

ANKARA YILDIRIM BEYAZIT UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES



**ANALYSIS OF GDPR NOTIFICATION EMAILS SENT BY
BLOCKCHAIN SERVICE PROVIDERS AND DEVELOPERS AND
SENTIMENT ANALYSIS OF TWEETS ABOUT GDPR
NOTIFICATION EMAILS**

M.Sc. Thesis by

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December, 2021

ANKARA

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BY BLOCKCHAIN SERVICE PROVIDERS AND
DEVELOPERS AND SENTIMENT ANALYSIS OF
TWEETS ABOUT GDPR NOTIFICATION EMAILS**

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M.Sc. THESIS EXAMINATION RESULT FORM

We have read the thesis entitled “**Analysis of GDPR Notifications Emails Sent by Blockchain Service Providers and Developers and Sentiment Analysis of Tweets about GDPR Notifications Emails**” completed by **Fatma EMÜL** under the supervision of **ASSIST. PROF. DR. M.ABDULLAH BÜLBÜL** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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ANALYSIS OF GDPR NOTIFICATION EMAILS SENT BY BLOCKCHAIN SERVICE PROVIDERS AND DEVELOPERS AND SENTIMENT ANALYSIS OF TWEETS ABOUT GDPR NOTIFICATION EMAILS

ABSTRACT

The General Data Protection Regulation (GDPR) aims to protect and personal data of European Union citizens. The GDPR, which entered into force in countries that became members of the European Union on 25 May 2018, covers all companies that process the personal data of citizens within the borders of the European Union. Severe penalties and sanctions can be imposed on companies that do not comply with GDPR articles. GDPR has created difficulties for many innovative technologies due to the rights it provides to individuals and the data processing principles it has determined. Blockchain systems, which make it impossible to delete data with the way they operate, do not meet the right to be forgotten that GDPR gives to individuals. The fact that the data will be processed indefinitely, uncertainties in the approval collection mechanisms and, difficulties in assigning responsibilities due to the anonymous environment are other factors that endanger the compliance of these systems with the GDPR. Therefore, this study has been focused on the views of blockchain service producers and developers about the topic. In the process of GDPR coming into effect; notification emails that were sent to users by these systems were collected and analyzed. Within the scope of the study, a website was prepared for the collection of e-mails. The post requesting these e-mails and containing the prepared website link was shared in forums on 129 different crypto currency official websites. The reactions of forum members and system administrators to this sharing were monitored and recorded for 6 weeks. The post was shared on 148 forums. Among them, it was observed that 30 of them were removed by the moderator, 79 of them were removed by Reddit's spam filters, 2 of them were waiting for approval and were not accepted, 20 of them were temporarily suspended, 15 of them were not answered, only 1 post was commented and after 1 post was shared, it was banned and the permission to view the site was removed. In summary, these notification email requests were not welcomed by the system administrators and ignored by the users. This situation has been interpreted as the GDPR compliance process is immature in this sector, resistance is encountered by the systems and the users do not have a sufficient level of awareness.

We continued the study by identifying people's attitudes and thoughts towards e-mails sent by companies. Thanks to Twitter, one of the most used social networks, we can easily follow what is happening all over the world about current issues and learn what people think. Using tweets shared by Twitter users, we determined what people thought about these emails they received. Thus, we were able to evaluate and analyze the positive or negative attitudes of people about these e-mails. We used the TextBlob library to do sentiment analysis on these tweets. Then we modeled the topic using the LDA algorithm. Then we made the topic modeling by using the LDA algorithm. Thus, we found out which topics were discussed in tweets containing positive, negative, or neutral emotions. Neutral sentiment tweets were often informative tweets. Negative tweets confirmed that people who received too many notification emails were annoyed. It has been observed that positive tweets belong to companies that legally secure themselves with notification e-mails and users who recover their forgotten accounts with these e-mails. With this study, a perspective is presented for companies and researchers who will work on this subject.

Keywords: GDPR, blockchain, notification email, data protection

BLOCKCHAIN HİZMET SAĞLAYICILARI VE GELİŞTİRİCİLERİ TARAFINDAN GÖNDERİLEN GDPR BİLDİRİM E-POSTALARININ ANALİZİ VE GDPR BİLDİRİM E-POSTALARIYLA İLGİLİ TWEETLERİN DUYGU ANALİZİ

ÖZ

Genel Veri Koruma Yönetmeliği (GDPR) Avrupa Birliği vatandaşlarının kişisel verilerini koruma ve gizlemeye yönelik oluşturulmuş yönetmeliktir. 25 Mayıs 2018 tarihinde Avrupa Birliği'ne üye olan ülkelerde yürürlüğe girmiş olan GDPR, Avrupa Birliği sınırları içerisindeki vatandaşların kişisel verilerini işleyen bütün şirketleri kapsar. GDPR maddelerine uyum sağlamayan şirketlere ciddi ceza ve yaptırımlar uygulanabilmektedir. GDPR bireylere sağladığı haklar ve belirlediği veri işleme prensipleri sebebiyle yenilikçi birçok teknoloji için zorluklar ortaya çıkarmıştır. Sahip olduğu işleyiş biçimiyle verilerin silinmesini imkânsız hale getiren blockchain (blok-zincir) sistemleri GDPR'nin bireylere tanıdığı unutulma hakkını karşılamamaktadır. Verilerin süresiz olarak işlenecek olması, onay toplama mekanizmalarındaki belirsizlikler, sağladığı anonim ortam sebebiyle sorumlulukların atanmasında yaşanan zorluklar bu sistemlerin GDPR'a uyumunu tehlikeye sokan diğer etmenlerdir. Dolayısıyla bu çalışmada blockchain hizmet sağlayıcılarının ve geliştiricilerinin konu hakkındaki görüşlerine odaklanılmış ve GDPR'nin yürürlüğe girdiği süreçte bu sistemler tarafından kullanıcılara atılan bildirim e-postaları toplanmış ve incelenmiştir. Çalışma kapsamında e-postaların toplanması için bir web sitesi hazırlanmıştır. 129 farklı kripto para birimlerinin resmi web sitelerindeki forumlarda bu e-postaları talep eden ve hazırlanan web sitesi linki içeren gönderi paylaşılmıştır. Forum üyelerinin ve sistem yöneticilerinin bu paylaşıma gösterdikleri reaksiyonlar 6 haftalık süreyle izlenmiş ve kayıt altına alınmıştır. Gönderi 148 tane forumda paylaşıldı. Bunlar arasında 30 tanesinin moderatör tarafından kaldırıldığı, 79 tanesinin Reddit'in spam filtreleri tarafından kaldırıldığı, 2 tanesinin onay beklediği ve kabul edilmediği, 20 tanesinde hesabın geçici olarak beklemeye alındığı, 15 tanesine cevap verilmediği, sadece 1 tane gönderiye yorum yapıldığı ve 1 tane gönderinin yasaklanıp siteyi görüntüleme izni kaldırıldığı gözlenmiştir. Özetle, bu bildirim e-posta talepleri sistem yöneticileri tarafından hoşnut karşılanmamış ve kullanıcıları tarafından önemsenmemiştir. Bu durum bu sektörde GDPR uyum sürecinin olgunlaşmadığı, sistemler tarafından dirençle karşılaştığı ve kullanıcıların yeterli farkındalık

seviyesinde olmadığı şeklinde yorumlanmıştır.

Çalışmaya, şirketler tarafından gönderilen e-postalara karşı kişilerin tutum ve düşüncelerini tespit ederek devam ettik. En çok kullanılan sosyal ağlardan biri olan Twitter sayesinde güncel konular hakkında tüm dünyada neler olduğunu kolayca takip edebilir ve kişilerin neler düşündüğünü öğrenebiliriz. Twitter kullanıcıları tarafından tweet adı verilen gönderiler ile yapılan paylaşımlardan, insanların aldıkları bu e-postalar hakkındaki düşüncelerini topladık. Böylece kişilerin bu mailler hakkında pozitif ya da negatif tutumlarının neler olduğunu değerlendirip analiz yapabildik. Bu tweetler üzerinde duygu analizi yapmak için TextBlob kütüphanesini kullandık. Daha sonra LDA algoritması kullanarak topik modellemesi yaptık. Böylece pozitif, negatif veya tarafsız duygu içeren tweetlerde hangi topikler üzerine konuşulduğunu bulduk. Tarafsız duygu tweetleri genellikle bilgilendirici tweetlerdi. Olumsuz tweetler, çok fazla bildirim alan kişilerin rahatsız olduklarını ifade ediyordu. Olumlu tweetlerin, bildirim e-postaları ile kendilerini yasal güvence altına alan şirketler ve unutulmuş hesaplarını bu e-postalar ile kurtaran kullanıcılara ait olduğu gözlemlenmiştir. Bu yaptığımız çalışma ile bu konuda çalışacak olan şirketler ve araştırmacılar için bir bakış açısı sunulmuştur.

Anahtar Kelimeler: GDPR, blockchain (blok-zincir), bildirim e-postası, veri koruma

NOMENCLATURE

Acronyms

GDPR	General Data Protection Regulation
LDA	Latent Dirichlet Allocation
HDP	Hierarchical Dirichlet Process
SVD	Singular Value Parsing



CONTENTS

M.Sc. THESIS EXAMINATION RESULT FORM.....	ii
ETHICAL DECLARATION	iii
ACKNOWLEDGMENTS	iv
ABSTRACT.....	v
ÖZ	vii
NOMENCLATURE.....	ix
LIST OF TABLES	xii
LIST OF FIGURES.....	xiii
CHAPTER 1 - INTRODUCTION.....	1
1.1 Motivation.....	1
1.2 Scope of the Work.....	2
1.3 Contributions.....	2
1.4 Thesis Organization	2
CHAPTER 2 - BACKGROUND.....	3
2.1 Blockchain.....	3
2.1.1 What is Blockchain?	3
2.1.2 How does Blockchain work?	4
2.2 General Data Protection Regulation.....	5
2.2.1 Personal Data Subject.....	5
2.2.2 Things to know about GDPR	6
2.2.3 Data Processing	7
2.3 Blockchain and General Data Protection Regulation Compliance	8
2.4 Sentiment Analysis.....	11
2.5 Topic Modelling.....	13
2.6 Related Works.....	15
CHAPTER 3 - IMPLEMENTATION	20
3.1 Web Site Implementation.....	20
3.1.1 Firebase	20
3.1.2 React.....	21
3.1.3 LimeSurvey	22
3.2 Web Site Content	23
3.3 Processes made after the website has been prepared	24

3.4 Data Retrieval	25
3.4.1 ScrapeHero Cloud	25
3.4.2 Preprocessing	26
3.5 Sentiment Analysis	27
3.5.1 TextBlob.....	27
3.6 Topic, Modelling.....	28
3.6.1 Latent Dirichlet Allocation.....	29
CHAPTER 4 – RESULTS	31
4.1 Survey Results.....	31
4.2 Results of Sentiment Analysis and Topic Modelling.....	33
CHAPTER 5 – CONCLUSION AND FUTURE WORK.....	38
REFERENCES.....	40
APPENDICES	46
Appendix A – Forum Link.....	47
Appendix B – Groups Names of Linkedin and Facebook	53
Appendix C – The Post Content	55
Appendix D – Examples of Web Page.....	56
CURRICULUM VITAE.....	59

LIST OF TABLES

Table 3. 1 Description of the fields of the table	21
Table 3. 2 Keywords written into the ScrapeHero Cloud to find tweets.....	25
Table 4. 1 Result of sentiment analysis without preprocessing	33
Table 4. 2 Result of sentiment analysis after preprocessing	33
Table 4. 3 Confusion Matrix	34
Table 4. 4 Neutral Tweets Topics.....	35
Table 4. 5 Negative Tweets Topics	36
Table 4. 6 Positive Tweets Topics.....	37
Table A. 1 Forum Link.....	47
Table B. 1 Groups names of Linkedin and Facebook	53

LIST OF FIGURES

Figure 2. 1 Simplified blockchain structure	3
Figure 2. 2 Sentiment Classification Techniques	122
Figure 3. 1 Word Cloud.....	30
Figure 4. 1 Total number of reactions from forum administrators and users.....	31
Figure 4. 2 The words in the neutral tweets topics and the weight of those words ..	35
Figure 4. 3 The words in the negative tweets topics and the weight of those words	36
Figure 4. 4 The words in the positive tweets topics and the weight of those words	37
Figure C. 1 The post content for the first Website.....	55
Figure C. 2 The post content for the second Website	55
Figure D. 1 Home page of the first Website.	56
Figure D. 2 The questions of the first website are asked to be answered	56
Figure D. 3 Home page of the second Website.....	57
Figure D. 4 Consent form of the second Website	57
Figure D. 5 Example of questions in the survey	58

CHAPTER 1

INTRODUCTION

1.1 Motivation

The General Data Protection Regulation (GDPR) is a regulation created to protect and hide the personal data of European Union citizens. The GDPR, which entered into force in countries that became members of the European Union on 25 May 2018, covers all companies that process the personal data of citizens within the borders of the European Union. Severe penalties and sanctions can be imposed on companies that do not comply with GDPR articles. GDPR has created difficulties for many innovative technologies due to the rights it provides to individuals and the data processing principles it has determined. Blockchain systems, which make it impossible to delete data with the way they operate, do not meet the right to be forgotten that GDPR gives to individuals. The fact that the data will be processed indefinitely, uncertainties in the approval collection mechanisms, difficulties in assigning responsibilities due to the anonymous environment it provides are other factors that endanger the compliance of these systems with the GDPR. Therefore, this study focuses on the views of blockchain service providers and developers on the subject, and the notification e-mails sent to users by these systems during the period in which the GDPR came into effect was aimed to be collected and analyzed.

Nowadays, tweets are used a lot for data processing. Twitter is an American microblogging and social networking service [1]. It publishes messages from users known as "tweets". On Twitter, people express their opinions openly by tweeting. There are many tweets about hot topics. After GDPR came to the fore, it attracted people's attention. After that, people started tweeting to express their thoughts on GDPR. We continued the study by analyzing the tweets sent against the emails reported to the individuals about the GDPR. After that, we researched who spoke positively about this mail and who spoke negatively.

1.2 Scope of the Work

In our work, a website was prepared for the collection of e-mails, and posts were posted on the forums on the official websites of 129 different crypto currencies, sharing this site and requesting e-mails. The reactions of forum members and system administrators to this sharing were monitored and recorded for 6 weeks. After that, the collected reactions were analyzed. We continued the study by analyzing the tweets sent against the e-mails reported to the individuals about the GDPR. After that, we researched who spoke positively about this mail and who spoke negatively. For this, we collected tweets that emails reported to individuals about GDPR. We did sentiment analysis on these tweets. By performing topic modeling, we found out which topics were discussed in positive, negative, or neutral tweets.

