

LINKERO

A Brand Monitoring Platform



This report is submitted in partial fulfilment of the requirements
for the
B.Sc. (Honours) Information Systems and Information Technology (DT249)
to the
School of Computing
College of Sciences & Health
Dublin Institute of Technology

Author: Stefano Richiardi

Student ID: D12124118

Supervisor:

Date: January 2019

Abstract

In this project I aim to build a data aggregator service for investigations and monitoring of counterfeit products online. The service will be implemented with a web interface for clients' access, an http server and specialized databases depending on data and performance requirements.

The core mission of this project is to try to simplify daily tasks of counterfeit investigations, and leverage server technologies to allow investigators to see the bigger picture painted when data from one case connect to one or multiple other cases previously unconnected.

Equally important will be the ability to deliver a product that is ready for production environment, that is: running on a virtual server accessible from the internet, protected from unauthorized intrusions and easily scalable should the user population grow significantly.

In this project I will also discuss pros and cons of data collection from online sources: from open API offered by online services to the community of developers, to unstructured data that can be scraped and schematized, and which legal implications need to be taken into account in light of the new European General Data Protection Regulation (aka GDPR).

Contents

Abstract	iii
1 Introduction	1
1.1 Project background	1
1.2 Background	2
1.3 Objectives	3
1.4 Scope	3
1.5 Challenges and learning requirements	3
1.6 Deliverables	3
2 Literature review	5
2.1 Introduction	5
2.2 Open Source Intelligence	5
2.3 GDPR	7
2.4 Server security standards	9
2.5 Ergonomy of software interface	9
2.6 Code development principles	9
2.7 Existing brand monitoring services	9
3 System design	11
3.1 Technologies	11
3.2 System architecture	11
3.3 Django page requests flow	11
3.4 Django ORM	11
3.5 Development methodology	11
3.6 Requirements	11
3.7 User cases	11
3.8 Sequence diagrams	11
3.9 Ergonomics design principles	11

4	Project implementation	13
4.1	Security settings	13
4.2	Functions	13
4.3	Exception handling	13
5	Testing and deployment	15
5.1	Unit testing	15
5.2	Integration testing	15
5.3	System testing	15
5.4	Usability testing	15
5.5	Deployment	15
6	Evaluation	17
6.1	Lessons learned	17
6.2	Future work	17
6.3	Conclusions	17
6.4	Deployment	17
	Bibliography	19

Chapter 1

Introduction

1.1 Project background

The European Union Intellectual Property Office, in collaboration with the OECD, estimated that in 2013 the value of imported counterfeit goods is 461 billions USD, which is 2.5% of the total imports in the world trade (CIT SOURCE HERE). The report also calculates that 5% of imported goods in EU are counterfeit. Counterfeit is an unfair commercial practice which takes advantage of the brand identity and presence on the market built by the brand owner, without incurring in the same costs of brand development (product design, quality standards and marketing). Other than a financial damage for the original brands, counterfeit products may pose safety risks, since they evade the strict quality and safety standards set by national and international agencies around the world. From counterfeit iPhone batteries that explode to counterfeit air-bags that do not trigger, they all can cause physical damage to consumers.

E-commerce has been rapidly expanding since its early days in mid '90 when online marketplaces like eBay and Amazon were launched. Although it is hard to make a global estimate of market share for e-commerce companies, if we take the US market, the Census Bureau estimated that in 2009 online sales accounted for 4% of all retail sales, whereas in 2017 the e-commerce market share went up to 9%. As legitimate retailers increase their presence online, shops selling counterfeit follow suit. In 2017 the Guardia custom identified xxx worth of counterfeit goods entering the Irish border, many of those destined for the European continental market.

This tool is designed to help users to extract data related to a specific brand from online platforms such as eBay, Mercadolibre, Allegro, in a tabular format. Online marketplaces offer API open to developers in order to enable automated interaction with their platforms. This tool will focus on extracting sales and business registration

data. The data will be stored in a database so that users can keep historical records of all their queries. At the same time, users will be able to leverage the growing dataset to link new investigations to old cases across all platforms whose data has already been stored in the database. For instance, searching the email address of a shop that deals counterfeit Diesel jeans may return details of multiple businesses registered on eBay and Mercadolibre at different times, as well as information about the administrator of a facebook page about counterfeit Raiban glasses. Users can use this tool to estimate brand damage caused based on the volume of sales, as well as a forensics platform to facilitate identity attribution of potential counterfeiters.

