul style="list-style-type: none"> <li>● Marketing and branding;</li> <li>● Technology development;</li> <li>● Information management.</li> </ul>	<ul style="list-style-type: none"> <li>● Proposing missing item to collection;</li> <li>● Estimating collection value;</li> <li>● Automating collection management.</li> </ul>	<ul style="list-style-type: none"> <li>● Continuous recommendations to keep retention</li> </ul>	<ul style="list-style-type: none"> <li>● Coins/Notes Collectors;</li> <li>Early adopters:               <ul style="list-style-type: none"> <li>● IBNS members;</li> <li>● Reddit / Facebook Groups Users.</li> </ul> </li> </ul>
	(6) Key Resources		(3) Channels	
	<ul style="list-style-type: none"> <li>● Information about coins/notes;</li> <li>● Technology;</li> <li>● Customer Loyalty.</li> </ul>		<ul style="list-style-type: none"> <li>● Direct sales via mobile app;</li> </ul>	
(9) Cost Structure			(5) Revenue Streams	
<ul style="list-style-type: none"> <li>● Team salaries;</li> <li>● Commissions to partners;</li> <li>● Payment for advertisement;</li> <li>● Fees for technology development.</li> </ul>			<ul style="list-style-type: none"> <li>● Commission fee of affiliate program;</li> <li>● One-time payments for estimating values of items;</li> <li>● Subscriptions for storing collection items.</li> </ul>	



Figure C.1 Business Model Canvas