1.3 Contributions

One of the main contributions of this study is that a website (<https://email-5e941.firebaseio.com>) has been prepared so that people can share the content of the notification mail about GDPR. A message was posted on crypto currency forums. It was requested to fill in the required fields of the prepared website. After posting, the reactions of forum members and system administrators were observed. Another contribution was the sentiment analysis by collecting tweets to understand the feelings of the people about the notification and emails. Then, the subject was modeled and it was found out which emotion contained which subject.

1.4 Thesis Organization

The thesis is organized as follows: First, the utilized concepts and background information are presented, and then technical contributions are given. In Chapter 2, General information for the Blockchain, GDPR, Sentiment Analysis, Topic Modelling, and the related works are given. In Chapter 3, the steps of the study are explained in detail. Finally, in Chapter 4, the results of the study are presented with possible future studies.

CHAPTER 2

BACKGROUND

2.1 Blockchain

2.1.1 What is Blockchain?

Blockchain is a chain structure consisting of blocks is a distributed database system that provides encrypted transaction tracking [2]. The "blocks" in the blockchain are made up of pieces of digital information. Specifically, they consist of three parts: Blocks store information about transactions such as the date, time, and dollar amount of your last online purchase. Blocks store information about who participated in the transactions. Blocks store information that distinguishes them from other blocks. We all have names, identification numbers, etc. to be different from each other. Likewise, each block contains codes called "hashes" that allow us to distinguish it from other blocks. These codes are created using special algorithms and are cryptography codes [3]. Therefore, it operates as a digital ledger where transactions are listed one after the other, not like traditional databases.

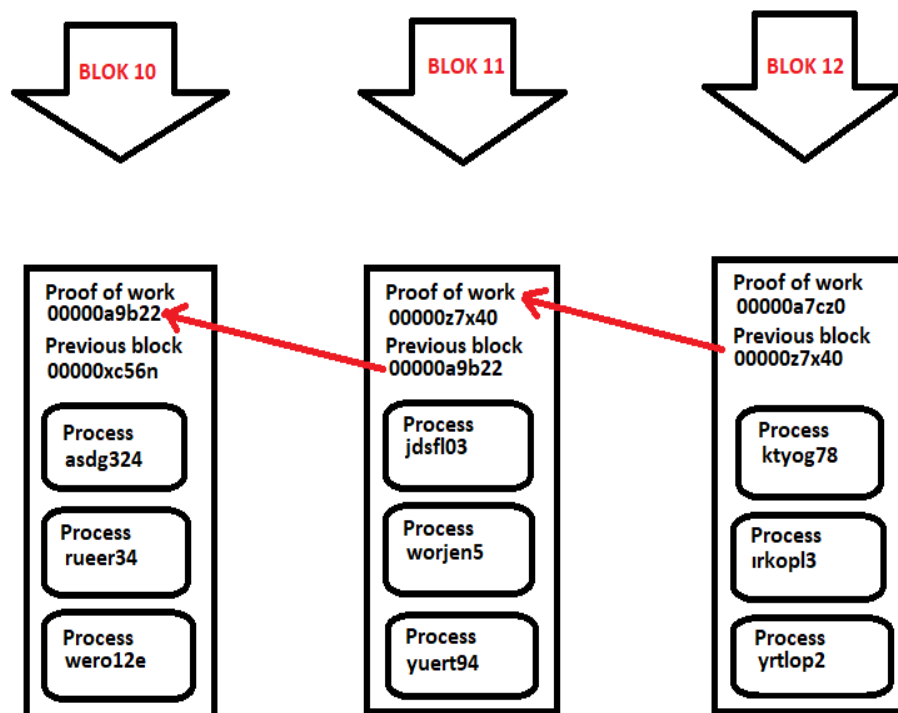


Figure 2. 1 Simplified blockchain structure

The data are ordered consecutively according to the entry date. Each block contains transaction information and the hash of the previous block. Since each block is encrypted linked to the previous one, modifying anyone creates changes in all subsequent blocks. This ensures that the data is never changed [4].

2.1.2 How Does Blockchain Work?

Blockchain does not have a standard operating model. The blockchain network can work in different ways depending on the way it is developed and its purpose. In the most basic sense, a process is performed on the designed network. A block is formed as a result of each transaction. As a result of the approval of many computers on the network, the transaction (block) is added to the block chain and each transaction is cryptographically linked to each other [5].

Blockchain working structure

Blockchain has a decentralized structure, the owner of the system is not a single person or institution, but all users are the administrators of the system. Thanks to its decentralized structure, all transactions take place directly from person to person, without intermediaries. Blockchain is made up of blocks. All transactions made by the users are recorded in the blockchain network with mathematical calculations and a new block is created for each new transaction. Users' names and surnames appear in the form of their numerical identification numbers. This feature provides anonymity during transactions. It is almost impossible to make changes in this structure, where all transactions and information are recorded. All blocks are interconnected and when you want to change a block, it will be incompatible with other blocks, so it is immediately noticed. With this feature, we can say that blockchain has key-lock compatibility.

Keys and authentication on blockchain

Blockchain uses the asymmetric encryption method, one of the asymmetric and symmetric encryption methods. In the asymmetric encryption method, encryption and decryption are done with two separate keys that are complementary to each other. If we simulate these keys, which we call the public key and private key, the username

acts as the public key and the password acts as the private key. The user name and transactions are visible to everyone, and only the user can see the password. This feature ensures that blockchain technology is transparent. As the name suggests, the symmetric encryption method is the encryption method in which decryption and encryption processes are performed with a single key. A digital signature is formed with the combination of a private key and a public key. Digital Signature is a cryptographic confirmation mechanism that proves the user's consent to the transaction through a Bitcoin wallet accessed with a private key. The digital signature guarantees that the information transmitted is error-free and that the information is transmitted by verifying the identity of the parties.

2.2 General Data Protection Regulation

The General Data Protection Regulation (GDPR) is a regulation created across Europe to protect the personal data of EU citizens. The GDPR, which has entered into force in European Union member countries since May 25, 2018, is about ensuring the security of personal data existing in large institutions and organizations in the European Union member countries within the framework of the rules specified in the regulation [6].

The GDPR covers all businesses that hold the personal data of their citizens within the borders of the European Union. Even if the location of the company is not located within the borders of the European Union, it is held responsible for the regulation because it collects the data of these citizens.

No personal data can be processed unless it is done as specified in the regulation or has explicit consent from the data subject. The person concerned has the right to revoke this consent at any time. The GDPR also includes data stored in the past. Serious penalties and sanctions await businesses that do not comply with the GDPR.

2.2.1 Personal Data Subject

Personal data subject within the scope of the regulation;

- Identity information (name, identification number),
- Bank account information,
- Address (home, work, etc.), location (geolocation),

- IP address, Cookie information, etc. internet data,
- Descriptive and biometric data of physical appearance,
- Race and origin information,
- Political view, ideology,
- Medical data (health status, drugs used, etc.)

Considering these items; tracking tools, social media and forum sites with user profiles, e-commerce sites that keep information such as address and identity record, content sites that provide comment/feedback feature (WordPress, etc.), and profile applications (disqus, gravatar, etc.), a website or apps that use various tags for retargeting, e-newsletter services fall under the GDPR.

2.2.2 Things to know about GDPR

The GDPR requires that in the case of recording or using personal data, the purpose of data collection and processing, its legal basis, how long the data is retained, and whether it is shared with any third party or outside the European Economic Area (AEA). Personal data owners have the right to request a copy of their data or request their deletion at any time. If a business encounters a breach that will adversely affect the privacy of personal data, it must notify the relevant persons within 72 hours. All businesses that process the data of citizens of the European Union member states, regardless of their location, are covered by the GDPR. Institutions or organizations that do not comply with the GDPR may be fined up to 20 million euros or up to 4% of the annual income of the institution or organization. While collecting personal data, the purpose of storing and processing the data should be clearly stated and the revocation of consent approval should be presented in an easily accessible manner. Notices of violation are required. It should be clearly stated which data of the persons is collected, for what purpose this data will be used, and for how long it will be stored.

2.2.3 Data Processing

Personal data must fall under at least one legal basis, otherwise, these data cannot be processed. According to Article 6 of the Regulation, the legal bases for data processing are as follows:

- If the person concerned has given consent to the processing of personal data;
- If the obligations arising from the contract made with the relevant person are fulfilled;
- For the data operator to comply with legal obligations;
- If the vital interests of the person concerned or another citizen are at stake;
- If a duty is performed in the public interest or an official office;
- For the legitimate interests of a data operator or a third party that is not overridden by the European Union Charter of Fundamental Rights.

It has rights regarding the personal data of individuals within the framework of GDPR. If any claim is made regarding these rights, you must respond to the request within 30 days [7]. The GDPR sets out seven key principles.

Lawfulness, fairness, and transparency

Persons have the right to know which personal data are collected and for what purpose these collected data are used. Therefore, it is necessary to give clear information about why personal data are collected, how and for how long it will be stored, and who else can access this data.

Purpose limitation

The purpose of processing the data needs to be clearly defined. It should be documented for this purpose. Privacy information for individuals should be included in the purpose. If it needs to be updated, it should be checked and special approval should be obtained.

Data minimization

The data that is needed for the purpose should be collected. It should be reviewed periodically. If there is data that is not needed, it should be deleted.

Accuracy

The accuracy of personal data must be guaranteed. The source of the data should be recorded and the accuracy of the data should be checked. If the data needs to be updated, it should be updated. An error log should be kept.

Storage limitation

It should be known why the personal data kept is needed. It should be stated how long it keeps personal data and this period should be justified. Whenever possible, there should be a policy with standard retention periods. We must have appropriate processes in place to comply with people's 'right to be forgotten' erasure requests. The personal data we need to hold for research or statistical purposes must be identified.

Integrity and confidentiality (security)

Appropriate security measures must be in place to protect the personal data collected. This is the principle of "integrity and confidentiality". It is known as the security principle of GDPR.

Accountability

It is necessary to take responsibility for what is done to personal data and how other principles are complied with. Appropriate measures and records should be in place to demonstrate compliance.

2.3 Blockchain and General Data Protection Regulation Compliance

It is necessary to evaluate the compliance of blockchain systems with GDPR. The first of the main technical features of blockchain systems is data immutability. Once data has been added, it cannot be deleted or changed. A blockchain is a series of data blocks. They are sequentially linked together via a cryptographic hash operation, where each block contains its hash as well as the hash of the previous block for validation and sorting. Any difference in input data will produce different output data. If the input data is different, it will cause the corresponding data block's hash to no longer match the hash value found in the next block. In this case, the chain is broken. This feature

of immutability has been discussed as one of the main concerns regarding GDPR compliance of blockchain systems [8] - [9]. Within the scope of the "Right to Erase ('right to be forgotten') in Article 17 of the GDPR, it seems that it is incompatible with the right of data subjects to request correction and/or deletion of data. A suggested solution to this problem is to unchain the personal data and put only the hashes on the chain [10]. Another solution is to chain the encrypted data and remove the key from the chain [11].

Another important feature of blockchain technology is that it is public and permissionless. This means that anyone can join the network as a node without authorization. Millard et al. discussed this feature, considering the principle of data protection by design and default as described in GDPR (Article 25). It raised some questions [12]. One of the questions is that it leads to confusion in identifying data controllers and data processors. There is a public blockchain system that maintains a copy of the distributed ledger. It is debatable whether each participant node should be seen as a data controller in this system. Also, contrary to the principle of "data minimization" stated in GDPR [13], [14], copying data on each node leads to a contradiction. This is also in contradiction with the fact that in Article 5(1)(c) of the Regulation, the amount of personal data collected to achieve the purposes for which the data is processed is "limited to what is necessary". It is also in conflict with the purpose limitation in another Article 5(1)(b) of the GDPR, which requires personal data to be "collected for specific, explicit and legitimate purposes and not further processed".

The identity of the data controller is important in systems that store personal data. As stated in Article 4 of the GDPR, the data controller is the person or institution that decides on the purposes and means of processing. In open blockchain systems, the system does not store any data that can be labeled as personal data. However, public key addresses used as aliases of participating nodes by such systems may still be considered personal data. Article 35 of the GDPR requires a mandatory DPIA (data protection impact assessment) to be made, which requires recording and keeping all processing activities. In some cases, the data controller is required to record and

evaluate all processing activities, which would require clarification of the entire data storage and processing chain, including responsibilities.

Another question raised by Millard et al. [12] was how, in public blockchains, controllers could instruct processors on the processing of personal data. To solve this problem, some researchers have suggested the use of smart contracts. Thus, they argued that data access, use, and transfer to data processors can be controlled. For example, Neisse et al. proposed a solution based on smart contracts deployed by data subjects for each data controller or data processor [15]. This solution allows data subjects (users) to monitor how their data is processed by data controllers and data processors and whether the processing of their data complies with their pre-approval. In other studies [16], [17], Loukil et al. proposed an approach that transforms privacy policies that explain the privacy preferences of the data subject into private smart contracts.

GDPR defines obligations that include obtaining explicit consent from the data subject for the processing of their data. Explicit consent means a specific, informed, and clear indication regarding the processing of personal data. The personal data used by a controller must have expressly consented to the use of the data subject. Article 7 of the GDPR establishes a consent framework with three basic rules. First, controllers are responsible for demonstrating that the data subject has given consent. Secondly, the data subject has the right to withdraw consent at any time. Finally, consent requests must be explicit.

When a transaction is made on the dataset in the blockchain, the same dataset will be processed by all nodes in the chain. For these reasons, explicit consent is required when downloading blockchains. In most public blockchain systems, a declaration of consent is required for any transaction made to be acceptable to data subjects. This seems difficult according to studies [18]. It has been suggested to use smart contracts to solve this problem [16], [17], [19]. People can download the chain's transaction history outside of the law enforcement regions on the public blockchain. The regional scope of public blockchains is difficult to manage.

A master node, which has a copy of all the data on the blockchain network, can be anywhere in the world, it is very difficult to determine which country the full-function nodes are in or the territorial area of which country's legislation. At this point, questions arise which country's law will apply to blockchain network structures and whether it is possible to apply the law of multiple countries at the same time. In addition, due to the uncertainty of which country's law will apply in case of a personal data breach or other different registration and notification obligations, the fulfillment of these obligations is also a different problem. In addition, it will be very difficult to determine whether the relevant countries are countries with sufficient protection and to fulfill similar obligations due to the difficulty in determining which countries are transferred to. Therefore, the only viable approach is to assume that GDPR always applies in all cases.

2.4 Sentiment Analysis

Sentiment analysis is the field of study in natural language processing that analyzes thoughts, evaluations, and emotions using text analysis, computational linguistics, and biometrics [20]. In sentiment analysis studies, it is questioned and analyzed whether the texts have positive, negative or neutral content. According to the result of this analysis, the attitude of individuals or a certain group about the subject related to the study is determined. In this respect, sentiment analysis can guide businesses on issues such as preliminary market research for a new product to be released, how a decision to be taken for a community will react positively or negatively, and people who will watch the movie decide to watch the movie based on previous comments [21].