1.2 Background

Identifying online counterfeit items starts with researches of a brand or product online presence. The aim is to identify sellers that offer a branded product sold at a price point below average retail price. An investigator would ideally prioritize sellers with higher business turnover, and ideally located in jurisdictions where legal action is a dependable and impartial option. For instance countries like Russia and China, to name few, do not always offer adequate protection for European and North American companies, making it more difficult to pursue compensation from actors located within their borders.

There are already different online companies that offer brand monitoring services: they range from keyword web-crawlers, to consumer sentiment analytics based on social platforms, to anti-counterfeit detection. We will review those companies and their services in details in the next chapter.

GDPR is the latest European Union legislation about processing of personal identifiable, privacy protected data belonging to European citizens. GDPR affects the implementation of this project in two ways: first, and most obvious, because users will submit limited personal data in order to be able to access Linkero services. Something as simple as an email address required to get notification for password recovery or data collection completed confirmation, is considered a PII (personal identifiable information) and thus is protected under GDPR. But GDPR affects also the collection of public personal details available online. This is the compliance requirement that is specific to companies providing *web scraping* services. When we deal with open source intelligence and attribution, PII are the most valuable data for anti-counterfeit investigations, therefore we will talk about how GDPR affects services like Linkero and what are the requirements to guarantee compliance (<https://blog.scrapinghub.com/web-scraping-gdpr-compliance-guide>).

1.3 Objectives

The goals set for this project fall in two main categories: business goals and personal goals.

In relation to the first type, the goal is to build a business ready web application for brand monitoring investigations. Being *business ready* means presenting a final application that run on a virtual server directly connected to the public internet, that implements all industry standard security features to guarantee that only authorized users can access its functions, and is scalable, designed to accomodate an exponentially growing number of users. The other aspect of the first goal refers to the ability to provide basic case management, data extraction and keyword searches capabilities tailored for brand monitoring and anti-counterfeit investigations.

On a personal level, I aim at gaining a hands-on understanding of specific web technologies (e.g. JQuery, Django framework, NGINX, uWsgi), NoSQL databases (MongoDB, Redis), asynchronous and non-blocking programming techniques (multithreading, AJAX, Pjthon Celery), development methodologies and testing practices.

1.4 Scope

This project will consist of a ready to deploy and use system for case management and web scraping data using eBay public API.

Regular users will be able to login, change password, set their preferred email address for general notifications and report delivery, launch queries, download unlimited times completed reports from the web interface, delete old queries, and search via keyword within all data collected and stored by any user in the database. Also the system will be configured to provide security protection against external unauthorized access and use of the system. Site administrators will manage the registration, password reset and deletion of users profiles.

1.5 Challenges and learning requirements

Young family committments, full time job and travel arrangements, SSL configuration, DKIM configuration, app specific issues.

1.6 Deliverables

Loren Ipsum

- full documentation of the system design, development and functions;
- a working implementation of the system;
- a PowerPoint presentation of the project.

Chapter 2

Literature review

2.1 Introduction

This chapter will provide an overview of different topics that informed design decisions made during the initial stages of the project. We will start looking at the discipline of Open Source Intelligence, which refers to all those protocols and techniques used by government and private agencies to piece together intelligence reports using publicly available sources, since Linkero is a tool that facilitates the structured collection and analysis of a limited portion of open source data. The legal aspect of data collection and analysis will be explored with a reasoned summary of what is GDPR and how it impacts similar online services. Three sections will be dedicated to industry level best practices in relation to the security of servers facing the public internet, the usability of software interfaces and current guidelines to build reusable, maintainable and expandable code. Finally we will review briefly what are some of the current services already offering brand monitoring tools and how they differ from one another.

2.2 Open Source Intelligence

Open Source Intelligence (more commonly referred to as OSINT) is a relatively young discipline, that is concerne with the art of piecing together strategic intelligence from publich sources of information. Michael Bazzel, a leading OSINT expert, defines it as:

any intelligence produced from publicly available information that is collected, explited, and disseminated in a timely manner to an appropriate audience for the purpose of addressing a specific intelligence requirement. for the CIA, it may mean information obtained from foreign news broad-

casts. For an attorney, it may mean data obtained from official government documents that are available to the public. For most people, it is publicly available content obtained from the internet [Bazzell(2015)].