There are three levels of classification in sentiment analysis. These levels are document-level, sentence-level, and aspect-level. The purpose of document-level sentiment analysis is to classify an opinion document as expressing a positive or negative opinion or sentiment. It accepts the entire document as a unit of information. The purpose of sentence-level sentiment analysis is to classify the sentiment expressed in each sentence. It is important whether the sentence is subjective or objective. Therefore, it is determined whether the first sentence is subjective or objective. It will be possible to determine whether the sentence expresses a positive or negative opinion.

We can think of sentences as short documents. Therefore, there is no fundamental difference between document-level and sentence-level classifications. The purpose of aspect-level sentiment analysis is to classify sentiment according to certain aspects of entities. Its assets and aspects are defined. For example, people say, "This product is not very useful, but it is cheap." They may have indicated different aspects of an entity in a sentence.

Data sets are important in sentiment analysis [22]. On social networking sites and micro-blogging sites, people can freely share their opinions about a topic. That's why social networking sites and micro-blogging sites are good sources of information. They can also be used as a data source in sentiment analysis.

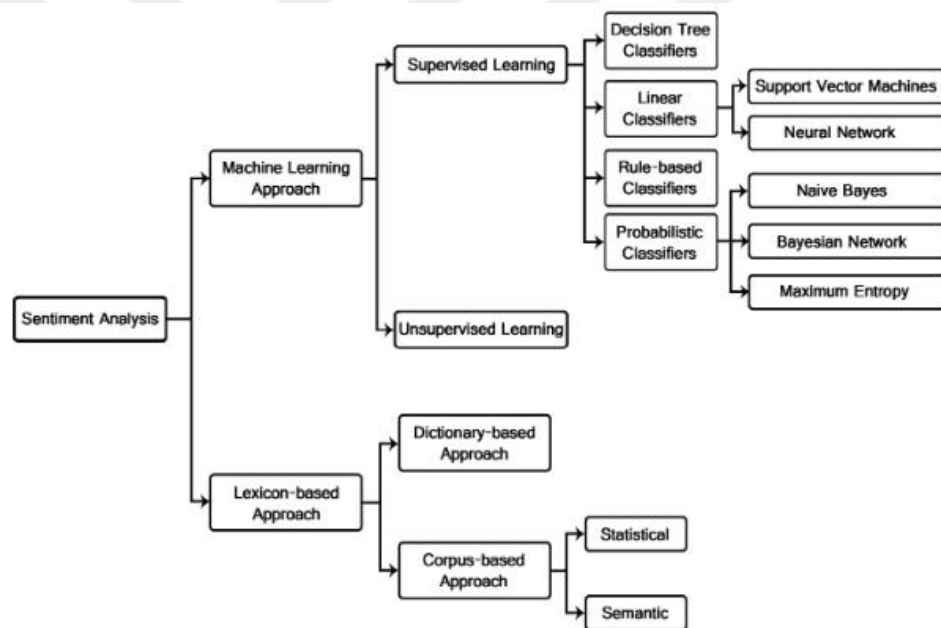


Figure 2. 2 Sentiment Classification Techniques [22]

There are two different approaches to sentiment analysis, one is machine learning and the other is lexicon-based. Since it is difficult to analyze the data one by one, it has become one of the important and studied topics in the fields of text mining and machine learning. While performing sentiment analysis, the data is made suitable for classification by preprocessing and cleaning with text mining methods. These pre-process include cleaning the symbols and punctuation marks in the message,

separating the text into words, creating term lists by finding the roots of each word, removing stop words consisting of prepositions, conjunctions, and pronouns in the text, creating a vector space model with the help of term frequencies and reverse document frequencies. Various methods such as binary, term frequency, inverse document frequency, n-grams are used in vector space models. These data, for which vector space model is created, are trained with the help of classification algorithms such as artificial neural networks, support vector machines, decision trees, which are frequently used in machine learning. For dictionary-based approaches, a sentiment analysis dictionary containing words and their sentiment scores is created. The disadvantage of the dictionary-based approach is that people use the richness of languages such as metaphors, idioms, and proverbs. However, the dictionary-based approach is advantageous in case of data shortages. Because it does not need very large data sets.

2.5 Topic Modelling

In machine learning and natural language processing, the subject model is a type of statistical model. Its purpose is to explore abstract topics that arise in a document. As a text-mining tool, topic modeling reveals hidden semantic structures in a text. Topic modeling provides us with ways to organize, understand, and summarize large collections of textual information. While determining the subject of a document, attention is paid to the fact that the word appears more or less. For example, if there is a document about dogs, words like dog bone will be used more often. Words such as "the", "is" will be ignored as they are in most documents. A document contains multiple topics in varying proportions. Topics identified by topic modeling techniques are similar word sets. A subject model captures this intuition in a mathematical framework; this allows to examine a range of documents and explore based on the statistics of the words in each, what the topics might be, and what the topic balance of each document is.

The topic model detects word frequency and distance between words. The most frequently appearing words and phrases are clustered. Thus, we can easily and quickly understand what each text group is talking about. This approach is unsupervised.

Therefore, no training is required.

Topic Modeling splits a corpus of documents into two. The first is a list of topics covered by the documents in the corpus. The other is a set of several documents from the corpus grouped by the topics they cover. Topic modeling methods attempt to find out what topics are in the compilation's documents. It also tries to find out how powerful this entity is.

Topic modeling algorithm:

- **Latent Semantic Indexing [23]:**

LSI, known as the distribution hypothesis, states that the meanings of words can be understood by looking at the contexts in which they are found. In other words, if the semantics of two words are close to each other, these two words will be similar.

LSI implements fast-cut SVD (Singular Value Parsing). The SVD parsing can be updated at any time with new observations for online, incremental, memory-efficient training. Returns both negative and positive words and topic weights.

The LSI method has solved the synonymy problem [23]. However, it offers only a partial solution to the polysemy problem.

- **Latent Dirichlet Allocation [24]:**

In the LDA model, each document is viewed as a mixture of topics that are present in the corpus. The model proposes that each word in the document is attributable to one of the document's topics. LDA was used as a baseline for comparison among other specialty models. The implementation of LDA provided by the gensim Python library was used. When M quantities of documents containing N-words are entered into the model, one of the outputs is the word frequency per subject represented by ψ . Another ϕ is the distribution of topics for each document, in other words, how relevant that topic is to the document. α is the parameter that indicates how many topics the documents consist of and whether a more specific distribution of topics per document is allowed. The larger the α and the more subjects, the more pronounced the distribution. β is the parameter that shows how many words the topics consist of and allows or does not allow a more specific word distribution per topic. The larger

the beta and the more words, the more pronounced the specific distribution.

2.6 Related Works

Different types of personal data are stored in blockchains. Therefore, whether Blockchain systems are compliant with GDPR is an important issue. Academics and practitioners have said that there may be a conflict between the way blockchains work and some of the GDPR's clauses [25]. Problems arise such as centralization in blockchains, data processing and storage, distribution of data among members of the community or giving data to unknown individuals or organizations, and how to avoid abuse. Possible ways to ensure the compatibility of the GDPR-Blockchain relationship have been explored [26]. Two types of solutions have been proposed to ensure compatibility [26]. First, to provide decentralized verification by keeping the content of transactions confidential. Integrating different cryptographic functions and custom computing schemes into blockchains. Second, blockchains can be used as decentralized verification machines. A data controller must be created that sets how the data will be linked to the blockchains.

Theoretical frameworks and practical suggestions for improving the interrelationships between Blockchain and GDPR were studied [27]. The Delphi method was used. This method helped to show how the relationship was by providing data from industry and policy experts. Private and public keys are used in the blockchain. These keys are considered personal data [27]. For these reasons, privacy impact assessment has been made in the research [27]. It is thought that if data processing information is kept in blockchains, more compliance with GDPR will increase. It turns out that if an active dialogue between blockchain developers and regulatory (data protection specialist) authorities helps to strengthen their mutual understanding and work, blockchains can become more privacy-friendly and regulated.

Companies need to check whether functions such as data storage and data use to comply with the rules set by the GDPR. It is suggested to use a blockchain-based approach to support data accountability and provenance tracking [19]. Two applications were made in this research. One has worked on data that is not constantly

changing. In the other application, dynamic data that constantly changes were studied. Blockchain recommendations are made for scalable problems. The blockchain-based approach relies on the use of publicly auditable contracts placed on a blockchain, and they concluded that it would increase transparency in terms of access and use of data.

In another study [28], data-driven analysis was conducted to understand how public online communications from blockchain developers and service providers on the GDPR see the challenges posed by the blockchain industry and how such communications can affect their users. Data has been collected for analysis. 314 public blockchain systems were taken into account when collecting data. Legal documents such as the privacy policies of the blockchain system, T&C (Terms and Conditions) documents, and other similar legal documents posted on the systems' official websites and public tweets of official Twitter accounts have been collected. As a result of the analysis, it was seen that 86 blockchain systems mentioned GDPR in one or two notification channels. Only 27 out of 86 systems have a legal document covering the GDPR. As a result, it has been acknowledged that the GDPR compliance issue in the blockchain system on why and how it is handled is a systematic lack of detail.

The discussion about GDPR can be analyzed by reviewing tweets on Twitter so that people's views on the GDPR can be learned. Research has been conducted to show the public's interest in GDPR [29]. Data were collected between 25 May - 25 November 2018. Netlytic [30] was used for social media data collection and analysis. Netlytic is a cloud-based tool. All public tweets that were on #GDPR for 6 months were collected. In total, 738,824 tweets and retweets shared by 246,862 different accounts were collected. Social Network Analysis (SNA) approach is used to find popular people on Twitter. Social network analysis (SNA) is the process of investigating social structures using networks and graph theory [31]. Focused on top 100 effective accounts. It has been reported that when examining public opinion on the GDPR and organizational public relations (PR) strategies, it shows that regulation is actively discussed by various stakeholders, especially cyber security and IT-related firms and consultants. However, companies that store or process personal data, government, and regulatory agencies, mainstream media, and academics are less involved than expected to have a

more active role.

The assumption that the in-depth e-mail interview is a reliable data collection method was accepted [32], [33]. In a study [33], it was concluded that when a mixed-mode interview strategy is considered, an e-mail interview can be an alternative to face-to-face and telephone conversations. A list of suggestions is presented for effective e-mail conversations. A study [32] by Hunter et al. was asked to use electronic questionnaires to see patient-reported results in a Sydney clinic. Semi-structured interviews were conducted with 20 patients. Thus, practical issues related to different survey formats can be explored. Mail invitations have been sent. Response rates and costs of the email were also evaluated. As a result, more patients were interviewed via e-mail invitations. It also offered a more cost-effective and practical alternative. It is assumed that the interface is well designed and user-friendly so that the patient can easily answer the questionnaires. While some patients were satisfied with the mail invitation, others felt that an alternative format should be offered.

It was wondered what people think about the protection of their rights. The research was conducted on what people think and feel about GDPR and whether they are interested in this topic in the world or only in Europe [34]. Tweets from 560923 internet users from 61 countries were collected for 8 months. Sentiment analysis was performed using the Polyglot library [35]. Region-by-region feelings were different. While tweets about GDPR increased in early 2018, they decreased afterward. The tweets were initially positive but later turned negative when email notifications were received.

Like the tweets about GDPR, there are also tweets about the Coronavirus. In our study, some people were curious about the sentiment about the coronavirus as we were wondering about the sentiment about GDPR. In some studies, they try to find the emotions of people by finding the emotions in these tweets. In a study [36], sentiment analysis was conducted about how people felt about COVID19 in different countries. Before making the sentiment analysis, preprocessing was done on the tweets. The result of sentiment analysis of tweets was not only shown as positive, negative, and

neutral. Which emotion the tweets contain was found by looking at the results of the Scores of emotions. These emotions are anger, anticipation, disgust, fear, joy, sadness, surprise, trust. NRC Emoticon Lexicon was used to find these emotions. Wordcloud is made for each country. Which emotion the countries contain is shown with a graphic. In another study [37] about the coronavirus, both sentiment analysis and which words were used frequently were investigated. Thus, it was tried to understand the psychology of the users. For word frequency, power-law was modeled with Unigram, bigram, and trigram frequencies. Sum of Squares of Error (SSE), R2, and Mean Squared Error (RMSE) were used to validate the results. Textblob was used for sentiment analysis. It has been observed that most tweets have positive polarity. Incomplete or incorrect information about COVID-19 spread on social media has caused people to worry. In a study [38], they wanted to find the policy that could be applied to social media platforms. The opinions of people who share and interact on Twitter about COVID-19 were analyzed. TextBlob library is used for labeling while analyzing. LDA was used when topic modeling was done.

Research has been done to improve performance in sentiment analysis. In this study [39], a new model was developed by performing sentiment analysis on tweets. First, the data was preprocessed. Emotions have been modified by looking at the emoticon dictionary. The URL and @ ones have been removed. Expressions such as not, no, never, n't are replaced with "not". Duplicates have been removed. Other languages have been translated into English. Stop words have been removed. The prior polarity score of each word was calculated. The score is set as negative if it is less than 0.5 and positive if it is greater than 0.8. They achieved the most accurate results by using Senti-feature and tree kernel.

There is another study [40] that offers an unsupervised method for sentiment analysis. The polarity of the tweets was found using three dictionaries (SenticNet [41], SentiWordNet [42], and SentislangNet [43]). First, preprocessing was done. Links and hashtags have been removed. Words like 'didn't', 'ain't', 'couldn't' are written such as 'did not', 'could not'. A modified version of the Twitter compatible tokenizer by Christopher Potts² has been used to capture all phrases and keep the slang and

abbreviation status. Words written like 'loooooooooove' have been corrected and turned into 'love'. The roots of the word have been found. Before 'not', 'never' etc. An antonym was found using WordNet to replace the words found and replaced with it. After preprocessing, the tweets are normalized and converted to unigrams (four grams, trigrams, bigrams, and unigrams). Then, emotion polarity was determined by using uni-grams to determine the emotion polarity of each tweet.



CHAPTER 3

IMPLEMENTATION

3.1 Web Site Implementation

We needed a web application to collect GDPR information emails from blockchain service providers and developers. For this, we designed and developed two web applications. While coding our first web application, we used React [44] and Cloud Firestore [45], and Hosting [46] provided by Firebase [47]. In our second web application, we used the open-source LimeSurvey [48] codes by purchasing hosting and domains.

3.1.1 Firebase

It is a Cloud-based platform developed by Google that enables user login authorization and data to be kept synchronously and in real-time without the need for the developer to deal with the server-side of web and mobile applications [49]. Firebase, which handles applications such as application management, usage tracking, data storage, sending notification without the need to write an extra server and server-side code, provides separate access for each application equipped with features such as Realtime Database, Notification, Remote Config in its new developer-friendly interface [50].

Firstly we created a project called email to firebase. Then we chose the hosting offered by firebase for free to publish the website.

Firebase also provides many conveniences to users in terms of data security. Thanks to a language (Firebase Rules) defined in the platform, we can limit the access to the database, and we can provide access of each authority to certain data by giving users certain privileges [51].

We determine that all users can read the data in the "Settings" section of the database and save data. The reason we want all users to save data is that we collect data from users.

We record the email contents in the database by making them anonymous.

Table 3. 1 Description of the fields of the table

body (the body part of the mail)
distributed ledger system (a distributed ledger system for which you received a GDPR email)
email (the email address of the person who wants to contact us to ask more questions)
filename (the name of the uploaded email file)
fullname (the name of the person who wants to contact us to ask more questions)
raw (unfragmented version of the uploaded email file)
recipients_emails (recipient's email address)
sender_date (email sent date)
sender_email (sender's email address)
sender_name (sender's name)
subject (subject of the email)

3.1.2 React

React is the most popular JavaScript library for building user interfaces (UI) [52]. It uses a method to render websites that offers great responsiveness to user output. Components of this tool were developed by Facebook. It was released as an open-source JavaScript in 2013. React is a JavaScript library. It can also be classified as a framework. This framework cannot work alone. Additional elements are needed for various purposes such as routing and management. React uses virtual DOM for better page optimization. This framework is easy to use and SEO-friendly. It supports component reusability. It simply uses the JSX extension, which is a great mix of HTML and JavaScript. React uses JSX not because it performs better, but because it makes it easier to write.

Website frontend made with react. It adjusted with reacting to connect to Cloud Firestore. Uploading .eml or .msg files and converting uploaded files to JSON objects was done with react. Validations and business rules are done with react. Actions were taken with reacting to make the received emails anonymous. The e-mail collection system was implemented to automatically remove personal data (e-mail address, name,

IP addresses, etc.) from the e-mail sent.

3.1.3 LimeSurvey

Limesurvey is an online statistical survey web application. Based on MySQL, SQLite, PostgreSQL, or MSSQL database. It is a free and open-source application written in PHP. As a web server-based software, it allows users to use a web interface to develop and publish online surveys, collect responses, generate statistics, and transfer data to other applications [53].

There are two different users in this program. These; admin and participants. The questions or tests prepared by the admin are transferred to the web environment. Then, the participants are reached via the message system. Participants can answer questions on a single page or progressively. The answers given by each participant to the questions are recorded separately in the database. The information saved in the database is evaluated by the admin.

The advantages of the LimeSurvey survey system are many [54]. It allows the participant to participate in the test without distance. It saves time in terms of preparation and presentation. Since the program is simple to set up and the preparation of the survey, it can be prepared easily. Since it has a simple usage, it can be easily applied by the users. Storage of data is easy and safe because it is recorded in the database system. It is very easy to collect and evaluate the results. Results caused by human error are prevented. Thus, the results are better suited to measurement and evaluation rules. Provides a chance to give feedback to the participant. It provides the opportunity to easily apply different assessment and evaluation approaches.

Instead of using the LimeSurvey survey directly, we created a survey website by using its code. We bought hosting and domain names from the goDaddy site. We did not make changes to the code, but we were able to manage it as we wanted.

3.2 Web Site Content

A web survey was created based on the study [55], which showed that one was more likely to respond to a Web survey. You can see the sample screens of the first site in

Appendix D. In the first website, we prepared, first, the purpose of our research was mentioned. Then, since the collected data will be stored under the control of Google (as a data collection platform) in Firebase and on the computers of the research team, the consent form was prepared. The consent form was important to us as we were asking people to send their mail. Other items in the content of the Consent form were as follows; that read and understood the purpose of the research, that understand that participation is voluntary and that are free to withdraw at any time without giving any reason, that responses will be anonymized before analysis, that agrees to take part in the research project. After clicking all the checkboxes in the Consent form, it is allowed to switch to the next page.

After the Consent form was approved, we asked people to enter their full name and email address if they allowed us to contact them for further questions, choose a distributed ledger system where they received a GDPR email, and upload the GDPR related email they received in .eml or .msg format.

We tried to provide more detailed information on the home page of the second website we prepared. You can see the sample screens of the second site in Appendix D. We have written the answers to questions. For example, who are we, what is the purpose of the research, what do we need from you, and how will we store and process your data. By clicking the "Next" button, we asked him to give his consent to participate in this survey and provide us with the information asked on each question.

A consent form was prepared on the second website. The consent form was required for the data collected in the data center in Europe and on the research team's computers. Other articles in the content of the consent form are as follows; Who reads and understands the purpose of the research, understands that participation is voluntary and can be withdrawn at any time without giving any reason, that the answers will be anonymized before analysis, who agrees to take part in the research project.

The questionnaire was prepared. The questions asked to be answered in the questionnaire were;

Email content (please anonymize!)

Name of the cryptocurrency (if not shown in email)

The date it was received (if not shown in email)

Were you aware of the tension between blockchains and GDPR? (e.g., the right to be forgotten cannot be respected)

Did the email help settle your concerns on your rights as defined in GDPR?

Any other comments you want us to know? (free text)

Do you want to add email content for another cryptocurrency?

3.3 Processes made after the website has been prepared

After the first web application was ready, post content was prepared to share on the Forums. Application link has been added to that post. You can find the post in Appendix C.

129 different cryptocurrency forums were found. You can find forum names, links, and actions in Appendix A. We became a member in all forums one by one. Then the post started to be shared on May 8, 2020. It was expected to collect mail for 6 weeks after posting. If emails could be collected, they would only be stored in Firebase and on the research team's computers until the end of the study, and then permanently and securely deleted from all storage areas.

After it was shared to the forums, we couldn't collect emails, so we wanted to make a second reliable website. So we thought that maybe we could gain the trust of people who wouldn't have access to Google data. We have prepared a post similar to the previous post on the second website.

We had the idea to advertise on Twitter. However, because Twitter's advertising process was very detailed and selective, there was a possibility that the survey link would not be published. Therefore, we didn't advertise on Twitter. Then, on November 1, 2020, we started to share in our circle, on Facebook and LinkedIn groups related to Blockchain. You can find the names of these groups and the addresses of their sites in Appendix B. We waited for 3 months to collect the data. However, unexpected reactions were encountered. We could not reach the emails. Nobody wanted to share

the mail. We continued the study by identifying people's attitudes and thoughts towards e-mails sent by companies.

3.4 Data Retrieval

Twitter is one of the most used social networking sites both in our country and around the world. A tweet is a short name given to posts posted by registered users on Twitter. The tweet is limited to 280 characters. In our study, tweets about GDPR notifications were studied. ScrapeHero Cloud was used to collect tweets.

3.4.1 ScrapeHero Cloud

It is a tool for downloading data from the Internet to a spreadsheet using ready-made web browsers or using APIs [56]. From Twitter profiles, hashtags and advanced search results, tweets, content, number of replies, number of retweets, Twitter handle, hashtags and more can be collected.

- Date limitation can be made. Past tweets can be retrieved.
GDPR notification until:2020-01-01 since:2019-01-01.
- A large-scale search can be done. Data can be collected periodically. It gives a list of tweets in the e-table. All tweets from specific Twitter profiles can be collected.
<https://www.twitter.com/Tesla>
- Tweets can be collected from the Twitter hashtag.
#GDPRday#privacy#DataGovernance#GDPR

Tweets were collected in ScrapeHero Cloud using the following keywords.

Table 3. 2 Keywords written into the ScrapeHero Cloud to find tweets

emails notification GDPR
emails updated Privacy Policy
emails notification data legislation
emails notification General Data Protection Regulation
emails updates on GDPR compliance

emails Privacy Policy Has Changed
emails Updating our Terms of Service
emails change privacy policies
emails updated privacy notice
emails notice gdpr

The dataset obtained using keywords written to ScrapeHero Cloud contains 5626 tweets from 4984 user accounts.

3.4.2 Preprocessing

Data preprocessing, some corrections made on the data set, completing the missing data, removing duplicate data, transforming, integrating, cleaning, normalizing, dimension reduction, etc. are transactions. Data-dependent preprocessing may not be required. Sentiment analysis was performed in both ways to understand whether preprocessing should be done. It was decided to perform preprocessing because it gave more accurate results after preprocessing.

- Words were added for emoticons.

Emotions:

:o :/ >:o (: :) >.< XD -__- o.O ;D :-) @_@ :P 8D :l >:(:D =|

For example, happy was added for :) and sad for :(

- Acronyms converted to full words.

Acronyms:

LOL: Laugh out loud

OMG: Oh my god

LMAO: Laughing my a** off

WTF: What the f***?

IDK: I don't know?

TBH: To be honest

BTW: By the way

THX: Thanks

SMH: Shaking my head

FFS: For f***'s sake

IDC: I don't care

ICYMI: In case you missed it

STFU: Shut the f*** up

DGAF: Don't give a f***

YOLO: You only live once

FYI: For your information

GG: Good game

IRL: In real life

- All URLs have been removed.
- Punctuation marks have been removed.
- All words are lowercase.
- Stop words were removed by tokenization.
- It was gathered under a single root by separating the suffixes of a word from its suffixes.

3.5 Sentiment Analysis

For a text to be interpreted emotionally, sentiment analysis is performed. Sentiment analysis is a rapidly growing field. There are several approaches to sentiment analysis. The Lexicon-based approach was one such approach. For dictionary-based approaches, emotion is defined by its semantic orientation and the density of each word in the sentence. This requires a predefined dictionary that classifies negative and positive words. Generally, a text message will be represented by the word bag. After assigning individual scores to all words, the final emotion is calculated by some pooling operation, such as averaging all the emotions [57]. Textblob library written in python language with the lexicon-based approach is used in the study.

3.5.1 TextBlob

TextBlob is a library written for processing textual data [58]. It is written in Python language. TextBlob provides an API. With that API, it can do natural language processing (NLP) tasks such as tagging, noun phrase extraction, sentiment analysis.

The method is written to perform sentiment analysis returns as Sentiment(polarity, subjectivity). The polarity score is in the range of [-1.0, 1.0]. The closer it is to -1, the more negative it is. The closer it is to 1, the positive it is. Subjectivity is between [0.0, 1.0]. It means 0.0 is very objective and 1.0 is very subjective.

To calculate polarity, average polarity is calculated using individual word scores from SentiWordNet. SentiWordNet is a dictionary of lexicon derived from the WordNet database, where each term is associated with numerical scores indicating positive and negative emotion information [59].

In the study, it was investigated in which range the correct results were obtained. If the result of the analysis is less than 0, that tweet is negative, if it is greater than 0.3, that tweet is positive, and if it is between 0 and 0.3, that tweet is neutral.

3.6 Topic Modelling

Topic modeling is text mining that explores semantic links within texts [60]. Thanks to topic modeling, a mass source is made understandable as collections of texts and large collections of these texts. Thus, people can have information about the subject of more resources in a shorter time.

Working principle

While subject modeling, word groups called topics are found in a text document in an unsupervised manner. The properties of these topics are that they often occur together in the text and usually consist of words that share a common or similar theme. Thus, with a predefined set of words, these topics can be used as phrases to best describe the entire document. In topic modeling, a collection of texts is taken as input, which has no numerical upper limit on the texts taken as input. Topic modeling algorithms are important in that they can list the documents in which similar or synonymous ones are mentioned for any term. Latent Dirichlet Allocation (LDA) algorithm, which is one of the probabilistic subject modeling approaches, also allows the calculation of query-document, subject-document, subject-query, and document-document similarities in

information retrieval systems, and thus, relevance rankings are created [60]. We used LDA for topic modeling in our study.

3.6.1 Latent Dirichlet Allocation (LDA)

LDA is a probabilistic model that assumes that every document has a topic and every topic is a set of words [61]. LDA is a model that is frequently used to capture the set of latent topics over documents within a corpus.

LDA was used as a baseline for comparison among other specialty models – the implementation of LDA provided by the gensim Python library was used.

LDA Implementation

We used the LDA algorithm in Python for topic modeling.

- **Loading data**

After performing sentiment analysis, we divided the dataset we have into three as positive, negative, and neutral. We then converted the split datasets to CSV files

- **Data cleaning**

Content, hashtag, and sentiment columns for topic modeling remained. Other columns have been removed. For analysis and reliable results, punctuation has been removed from the content of the content column and then tweets have been converted to lowercase. URLs are also removed

- **Exploratory analysis**

A visual representation of the most common words is obtained with the word cloud. Wordcloud package can be used to create a word cloud. A word cloud was created to check if the pre-processing of the tweets was sufficient. Thus, it was decided that the preprocessing was sufficient.

CHAPTER 4

RESULTS

4.1 Survey Results

We sent posts for each of 129 cryptocurrencies. Looking at the forums of cryptocurrencies, it was found that 8 of them do not have forums. This is why no posts were posted for 8 of them. 181 forum links were found, but 33 of them could not be posted. The reason why the post could not be posted was that 14 of them did not have permission to post, 16 of them were waiting for approval, 1 of them failed to activate email, 1 of them did not allow primary email, and 1 of them threw an error because the database connection could not be established while posting. The reactions to the post after 6 weeks are listed below.

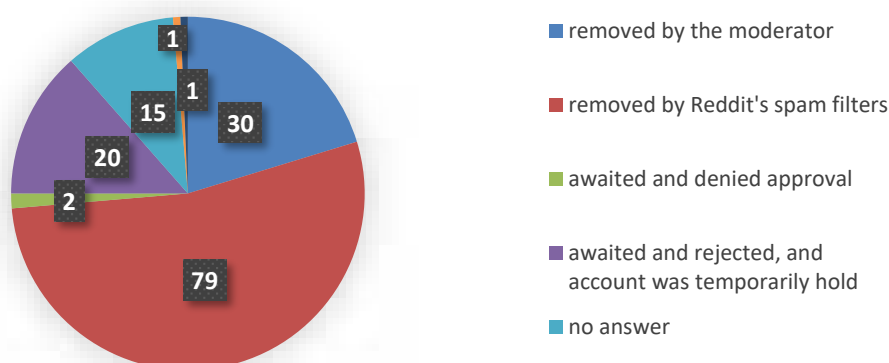


Figure 4. 1 Total number of reactions from forum administrators and users

We posted to in 148 forum links. We had different reactions from people. 30 posts were removed by moderators, 79 posts were removed by Reddit's spam filters, 2 posts were awaited and denied approval, 20 posts were awaited and rejected, and the account was temporarily held, 15 posts were not answered, 1 post was commented and after 1 post was posted, the permission to view the site was removed.

As seen in the reactions, nobody wanted to share their mail. People were not reached enough, perhaps because moderators or filtering removed the post immediately.