As Bezzell explains, OSINT is not necessarily based on online sources, at least in its most broad definition. Journalistic style, old fashion dossiers filled with newspaper clippings are a form of OSINT. However it is fair to say that whenever OSINT is mentioned today, it will automatically produce the expectation that a large proportion of content is source through the internet. Another important author in this field, Stewart K. Bertram, explains:

older OSINT research was limited by both the coverage of its information and the ability of the researcher to focus the capability on a specific subject, be it a person, location or topic. [...] What has changed this status quo is the arrival of the Internet, and particularly the explosion in the use of social media technology circa 2000. The rise of these two technologies created a multilingual, geographically distributed, completely unregulated publishing platform to which any user could also become an author and a publisher. [...] By increasing the coverage and focus of OSINT the Internet effectively promoted OSINT from a supporting role to finally sit alongside other more clandestine and less accessible investigative capabilities [Bertram(2015)].

These explosion of sources of information causes another problem: reliability. Unless we are sourcing information for a scientific magazine which follows the rigorous fact checking protocol of most scientific researches, then we are facing a vast landscape of information with various degrees of veridicity: reliable fact-checked sources on one side and *fake news* at the other end of the spectrum. The work of the OSINT investigator is to move in this virtually infinite universe of news, pick only relevant information and establish how reliable they are. Again this is not new, it is called *intelligence analysis*: “[...] the application of individual and collective cognitive methods to weigh data and test hypotheses within a secret socio-cultural context” [Hayes(2007)]. Information are scored from A (reliable) down to E (unreliable), plus F (reliability unknown).

Within the domain of counterfeit investigations, OSINT can have a number of roles to play. First off and foremost, should be used to establish if the items being sold are genuine or counterfeits. Secondly, it can be used to establish the extent of profits made (and therefore loss of income for the original brand) by the merchant selling them. And finally, OSINT can provide vital help in identifying the identity of the merchant as well as that of the manufacturer.

2.3 GDPR

The General Data Protection Regulation (EU) 2016/679 (a.k.a. GDPR) is the latest legislative effort of the European Union, that regulates the collection and use of European citizens' data. The two main goals that guided this new legislation were already set in 2015 by the Council of the European Union, which stated: "The twofold aim of the Regulation is to enhance data protection rights of individuals and to improve business opportunities by facilitating the free flow of personal data in the digital single market" [of the Council(2015)]. Essentially the GDPR gives more control to European citizens over the use of their data, thus restricting the ability of private and public organizations to process Personally identifiable information (a.k.a. PII) data, and at the same time it becomes a legislative framework that standardizes personal data processing in every country member of the European Union. Let's see in more detail what this entails and what are the consequences for a product like Linkero.

First off it is important to clarify some of the terminology used in the legislation. *Personally identifiable information*, or PII, is defined in privacy laws as one single piece of data that alone can identify a single person. For instance first and last name, an email address, a physical address, a phone number, passport serial number, credit card number, a picture portraying an individual, a combination of username and password. GDPR applies to the collection, process and storage of PII. A *Data Controller* is any organization that collects and manages PII from European citizens. That includes online private companies (e.g. Google, Facebook the most obvious), as well as public institutions like primary and secondary schools and hospitals to name few. Another party that is involved in the handling of private data is the *Data Processor*, which in some cases it coincides with the Data Controller itself, when data is analysed internally, or with any other organization (e.g. contractors, vendors, suppliers, etc.) that receives PII from the Data Controller and processes it in its behalf. Finally the *Data Protection Officer* is a public office that is appointed to overlook and audit every Data Controller in its area of control.

What GDPR means for European citizens is that as of May 25th 2018, when it officially came into force, it grants much more rights over their own personal data, compared to previous legislations. These rights include *data portability*, which is to say that any Data Controller has to structure the collection and storage of PII in such a way that those information can be removed, transferred and re-allocated to another Data Controller without any further modification. In other words, this is a way to guarantee interoperability between Data Controllers, preventing single Controllers to lock-in their users. GDPR also states that EU citizens have the *right to information and transparency*, so that at any moment they can request their PII to be disclosed as

it has been collected up to that point in time. Another right that generated a lot of discussion, is the *right to be forgotten*, which states that users can have their information permanently erased from a Data Controller, if they no longer require their services.