Studies such as [63] , [64] try to reach wider audiences by sharing their surveys on

social networks such as LinkedIn and Facebook. When we could not collect mail, we shared the link of the second website on Facebook and LinkedIn groups related to the Blockchain and in our environment. LinkedIn was shared in 4 groups and 57 groups on Facebook. Only 35 people took part in the survey. 8 people completed the survey. 27 people left without completing the survey. Only 4 people shared the email they received. When looking at the survey statistics, it is seen that 27 people accepted the consent form. Most people close the survey when they see the survey questions after they approve the consent form.

When we look at the e-mails sent, one of them was sent by The Coinbase Team. They explained that they have new policies in the mail content and that this policy applies to Coinbase customers and that all customers will have the ability to access, modify and make other requests, and how they share information with organizations and service providers to provide a safe, reliable and customized customer experience. They asked them to read the policy.

An email was sent by CEX.IO in the content of the mail answered in the other survey. Users who have made changes to the Privacy Policy and Terms of Use are asked to accept this. The changes made are as follows; The types of personal data to be collected and how to use them, information processing, sharing information with third parties, your rights associated with your data, and storing your data.

An email was sent by Team Poloniex in the content of the mail answered in the other survey. Poloniex User Agreement has been updated. The changes to the contract are designed to provide more clarity and certainty surrounding your use of Poloniex services. Polo Digital Assets, Ltd. will continue to process your personal information for the purposes for which you provided it or as otherwise set out in its privacy policy.

To summarize, in general, privacy policies have been updated and users have been informed about their rights.

4.2 Results of Sentiment Analysis and Topic Modelling

We obtained the sentiment analysis results in two ways is that one with preprocessing and the other without preprocessing.

Table 4. 1 Result of sentiment analysis without preprocessing

Sentiment	Number of Tweets
Negative	1205
Neutral	1832
Positive	2589

After sentiment analysis without preprocessing, 1205 tweets were negative, 1832 tweets were neutral, and 2589 tweets were positive.

Table 4. 2 Result of sentiment analysis after preprocessing

Sentiment	Number of Tweets
Negative	1204
Neutral	3622
Positive	800

When preprocessed before sentiment analysis, 1204 tweets were negative, 3622 tweets were neutral, and 800 tweets were positive.

Very different results were obtained by preprocessing. The sentiments of the tweets were checked so that a decision could be made on whether to pre-process. Sentiments found without preprocessing were more positively marked. However, those tweets did not contain emotion. Therefore, it was decided to pre-process it. It was observed that the number of positives decreased and the number of neutrals increased after preprocessing. The number of negatives also increased, but not by much.

Table 4. 3 Confusion Matrix

	True Class			
		Negative	Neutral	Positive
	Negative	1199	3	2
	Neutral	865	2478	279
	Positive	72	84	644

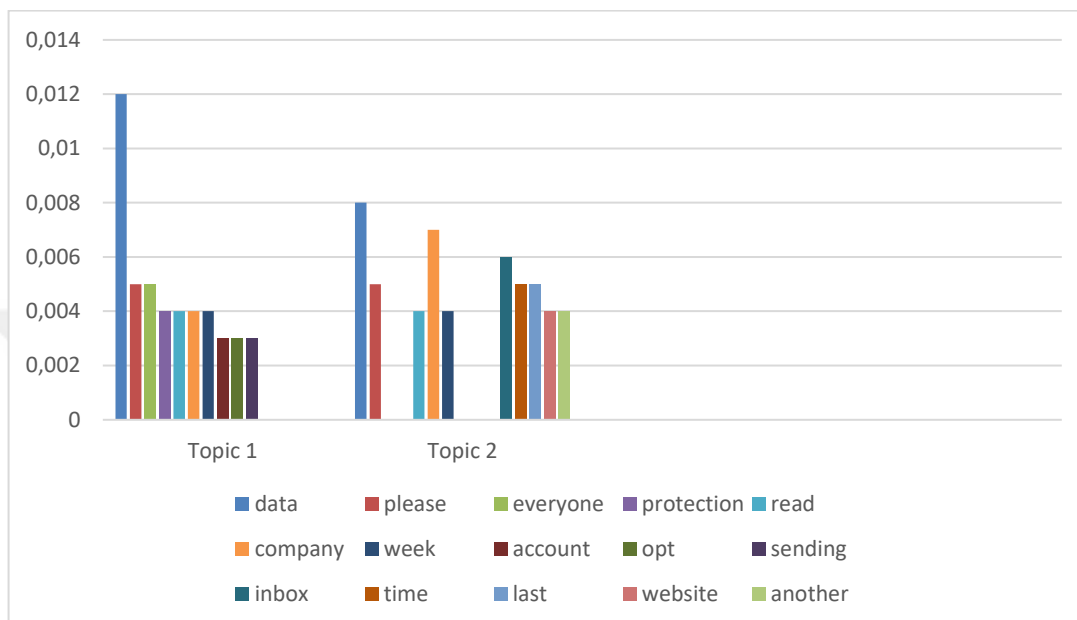
We calculated the accuracy rate. The accuracy rate is 0.78. The accuracy rate of the clustering-based approach is about 77% and taking into account its advantage in terms of low cost and effectiveness, this accuracy rate is acceptable [65].

Afterward, a topic modeling was made for which emotion and which topics were discussed. We calculated the coherence score to determine the number of topics. The coherence score helps to different topics that are semantically interpretable and topics that are artifacts of statistical inference. The number of topics is decided by evaluating the Coherence Score between topics inferred by the model. We determined the number of topics according to the highest score. The following are topics with the ten words in each of the topics along with their respective weights.

When the topic number of neutral tweets was selected as 2, the coherence score was 0.304. We chose the topic number as 2 because this topic number has the highest coherence score.

Table 4. 4 Neutral Tweets Topics

Topic number	Description of extracted topics
Topic 1:	Update notifications about GDPR are sent to emails.
Topic 2:	Users need to approve the privacy policy sent to their emails.

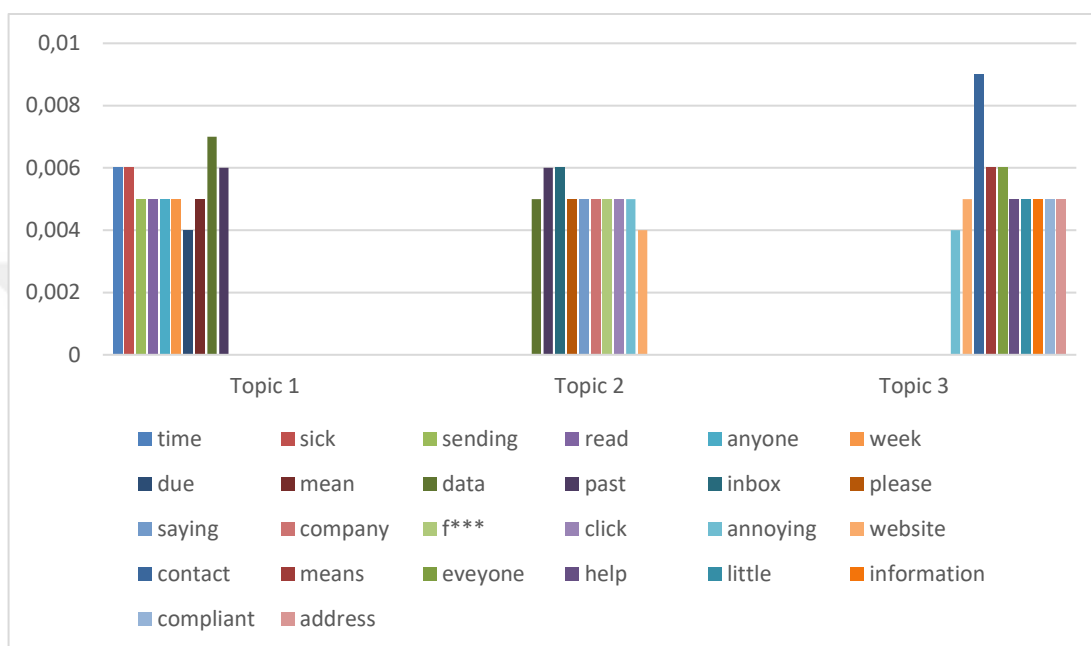
**Figure 4. 2** The words in the neutral tweets topics and the weight of those words

The list of the extracted neutral tweets topics is shown in Table 4.4. In Figure 4.2, each topic is the most common word and the weight each word adds to the topic. As can be seen in the table, the topic of neutral sentimental tweets is usually tweeted that are sent to inform people. These tweets are usually sent by companies, digital markets, and lawyers.

When the topic number of negative tweets was selected as 3, the coherence score was 0.445. We chose the topic number as 3 because this topic number has the highest coherence score.

Table 4. 5 Negative Tweets Topics

Topic number	Description of extracted topics
Topic 1:	Getting too many emails
Topic 2:	Companies sending notifications repeatedly
Topic 3:	Some companies do not provide enough information about GDPR

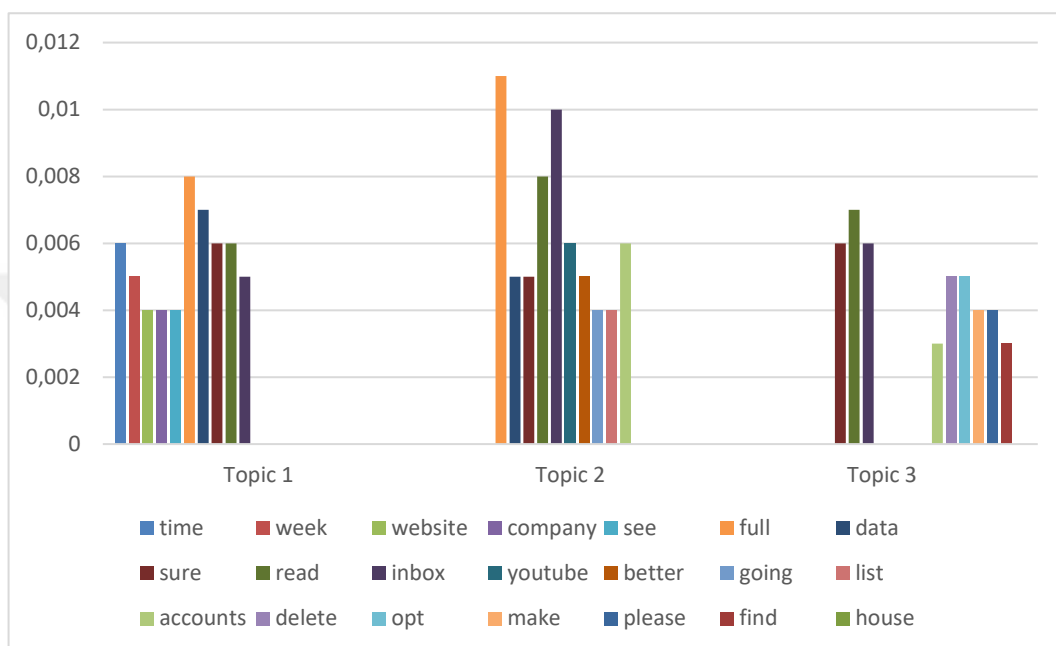
**Figure 4. 3** The words in the negative tweets topics and the weight of those words

The list of the extracted negative tweets topics is shown in Table 4.5. In Figure 4.3, each topic is the most common word and the weight each word adds to the topic. As can be seen from the table, the topic of negative sentiment tweets is usually about people getting tired of receiving too many notification emails, companies sent notifications repeatedly and some companies do not provide enough information about GDPR. These tweets were usually posted by everyone.

When the topic number of positive tweets was selected as 3, the coherence score was 0.504. We chose the topic number as 3 because this topic number has the highest coherence score.

Table 4. 6 Positive Tweets Topics

Topic number	Description of extracted topics
Topic 1:	Liking the news about GDPR
Topic 2:	Updating Youtube privacy policy
Topic 3:	Remembering and deleting unused or forgotten accounts

**Figure 4. 4** The words in the positive tweets topics and the weight of those words

The list of the extracted positive tweets topics is shown in Table 4.6. In Figure 4.4, each topic is the most common word and the weight each word adds to the topic. As can be seen from the table, the topic of positive tweets is usually the news published in March 2018, when the GDPR is newly accepted, companies send notifications, and forgotten accounts remember. As seen in the tweets posted by the companies, they seemed happy to send the privacy policy update notifications to the users. Users also seem happy that they can remember the accounts they forgot and delete their accounts.

CHAPTER 5

CONCLUSION AND FUTURE WORK

After the GDPR came into force on 25 May 2018, a lot of work started to be done on blockchain systems. Since personal data are also stored in blockchain systems, Blockchain system users had to inform whether it is compatible with gdpr or not. The email was sent for information. Our goal was to examine these emails to better understand how blockchain service providers and developers communicate the GDPR to their users via email, and how their users perceive the GDPR and such email communications. We posted to on forums to reach these emails. All emails received would be anonymized to remove any personal data that could potentially identify people. However, unexpected reactions were encountered. We could not reach the emails. Nobody wanted to share the mail. Maybe it's because we're new to the forums and people don't trust us enough. Another reason could be that people did not see posts, perhaps because moderators or filtering removed the post immediately. For this reason, we made a more reliable website. We shared in our circle, on Facebook and LinkedIn groups related to Blockchain. Again, we could not achieve the result we wanted. These notification e-mail requests were not welcomed by system administrators and ignored by users. This situation has been interpreted as the GDPR compliance process in this sector is immature, the systems are faced with resistance and the users do not have sufficient awareness. Since we could not collect enough data from the survey, we wanted to investigate whether the tweets about GDPR notification emails on Twitter were positive, negative, or neutral. The data set was prepared by collecting tweets using keywords. Sentiment analysis was performed with this data set. Thus, it was found out what emotion the tweets contained. Then, positive, negative, and neutral tweets were grouped separately. Topic modeling was done for each group. Neutral sentiment tweets were often informative tweets. Negative tweets were complaints about too many notifications. Positive tweets were that companies are happy to send notification emails and users can remember forgotten accounts and delete them. With this study, a perspective is presented for companies and researchers who will work on this subject.

In future work, it will be to find popular people related to Blockchain on Twitter and

ask them to share the link we have made by contacting them. Thus, more data will be reached and we will be able to do analysis.



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APPENDICES

Appendix A – Forum Link

Appendix B – Groups Names of Linkedin and Facebook

Appendix C – The Post Content

Appendix D – Examples of Web Page



Appendix A – Forum Link

Table A. 1 Forum Link

Name	Forum Link	Action	Reaction
1-Bitcoin (BTC)	https://bitcointalk.org/index.php?action=pm	Post	removed by the moderator
	https://bitcoin.stackexchange.com/questions/96168/gdpr-notification-emails	Post	removed by the moderator
	https://www.reddit.com/r/Bitcoin/comments/gqh2nm/gdpr/	Post	removed by the moderator (comments: action1.PNG)
	https://www.reddit.com/r/gdpr/comments/gqhsst/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/BitcoinMarkets/comments/gqih0e/gdpr_notification_emails/	Post	awaiting approval for post
2-Ethereum (ETH)	https://ethereum.stackexchange.com/questions/83716/gdpr-notification-emails	Post	removed by the moderator
	https://ethereum-magicians.org/t/dapplets-rethinking-dapp-architecture-for-better-adoption-and-security/2799	Post	awaiting approval for post and not accepted and Account temporarily on hold
	https://www.reddit.com/r/ethfinance/comments/gqixox/gdpr_notification_emails/	Post	removed by the moderator
	https://www.reddit.com/r/ethdev/comments/gqiyc5/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/ethtrader/comments/gqiyvs/gdpr_notification_emails/	Post	removed by Reddit's spam filters
3-XRP	https://www.xrpchat.com/topic/34820-gdpr-notification-emails/	Post	banned (do not have permission to view this site)
	https://www.reddit.com/r/Ripple/comments/gqjfv0/gdpr_notification_emails/	Post	removed by the moderator
	https://www.reddit.com/r/XRP/comments/gqjhtr/gdpr_notification_emails/	Post	removed by the moderator
4-Tether (USDT)	https://www.reddit.com/r/Tether/comments/gqjgl0/gdpr_notification_emails/	Post	removed by the moderator
5-Bitcoin Cash (BCH)	https://bitcointalk.org/index.php?topic=2040221.new#new	Post	awaiting approval for post and not accepted
	https://www.reddit.com/r/BitcoinCash/comments/gqjh9v/gdpr_notification_emails/	Post	removed by Reddit's spam filters
6-Chainlink (LINK)	https://www.reddit.com/r/Chainlink/comments/gu7xnt/gdpr_notification_emails/	Post	removed by the moderator
7-Litecoin (LTC)	https://litecointalk.io/t/mimblewimble-progress-update-thread/26678	Post	awaiting approval for post and not accepted and Account temporarily on hold
	https://www.reddit.com/r/litecoin/	Post	removed by the moderator
	https://www.reddit.com/r/LitecoinProjects/comments/gqjimpw/gdpr_notification_emails/	Post	removed by Reddit's spam filters
8-Bitcoin SV (BSV)	https://www.reddit.com/r/bitcoinsv/comments/gqjj3r/gdpr_notification_emails/	Post	removed by reddit's spam filters
9-Crypto.com Coin (CRO)	https://www.reddit.com/r/CryptoCurrency/comments/gu85t2/gdpr_notification_emails/	Post	removed by the moderator
	https://www.reddit.com/r/CryptoCurrencies/comments/gu86d9/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/Crypto_com/comments/ho70mu/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://discord.com/channels/372888022452011008/372888022452011010	Post	no answer
10-Binance Coin (BNB)	https://www.reddit.com/r/binancealtcoins/comments/gqjsbd/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/binance/comments/gqjsoi/gdpr_notification_emails/	Post	removed by the moderator
	https://www.reddit.com/r/BinanceExchange/comments/gqjtju/gdpr_notification_emails/	Post	removed by the moderator
11-Cardano (ADA)	https://forum.cardano.org/c/education/17?order=views	Post	awaiting approval for post and not accepted and Account temporarily on hold
	https://www.reddit.com/r/cardano/comments/gu7uf4/gdpr_notification_emails/	Post	awaiting approval for post

12-EOS	https://www.reddit.com/r/eos/comments/gqjui2/gdpr_notification_emails/	Post	removed by Reddit's spam filters
13-Tezos (XTZ)	https://tezos.stackexchange.com/questions/2796/gdpr-email-notification	Post	removed by the moderator
	https://www.reddit.com/r/tezostrader/comments/gqjy7z/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://forum.tezosagora.org/top/quarterly	Post	awaiting approval for post and not accepted and Account temporarily on hold
14-Stellar (XLM)	https://www.reddit.com/r/Stellar/comments/gu8024/gdpr_notification_emails/	Post	removed by the moderator
	https://galactictalk.org/d/2384-gdpr-notification-emails	Post	no answer
15-TRON (TRX)	https://www.reddit.com/r/tron/comments/gu8g9q/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/Tronix/comments/igudcs/gdpr_email_notification/	Post	removed by Reddit's spam filters
16-Cosmos (ATOM)	https://www.reddit.com/r/Cosmos/comments/hnbzky/gdpr/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/cosmosnetwork/comments/igunxh/gdpr_email_notification/	Post	one comment (comment: action2.PNG)
	https://forum.cosmos.network/t/account-temporarily-on-hold/3924	Post	awaiting approval for post and not accepted and Account temporarily on hold
17-Monero (XMR)	https://forum.getmonero.org/register	Post	Your IP address has been blacklisted as spam.
	https://www.reddit.com/r/Monero/comments/gu8dcw/gdpr_notification_emails/	Post	awaiting approval for post
	https://www.reddit.com/r/MoneroMining/comments/gu8dwf/gdpr_notification_emails/	Post	removed by the moderator
	https://forum.cosmos.network/t/list-of-projects-in-cosmos-tendermint-ecosystem/243	Not post	
18-USD Coin (USDC)	https://discord.com/channels/473781666251538452/473781666251538454	Not post	
	https://www.reddit.com/r/USDC/comments/ih78bq/gdpr_email_notification/	Post	removed by Reddit's spam filters
19-UNUS SED LEO (LEO)	https://www.reddit.com/r/bitfinex/comments/gu8fmp/gdpr_notification_emails/	Post	removed by the moderator
20-Neo	https://www.reddit.com/r/NEO/comments/gu8jjh/gdpr_notification_emails/	Post	removed by the moderator
	https://community.o3.network/	Post	awaiting approval for post and not accepted and Account temporarily on hold
21-Aave (LEND)	https://www.reddit.com/r/Aave_Official/comments/hng96u/gdpr_notification_emails/	Post	removed by Reddit's spam filters
22-Huobi Token (HT)	https://www.reddit.com/r/HuobiGlobal/comments/ih7z0c/gdpr_email_notification/	Post	removed by Reddit's spam filters
23-IOTA (MIOTA)	https://www.reddit.com/r/Iota/comments/hnbnmt/gdpr_notification_emails/	Post	removed by the moderator
24-VeChain (VET)	https://www.reddit.com/r/Vechain/comments/hnd5ha/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://gitter.im/vechain/thor#	Not post	
25-NEM (XEM)	https://forum.nem.io/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/nem/comments/hnedup/gdpr_notification_emails/	Post	removed by Reddit's spam filters
26-Dash	https://www.reddit.com/r/dashpay/comments/ih8vq8/gdpr_email_notification/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/dash/comments/hnbtbm/gdpr/	Post	removed by Reddit's spam filters
27-OMG Network (OMG)	https://www.reddit.com/r/OMGnetwork/comments/ih9gf8/gdpr_email_notification/	Post	removed by Reddit's spam filters
28-Ethereum Classic (ETC)	https://www.reddit.com/r/EthereumClassic/comments/gu8j1j/gdpr_notification_emails/	Post	removed by the moderator
29-Zcash (ZEC)	https://www.reddit.com/r/zec/comments/ih9pqo/gdpr_email_notification/	Post	removed by Reddit's spam filters
	https://forum.zcashcommunity.com/t/account-temporarily-on-hold/36783	Post	awaiting approval for post and not accepted and Account temporarily on hold
30-Maker (MKR)	https://forum.makerdao.com/top/monthly	Not post	

	https://www.reddit.com/r/MakerDAO/comments/hnco7o/gdpr_notification_emails/	Post	removed by Reddit's spam filters
31-Ontology (ONT)	https://www.reddit.com/r/OntologyNetwork/comments/hne7sq/gdpr_notification_emails/	Post	removed by Reddit's spam filters
32-Synthetix Network Token (SNX)	https://www.reddit.com/r/synthetix_io/comments/hnglga/gdpr_notification_emails/	Post	removed by Reddit's spam filters
33-Celo	https://forum.celo.org/	Post	awaiting approval for post and not accepted and Account temporarily on hold
	https://www.reddit.com/r/celo/comments/ihg4j1/gdpr_email_notification/	Post	removed by Reddit's spam filters
34-Basic Attention Token (BAT)	https://www.reddit.com/r/BATProject/comments/ihgets/gdpr_email_notification/	Post	removed by Reddit's spam filters
35-HedgeTrade (HEDG)	https://www.reddit.com/r/HedgeTrade/comments/hncx46/gdpr_notification_emails/	Post	removed by the moderator
36-0x (ZRX)	https://www.reddit.com/r/0xbitcoin/comments/hnekdu/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/0xProject/comments/ihgoo2/gdpr_email_notification/	Post	removed by Reddit's spam filters
	https://forum.0x.org/t/looking-for-help/328/10	Post	awaiting approval for post and not accepted and Account temporarily on hold
37-yearn.finance (YFI)	https://www.reddit.com/r/yearnfinance/comments/ihh2nq/gdpr_email_notification/	Post	removed by Reddit's spam filters
38-Compound (COMP)	https://www.reddit.com/r/Compound/comments/hncem5/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://www.comp.xyz/latest	Post	awaiting approval for post and not accepted and Account temporarily on hold
39-Dai	https://forum.makerdao.com/t/account-temporarily-on-hold/3125	Post	awaiting approval for post and not accepted and Account temporarily on hold
40-THETA	https://www.reddit.com/r/thetadoken/comments/ho9bl7/gdpr_notification_emails/	Post	removed by Reddit's spam filters
41-Algorand (ALGO)	https://www.reddit.com/r/AlgorandOfficial/comments/hnhyi5/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://forum.algorand.org/t/betanet-update-version-2-1-0/1898	Post	awaiting approval for post and not accepted and Account temporarily on hold
42-Dogecoin (DOGE)	https://www.reddit.com/r/dogecoin/comments/hnc84t/gdpr_notification_emails/	Post	removed by Reddit's spam filters
43-BitTorrent (BTT)	https://forum.bittorrent.com/topic/53335-gdpr-notification-emails/	Not post	
	https://www.reddit.com/r/Bittorrent/comments/ho4kdz/gdpr_notification_emails/	Post	removed by the moderator
44-Ren (REN)	https://www.reddit.com/r/RenProject/comments/iuu7pd/gdpr_email_notification/	Post	removed by Reddit's spam filters
45-DigiByte (DGB)	https://www.reddit.com/r/Digibyte/comments/hnfpqm/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://dgbforum.com/forums/	Not post	
46-TrueUSD (TUSD)	https://www.reddit.com/r/TrustToken/	Not post	awaiting approval for post
47-UMA			
48-Qtum	https://www.reddit.com/r/Qtum/comments/hnxx55/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://bitcointalk.org/index.php?topic=1720632.8888	Not post	
49-ICON (ICX)	https://www.reddit.com/r/icon/comments/hnfhq/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/helloicon/comments/iuuwp4/gdpr_email_notification/	Post	removed by the moderator
50-Energy Web Token (EWT)	https://www.reddit.com/r/EnergyWeb/comments/iiv6vs/gdpr_email_notification_by_blockchain_service/	Post	removed by Reddit's spam filter
51-FTX Token (FTT)	https://www.reddit.com/r/FTXToken/comments/hng1f7/gdpr_notification_emails/	Post	removed by the moderators
52-OKB (OKB)	https://www.reddit.com/r/OKEx/comments/hnf199/gdpr_notification_emails/	Post	removed by Reddit's spam filters

53-Waves	https://www.reddit.com/r/Waves/submit?draft=bb465fc2-c1c4-11ea-b1c0-222db3135fc5	Not post	awaiting approval for post
	https://www.reddit.com/r/Wavesplatform/comments/ho03le/gdpr_notification_emails/	Post	removed by Reddit's spam filters
54-Hyperion (HYN)	https://talk.hyn.space/	Not post	can not activate email
55-Kyber Network (KNC)	https://www.reddit.com/r/kybernetwork/comments/hnf933/gdpr_notification_emails/	Post	removed by Reddit's spam filters
56-Aragon (ANT)	https://forum.aragon.org/t/account-temporarily-on-hold/2290	Post	awaiting approval for post and not accepted and Account temporarily on hold
57-Band Protocol (BAND)	https://www.reddit.com/r/bandprotocol/comments/ijeylp/gdpr_email_notification/	Post	no answer
58-Kusama (KSM)	https://www.reddit.com/r/Kusama/comments/ijfadx/gdpr_email_notification/	Post	no answer
59-Ampleforth (AMPL)	https://www.ampltalk.org/app/	Not post	
60-Elrond (ERD)	https://www.reddit.com/r/elrondnetwork/comments/ho1u2f/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://forum.elrond.com/topic/528-gdpr-notification-emails/		
61-Loopring (LRC)	https://www.reddit.com/r/loopring/submit?draft=c29d841e-c1d6-11ea-a80e-6e2e7fce816e	Not post	awaiting approval for post
	https://www.reddit.com/r/loopringorg/comments/ho1f71/gdpr_notification_emails/	Post	removed by Reddit's spam filters
62-Paxos Standard (PAX)	https://www.reddit.com/r/PaxosStandardToken/submit	Not post	awaiting approval for post
63-Augur (REP)	https://www.reddit.com/r/Augur/comments/hnh5mb/gdpr_notification_emails/	Post	removed by Reddit's spam filters
64-Hedera Hashgraph (HBAR)	https://www.reddit.com/r/Hedera/comments/hnhp1t/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/hashgraph/comments/ijfjji/gdpr_email_notification/	Post	no answer
65-Balancer (BAL)	https://forum.balancer.finance/	Post	awaiting approval for post and not accepted and Account temporarily on hold
66-Ocean Protocol (OCEAN)	https://discord.com/invite/TnXjkr5	Not post	
67-Flexacoin (FXC)	https://www.reddit.com/r/Flexacoin/submit?draft=b860ef88-c1d4-11ea-893b-5e0c3e0b91de	Not post	awaiting approval for post
68-Zilliqa (ZIL)	https://www.reddit.com/r/zilliqa/comments/hnhe5d/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://revain.org/projects/zilliqa#81943982-0334-48b0-b0b4-674c7b74377f	Not post	
69-Lisk (LSK)	https://www.reddit.com/r/Lisk/comments/hnzbbh/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://research.lisk.io/	Post	awaiting approval for post and not accepted and Account temporarily on hold
70-Swipe (SXP)	https://www.reddit.com/r/Swipe_io/comments/ijg289/gdpr_email_notification/	Post	no answer
71-Terra (LUNA)	https://discord.com/invite/bYfyhUT	Not post	
72-Decred (DCR)	https://www.reddit.com/r/decred/comments/hni9ia/gdpr_notification_emails/	Post	removed by the moderator
73-Siacoin (SC)	https://www.reddit.com/r/siacoin/comments/hnyn55/gdpr_notification_emails/	Post	removed by the moderator
74-Binance USD (BUSD)	https://www.reddit.com/r/BinanceExchange/comments/hnya8l/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://www.reddit.com/r/binance/comments/ijgcl4/gdpr_email_notification/	Post	no answer
75-bZx Protocol (BZRX)			
76-Bitcoin Gold (BTG)	https://forum.bitcoingold.org/top/yearly	Not post	Primary email is not allowed.
	https://www.reddit.com/r/BitcoinGoldHQ/comments/hnygev/gdpr_notification_emails/	Post	removed by Reddit's spam filters
77-Enjin Coin (ENJ)	https://forum.enjin.io/d/112-gdpr-notification-emails	Post	awaiting approval for post and not accepted and Account temporarily on hold
	https://www.reddit.com/r/EnjinCoin/comments/hnyu8n/gdpr_notification_emails/	Post	removed by the moderator