GDPR also set more stringent constraints to the operation of organization that fall within its scope. GDPR is self-declared *transnational in scope*, meaning that it applies to every company, anywhere in the world, as long as they hold EU citizens' PII data. Obviously, enforcement is an issue in cases such as companies that are based somewhere in the Cayman Islands. However this aspect is mainly ment at large multinational corporations, that could simply transfer their databases to another jurisdiction outside the EU. Those multinational would still be subjected to EU law and would still be accountable as long as they have legal presence in any EU member state, regardless of where the PII data actually sits. GDPR also establishes a stronger *Data Subject consent*. This means that Data Controllers can no longer assume that their users data can be processed and used for whatever purpose, just because PII were given to them during the registration process, for instance, nor they can pre-tick the data consent acknowledgment box, or ask the user to tick a box only if they do not consent to the treatment of their data. On the contrary, Data Controllers have to explicitly ask and receive users consent, and consent has to be renewed over time. Finally, GDPR requires organization to *report data breaches* within 72 hours after the breach was discovered. Data Controllers not only have to notify the supervisory authority and their users, but the notification has to carry adequate details to explain how the incident occurred, how many users are affected, and how is the organization going to respond.

With all these new rights and obligations in place, the last part of the legislation concerns relative and proportionate *sanctions* for organizations that fail to comply. There are three levels of penalties that can be imposed:

1. a warning letter for the first time an organization is found in breach of GDPR, and if the breach is non-intentional;
2. a more serious breach could result in the order to commit to regular periodic data protection audits;
3. and finally, if the breach is deemed to be serious enough, GDPR the prescribes two sets of financial fines depending of which obligations were missed by the Data Controller, the harsher of which could amount to up to €20 millions or up to 4% of the annual turnover estimated from the prior financial year.

The question now is: how does GDPR affect online services that for their nature collect and process bits of PII that are publicly available? First and foremost, GDPR

applies only to PII belonging to EU citizens, therefore we can say that an online service that collects PII can keep on providing its functions without any further thought as long as it stays clear of EU citizens, as cynical as it may sound. But let's say some users will be pointing the service to PII of European users, will that be sufficient to be found in breach of GDPR? The answer to this latter question is not a clear-cut *no*, there are actually use-cases where collection can still be an option. Obviously those cases do not include when the Data Subject officially expressed consent to the organization scraping his or her PII, that is not how data scraping works, especially in the context of open source investigations. Although this may be a theoretical argument, organizations may have a *legitimate interest* in scraping, storing and processing publicly available PII. In the specific context in which Linkero is designed, we are talking about an Intellectual Property owner, or an agent in their behalf, that has a vested interest in gathering information about an online shop that sells their products, under market value, or without being an officially approved reseller. Having said that, GDPR definitely limits and restricts, for better or worse, the ability to extract, store and process public PII.

To conclude this section, it is interesting to mention how higher privacy protection is a difficult balance and has its own trade-offs. This is the case of PII that were once in the public WHOIS domain.

2.4 Server security standards

Loren Ipsum ...

2.5 Ergonomy of software interface

Loren Ipsum ...

2.6 Code development principles

Loren Ipsum ...

2.7 Existing brand monitoring services

Loren Ipsum ...

Chapter 3

System design

- 3.1 Technologies**
- 3.2 System architecture**
- 3.3 Django page requests flow**
- 3.4 Django ORM**
- 3.5 Development methodology**
- 3.6 Requirements**
- 3.7 User cases**
- 3.8 Sequence diagrams**
- 3.9 Ergonomics design principles**

Chapter 4

Project implementation

4.1 Security settings

4.2 Functions

4.3 Exception handling

Chapter 5

Testing and deployment

5.1 Unit testing

5.2 Integration testing

5.3 System testing

5.4 Usability testing

5.5 Deployment

Chapter 6

Evaluation

6.1 Lessons learned

6.2 Future work

6.3 Conclusions

6.4 Deployment

Bibliography

[Bazzell(2015)] Michael Bazzell. *Open Source Intelligence Techniques*. Amazon.co.uk Ltd, 2015.

[Bertrom(2015)] Stewart K. Bertrom. *The Tao of Open Source Intelligence*. IT Governance Publishing, 2015.

[Hayes(2007)] Joseph Hayes. *Analytic Culture in the U.S. Intelligence Community*. Ed. Center for the Study of Intelligence, 2007.

[of the Council(2015)] Presidency of the Council. Proposal for a regulation of the european parliament and of the council on the protection of individuals with regard to the processing of personal data and on the free movement of such data (general data protection regulation). *Official Journal of the European Union*, 2015.