78-Reserve Rights (RSR)	https://www.reddit.com/r/ReserveProtocol/submit?draft=093fe43a-c217-11ea-83fc-b6acddde95d5	Not post	awaiting approval for post
79-THORChain (RUNE)	https://www.reddit.com/r/THORChain/comments/ijgmse/gdpr_email_notification/	Post	no answer
80-Bitcoin Diamond (BCD)	https://www.reddit.com/r/BitcoinDiamond/submit	Not post	awaiting approval for post
	https://bbs.btc.d.io/%20	Not post	Error establishing a database connection
81-Ravencoin (RVN)	https://www.reddit.com/r/Ravencoin/comments/hnzxhq/gdpr_notification_emails/	Post	removed by the moderator
	https://bitcointalk.org/index.php?topic=3238497	Not post	
82-Nano	https://www.reddit.com/r/nanocurrency/comments/hnzi6p/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://forum.nano.org/t/nano-slogan/401/3	Post	awaiting approval for post and not accepted and Account temporarily on hold
83-Numeraire (NMR)	https://www.reddit.com/r/numeraire/submit?draft=3e1a5132-c225-11ea-85eb-7a2468c95b0f	Not Post	awaiting approval for post
	https://forum.numer.ai/	Post	awaiting approval for post and not accepted and Account temporarily on hold
84-Decentraland (MANA)	https://www.reddit.com/r/decentraland/comments/hobxrx/gdpr_notification_emails/	Post	removed by Reddit's spam filters
85-Solana (SOL)	https://www.reddit.com/r/solana/comments/ijh26x/gdpr_email_notification/	Post	no answer
	https://forums.solana.com/t/gdpr-notification-emails/799	Post	awaiting approval for post and not accepted
86-Kava.io (KAVA)			
87-Blockstack (STX)	https://www.reddit.com/r/blockstack/comments/ho5tuj/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://forum.blockstack.org/search?q=gdpr	Post	awaiting approval for post and not accepted and Account temporarily on hold
88-Bytom (BTM)	https://www.reddit.com/r/Bytom_official/submit?draft=9f6b359e-c1e1-11ea-bb19-72944b253e9b	Not post	awaiting approval for post
89-DFI.Money (YFI)			
90-Nervos Network (CKB)	https://www.reddit.com/r/NervosNetwork/comments/ho1me7/gdpr_notification_emails/	Post	removed by Reddit's spam filters
	https://talk.nervos.org/t/aikon-creating-identities-on-nervos/4384/9	Post	no answer
91-Golem (GNT)	https://www.reddit.com/r/GolemProject/comments/ijhskt/gdpr_email_notification/	Post	no answer
92-Status (SNT)	https://discuss.status.im/t/status-app-privacy-policy-refresh/1762/5	Post	awaiting approval for post and not accepted and Account temporarily on hold
	https://www.reddit.com/r/statusim/comments/iji2fe/gdpr_email_notification/	Post	no answer
93-JUST (JST)			
94-Serum (SRM)			
95-HUSD			
96-Bancor (BNT)			
97-Storj	https://www.reddit.com/r/storj/comments/ijidr7/gdpr_email_notification/	Post	no answer
98-iExec RLC (RLC)	https://www.reddit.com/r/iexec/comments/ho4z38/gdpr_notification_emails/	Post	removed by Reddit's spam filters
99-Holo (HOT)	https://forum.holo.host/	Not post	
	https://www.reddit.com/r/holochain/comments/ijiny3/gdpr_email_notification/	Post	no answer
100-ZB Token (ZB)	https://www.reddit.com/r/ZBExchange/comments/ijj06k/gdpr_email_notification/	Post	no answer
101-Divi	https://forum.diviproject.org/top/yearly	Not post	
	https://www.reddit.com/r/divi/comments/ho3cvi/gdpr_notification_emails/	Post	removed by Reddit's spam filters
102-OmiseGO	https://www.reddit.com/r/omise_go/comments/hngw21/gdpr_notification_emails/	Post	removed by Reddit's spam filters

103-maticnetwork	https://www.reddit.com/r/maticnetwork/comments/ho5ihn/gdpr_notification_emails/	Post	removed by Reddit's spam filters
104-SwissBorg	https://www.reddit.com/r/swissborg/comments/ho81v9/gdpr_notification_emails/	Post	removed by Reddit's spam filters
105-MonaCoin	https://www.reddit.com/r/monacoin/comments/ho0yvo/gdpr_notification_emails/	Post	removed by Reddit's spam filters
106-Electroneum	https://www.reddit.com/r/Electroneum/comments/hoa7p3/gdpr_notification_emails/	Post	removed by Reddit's spam filters
107-ZBExchange	https://www.reddit.com/r/ZBExchange/comments/ho24sp/gdpr_notification_emails/	Post	removed by Reddit's spam filters
108-KuCoin Shares	https://www.reddit.com/r/kucoin/comments/ho7m4l/gdpr_notification_emails/	Post	removed by Reddit's spam filters
109-Steem	https://www.reddit.com/r/steemit/comments/ho3z3z/gdpr_notification_emails/	Post	removed by Reddit's spam filters
110-DxChain Token	https://www.reddit.com/r/DxChain/submit?draft=76d51e1c-c1da-11ea-bdb8-4667295b57b1	Post	awaiting approval for post
111-Komodo	https://www.reddit.com/r/komodoplatform/comments/ho4awm/gdpr_notification_emails/	Post	removed by Reddit's spam filters
112-Energi	https://www.reddit.com/r/energicryptocurrency/comments/ho8mzv/gdpr_notification_emails/	Post	removed by Reddit's spam filters
113-Matic Networks	https://www.reddit.com/r/maticnetwork/comments/hoascx/gdpr_notification_emails/	Post	removed by Reddit's spam filters
114-Nexo	https://www.reddit.com/r/Nexo/comments/ho0jh5/gdpr_notification_emails/	Post	removed by Reddit's spam filters
115-Hive	https://www.reddit.com/r/hivecoin/comments/ho7c7d/gdpr_notification_emails/	Post	removed by Reddit's spam filters
116-Verge	https://www.reddit.com/r/vergecurrency/comments/ho0sy4/gdpr_notification_emails/	Post	removed by Reddit's spam filters
117-Seele-N	https://www.reddit.com/r/SeeleNetwork/submit	Not post	awaiting approval for post
118-Unibright	https://www.reddit.com/r/Unibright/comments/hob2gi/gdpr_notification_emails/	Post	removed by the moderator
119-MaidSafeCoin	https://www.reddit.com/r/maidsafe/submit?draft=25ac7670-c225-11ea-a94b-aa611cd5b324	Not post	awaiting approval for post
120-BitShares	https://www.reddit.com/r/BitShares/comments/ho63ui/gdpr_notification_emails/	Post	removed by Reddit's spam filters
121-ABBC Coin	https://www.reddit.com/r/ABBCoin/comments/ho8c6t/gdpr_notification_emails/	Post	removed by the moderator
122-HyperCash	https://www.reddit.com/r/HyperCash/submit?draft=57e970f2-c225-11ea-a221-ca4e148b4b8f	Not post	awaiting approval for post
123-Celsius	https://www.reddit.com/r/CelsiusNetwork/comments/ho2q6m/gdpr_notification_emails/	Post	removed by Reddit's spam filters
124-IOST	https://www.reddit.com/r/IOST/comments/ho2dyg/gdpr_notification_emails/	Post	removed by Reddit's spam filters
125-Elastos	https://www.reddit.com/r/Elastos/comments/hobczj/gdpr_notification_emails/	Post	removed by Reddit's spam filters
126-Horizen	https://www.reddit.com/r/Horizen/comments/ho6jju/gdpr_notification_emails/	Post	removed by Reddit's spam filters
127-CyberVein	https://www.reddit.com/r/CyberVeinOfficial/comments/hobnli/gdpr_notification_emails/	Post	removed by Reddit's spam filters
128-ReddCoin	https://www.reddit.com/r/reddCoin/comments/hoc7xn/gdpr_notification_emails/	Post	removed by Reddit's spam filters
129-Chiliz	https://www.reddit.com/r/chiliZ/comments/ho8xwd/gdpr_notification_emails/	Post	removed by Reddit's spam filters

Appendix B – Groups Names of LinkedIn and Facebook

Table B. 1 Groups names of LinkedIn and Facebook

LinkedIn
1-Chief Executives CEO, COO, CFO, CTO & CXO's (Startups, Investors, Blockchain & Dealflow)
2-Financial Analysts and Portfolio Managers / Stock and Cryptocurrency Markets
3-IT Blockchain Developers, Traders (Bitcoin), Investors and Consultants (BIG)
4-Software & Technology Professionals: Managers HR Recruiters Blockchain Investors (BIG)
Facebook
1-Blockchain.com
2-Blockchain (https://www.facebook.com/groups/160530481162362/)
3-Blockchain Today (https://www.facebook.com/groups/477611716510060/)
4-Bitcoin, Ethereum, altcoins, cryptocurrency, and financial news (https://www.facebook.com/groups/499956994210232/)
5-Crypto-World By S@S (https://www.facebook.com/groups/279400903142943/)
6-The World Of Blockchain And Cryptocurrencies (Bitcoin & Altcoins) By SAS (https://www.facebook.com/groups/468832447273589/)
7-BlockChain And Cryptos (https://www.facebook.com/groups/nbsolutions/)
8-EDC Blockchain Masternode (https://www.facebook.com/groups/204626490424374/)
9-Blockchain Development (https://www.facebook.com/groups/1441213315940448/)
10-CryptoCurrency & Blockchain: Bitcoin Altcoin Trading News Analysis (https://www.facebook.com/groups/blockchainhub/)
11-Blockchain (https://www.facebook.com/groups/143322019583033/)
12-Blockchained India (https://www.facebook.com/groups/blockchainedindia/)
13-Blockchain Fundamentals Course (https://www.facebook.com/groups/149074865740762/)
14-Bitcoin CryptoCurrency Blockchain Trading, Mining Investment EXCLUSIVE CLUB (https://www.facebook.com/groups/BITCOINCRYPTOCURRENCYmarket/)
15-Become a Professional Blockchain Developer - Eat The Blocks (https://www.facebook.com/groups/222716919099261/)
16-#Blockchain#Cryptocurrency & #DeFi #Africa Ecosystem (https://www.facebook.com/groups/httpcocoindcoin.cohome1/)
17-Cryptocurrency 2020: Bitcoin, Altcoins, Blockchain, News (https://www.facebook.com/groups/564134050802928/)
18-Crypto Coin Gain (https://www.facebook.com/groups/548048192338849/)
19-Cryptocurrency Malaysia (https://www.facebook.com/groups/319846938424569/)
20-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 Bermuda (https://www.facebook.com/groups/freebtbermuda/?multi_permaLinks=747852946079150%2C747852849412493%2C747820679415710%2C747723036092141%2C747716562759455&notif_id=1607643310496066&notif_t=group_activity&ref=notif)
21-Blockchain News and Opinion (https://www.facebook.com/groups/blockchainnews/)
22-Crypto currency Acquisition (https://www.facebook.com/groups/366377731033194/)
23-Learn Cloud Computing/DevOps/AWS/Azure/Blockchain (https://www.facebook.com/groups/3474654485882523/)
24-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 Argentina (https://www.facebook.com/groups/freebitcoinargentina/)
25-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 Ecuador (https://www.facebook.com/groups/freebtcecuador/)
26-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 Hong Kong (https://www.facebook.com/groups/cryptobullz/)
27-Blockchain Technology Cryptocurrency BTC (https://www.facebook.com/groups/275109772932131/)
28-Bitcoin Cryptocurrency & Blockchain --India (https://www.facebook.com/groups/734315360724877/)
29-Blockchain Community India (https://www.facebook.com/groups/blockchaincommunityindia/)
30-Türkiye Kripto Para ve Blockchain Topluluğu (https://www.facebook.com/groups/340399116696308/)
31-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 Spain (https://www.facebook.com/groups/freebitcoinspain/)

32-Cryptocurrency Group (Cryptocurrency Group)
33-BITCOIN WORLD CONNECT-CRYPTO CURRENCY INFO (https://www.facebook.com/groups/268469103855298/)
34-Blockchain Entrepreneurs Billionaire (https://www.facebook.com/groups/1269343263089900/)
35-CryptoCurrency Entrepreneurs (https://www.facebook.com/groups/977420999015649/)
36-Crypto / Blockchain / Bitcoin / Altcoin lovers (News) (https://www.facebook.com/groups/1966492270268596/)
37-Blockchain Startup: Developers, Entrepreneurs and Learner (Blockchain Startup: Developers, Entrepreneurs, and Learner)
38-Bitcoin & Cryptocurrency Blockchain Crypto Trading Ethereum Alts (https://www.facebook.com/groups/391757321640145/)
39-Bitcoin + Cryptocurrency Insight and Discussion Group (Blockchain, Crypto) (https://www.facebook.com/groups/257878608476589/)
40-Bitcoin & Blockchain Development and use (https://www.facebook.com/groups/developmentblockchain/)
41-Bitcoin World investment SAS (B https://www.facebook.com/groups/312800043354122/)
42-Bitcoin Ico investment faucet earnings SAS (https://www.facebook.com/groups/660357904584334/)
43-SMART CONTRACTS (TRON /ETHEREUM) (https://www.facebook.com/groups/853905615012947/)
44-PiCrypto PH Support Circle (https://www.facebook.com/groups/458313184990205/)
45-blockchain technology (https://www.facebook.com/groups/170870466842708/)
46-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 Georgia (https://www.facebook.com/groups/freebtcgeorgia/)
47-STO, IEO, Bitcoin, Training, and Blockchain Investments 2020 United States (https://www.facebook.com/groups/freebitcoinusa/)
48-STO, IEO, Bitcoin, Training, and Blockchain Investments 2020 Germany (https://www.facebook.com/groups/freebtcgermany/)
49-STO, IEO, Bitcoin, Training, and Blockchain Investments 2020 Mexico (https://www.facebook.com/groups/freebitcoinmexico/)
50-STO, IEO, Bitcoin, Training, and Blockchain Investments 2020 Slovenia (https://www.facebook.com/groups/freebticslovenia/)
51-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 Indonesia (https://www.facebook.com/groups/freebtcindonesia/)
52-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 Singapore (https://www.facebook.com/groups/freebitcoinsingapore/)
53-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 Sweden (https://www.facebook.com/groups/freebitcoinsweden/)
54-Blockchain Innovation (https://www.facebook.com/groups/345031479581625/) onayımı bekliyor
55-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 Turkey (https://www.facebook.com/groups/freebitcointurkey/)
56-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 China (https://www.facebook.com/groups/freebitcoinchina/)
57-STO, IEO, Bitcoin, Training and Blockchain Investments 2020 Malta (https://www.facebook.com/groups/freebitcoinmalta/)

Appendix C – The Post Content

Hi everyone,

We are conducting a research to understand how blockchain service providers and developers communicated GDPR to their users via email and how their users perceived GDPR and such email communications. We hope that a better understanding will help the whole sector to find better ways to make blockchain systems more GDPR friendly.

In this context, we would like to collect GDPR notification emails you were sent by blockchain service providers. Please click the link below to go to our Web site (or copy and paste the link into your Internet browser) and then upload the emails you received.

<https://email-5e941.firebaseio.com/>

It is also possible forward those emails to infogdpr20@gmail.com.

Thank you very much for your time and cooperation.

Figure C. 1 The post content for the first Website

Hi everyone,

We are conducting a research to understand how blockchain service providers and developers communicated GDPR to their users via email and how their users perceived GDPR and such email communications. We hope that a better understanding will help the whole sector to find better ways to make blockchain systems more GDPR friendly.

In this context, we would like to collect GDPR notification emails you were sent by blockchain service providers. Please click the link below to go to survey (or copy and paste the link into your Internet browser) and then upload the emails you received.

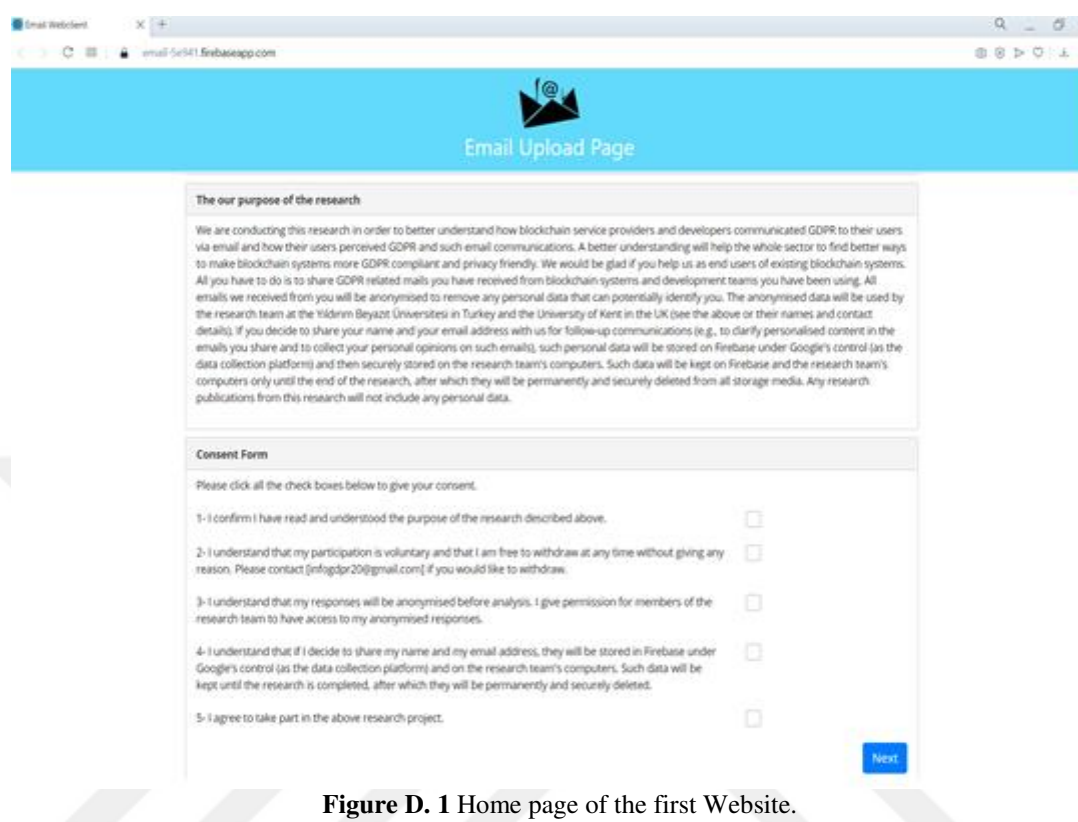
<https://www.gdpr-research-survey.com/index.php/975697?lang=en>

It is also possible to forward those emails to destek@gdpr-research-survey.com

Thank you very much for your time and cooperation.

Figure C. 2 The post content for the second Website

Appendix D – Examples of Web Page



The our purpose of the research

We are conducting this research in order to better understand how blockchain service providers and developers communicated GDPR to their users via email and how their users perceived GDPR and such email communications. A better understanding will help the whole sector to find better ways to make blockchain systems more GDPR compliant and privacy friendly. We would be glad if you help us as end users of existing blockchain systems. All you have to do is to share GDPR related mails you have received from blockchain systems and development teams you have been using. All emails we received from you will be anonymised to remove any personal data that can potentially identify you. The anonymised data will be used by the research team at the Yildirim Beyazıt Üniversitesi in Turkey and the University of Kent in the UK (see the above or their names and contact details). If you decide to share your name and your email address with us for follow-up communications (e.g., to clarify personalised content in the emails you share and to collect your personal opinions on such emails), such personal data will be stored on Firebase under Google's control (as the data collection platform) and then securely stored on the research team's computers. Such data will be kept on Firebase and the research team's computers only until the end of the research, after which they will be permanently and securely deleted from all storage media. Any research publications from this research will not include any personal data.

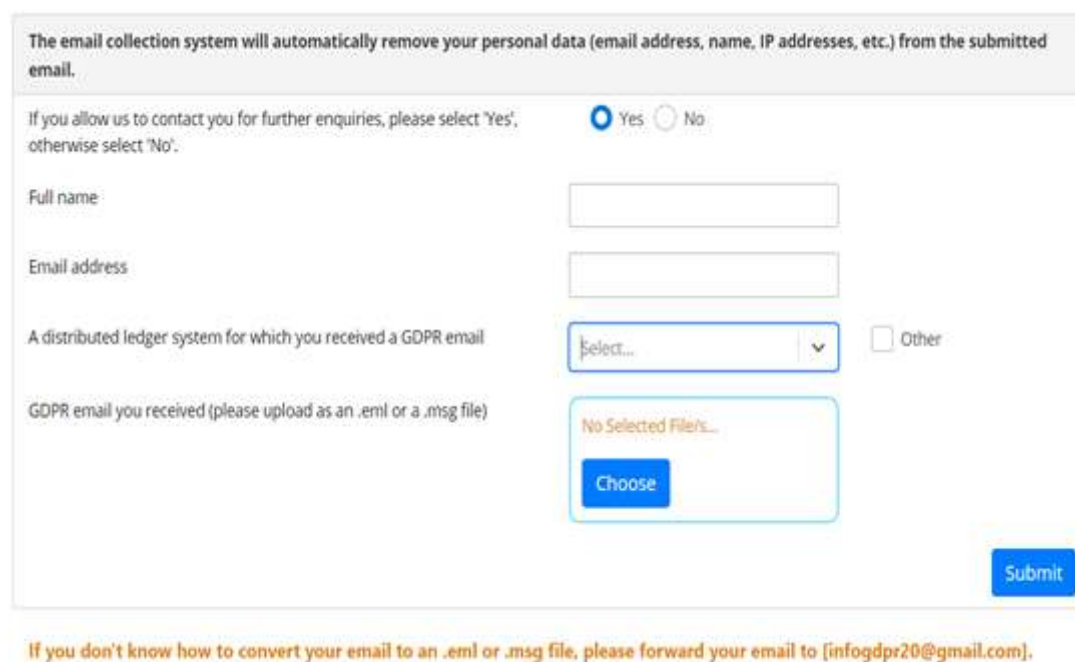
Consent Form

Please click all the check boxes below to give your consent.

- 1- I confirm I have read and understood the purpose of the research described above. ☐
- 2- I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. Please contact [info@gdpr20@gmail.com] if you would like to withdraw. ☐
- 3- I understand that my responses will be anonymised before analysis. I give permission for members of the research team to have access to my anonymised responses. ☐
- 4- I understand that if I decide to share my name and my email address, they will be stored in Firebase under Google's control (as the data collection platform) and on the research team's computers. Such data will be kept until the research is completed, after which they will be permanently and securely deleted. ☐
- 5- I agree to take part in the above research project. ☐

[Next](#)

Figure D. 1 Home page of the first Website.



The email collection system will automatically remove your personal data (email address, name, IP addresses, etc.) from the submitted email.

If you allow us to contact you for further enquiries, please select 'Yes', otherwise select 'No': ☒ Yes ☐ No

Full name:

Email address:

A distributed ledger system for which you received a GDPR email: ☐ Other

GDPR email you received (please upload as an .eml or a .msg file):

If you don't know how to convert your email to an .eml or .msg file, please forward your email to [info@gdpr20@gmail.com].

Figure D. 2 The questions of the first website are asked to be answered

GDPR notification emails - X

www.gdpr-research-survey.com/index.php/375497

LimeSurvey Load unfinished survey

Who are we?

We are researchers from the Ankara Yıldırım Beyazıt Üniversitesi in Turkey and the University of Kent in the UK (see the above or their names and contact details).

What is the purpose of the research?

This research is about blockchain service providers and developers communicated GDPR to their users via email. We are conducting this research in order to better understand how blockchain service providers and developers communicated GDPR to their users via email and how their users perceived GDPR and such email communications.

What do we need from you?

You have to do is to share GDPR related mails you have received from blockchain systems and development teams you have been using.

How will we store and process your data?

Your data will be securely stored on the website, whose hosting server is physically located in Europe. The data collected will be transferred to the research team's computers in Turkey, and then permanently deleted from the web server. Anonymised data will be shared with the UK researchers but they will not be involved in the data collection and anonymisation process, except for providing their academic opinions on how data should be processed and shared with them. All collected data will be protected in accordance with Law No 6698 On The Protection Of Personal Data in Turkey. The data you submitted will be manually inspected and we will sanitise the data to remove any unintentionally disclosed personal data.

Your consent

By clicking the "Next" button, you agree to give us your consent on participating in this survey and giving us the information asked by each question.

There are 11 questions in this survey.

Next

Figure D. 3 Home page of the second Website

LimeSurvey Resume later

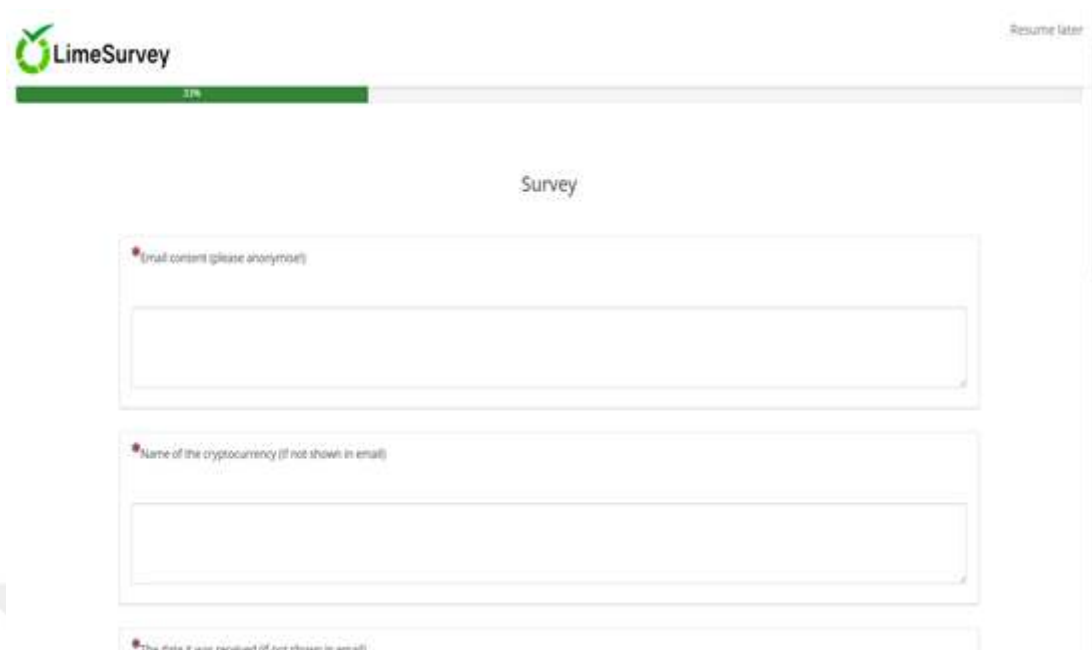
10%

Consent Form

Please click all the check boxes below to give your consent.

I confirm I have read and understood the purpose of the research described above.	☐
I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. Please contact [destek@gdpr-research-survey.com] if you would like to withdraw.	☐
I understand that my responses will be anonymised before analysis. I give permission for members of the research team to have access to my anonymised responses.	☐
I understand that if I decide to share my name and my email address, they will be stored on the data center in Europe and on the research team's computers. Such data will be kept until the research is completed, after which they will be permanently and securely deleted.	☐
I agree to take part in the gdpr notification emails research project.	☐

Figure D. 4 Consent form of the second Website



The image shows a LimeSurvey web interface. At the top left is the LimeSurvey logo. A green progress bar indicates 37% completion. In the top right corner, there is a 'Resume later' link. The survey title 'Survey' is centered. Below the title are three text input fields, each with a red asterisk indicating a required question. The first field is labeled '(Email content (please anonymise))'. The second field is labeled 'Name of the cryptocurrency (if not shown in email)'. The third field is labeled 'The date it was received (if not shown in email)'. A vertical scrollbar is visible on the right side of the survey area.

Figure D. 5 Example of questions in the survey

CURRICULUM VITAE

PERSONAL INFORMATION

Name Surname : Fatma EMÜL

Date of Birth :

E-mail :

EDUCATION

High School : Selçuk Anadolu Lisesi / SİVAS (2006-2010) (79.59/100)

Bachelor :Ankara Yıldırım Beyazıt University / Ankara (2011-2017) (3.37/4.0)

Master Degree : Ankara Yıldırım Beyazıt University / (2018-2021) (4.0/4.0)