Contact Tracing Apps for Community Resilience Battle Against COVID-19 The App Review Analysis From US COVIDWISE; France TousAntiCovid; Finland Koronavilkku; and China Alipay Health Code

Boyang Zhang, Tampere Universities, Finland
Hui Xu, Shanghai Maritime University, China
Yingdong Liu, University of Strasbourg, France

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Abstract
The purpose of this research is to interpret of what features are discussed in the COVID-19 contact tracing apps' reviews by utilizing opinion methods. Four apps are selected including: US COVIDWISE; Finland Koronavilkku; France TousAntiCovid: and China Alipay health code. The features of the apps' reviews are extracted and categorized into various groups, to measure the effectiveness of the contact tracing apps. Sentiment analysis is performed upon each individual review. Interpreted issues are assigned to each specific opinion features in the apps' reviews. In the perspective of community resilience, contact tracing apps play vitally significant approach to combat the spread of COVID-19 not only locally but also globally. The effectiveness of apps requires collaboration of local capitals, health organizations, and governments.

Keywords: Contact Tracing Apps, COVID-19, Community Resilience, Opinion Mining Features

Introduction

According to statistics from Worldometers ("Coronavirus Update (Live)," 2020), a real-time information data update website, as of 09:11 GMT on November 13, 2020, the cumulative number of confirmed cases of new coronary pneumonia worldwide exceeded 53.07 million, with a cumulative total of 53,109,750 confirmed cases and 1,299,651 cumulative deaths of over 1.29 million. Therefore, the global situation of COVID-19 is still very serious, in which, the United States, India, Brazil, France, the number of confirmed cases and deaths are particularly prominent, while China and Finland are in a relatively good situation. Especially China, as the initial outbreak of the epidemic is more serious countries, the control of the epidemic is very efficient, rapidly reducing the number of infected people and the speed of infection. Thus, the control of the COVID-19 is an important issue that needs to be regulated.

Mobile contact tracing app is one of the more popular and effective digital epidemic control methods nowadays (Cho et al., 2020; Kostka and Habich-Sobiegalla, 2020; Siffels, 2020; Trang et al., 2020; Wang and Liu, 2020), people's health status and new crown infections can be kept abreast of, and in response to the specific circumstances of the contact tracing apps, the relevant departments can respond in a timely manner (treatment, quarantine, observation, release, etc.) (Borasio et al., 2020; Hoffman et al., 2020). In practice, contact tracing apps have been used in a number of countries and have achieved good epidemic control results. However, the existing studies have not systematically reviewed the global overview of contact tracing apps from the Google Play reviews, how they are used and what results they have achieved. Therefore, in this paper, we use the four typical countries (USA, Finland, France, China) where contact tracing apps are used as case studies, to specifically sort out the issues related to community resilience.

COVIDWISE

COVIDWISE was launched by the stage of Virginia, Unite States, in both Google Play and Apple App Store. Each state is developing similar apps which are cooperated with Association of Public Health Laboratories in US (Skoll et al., 2020). COVIDWISE uses Bluetooth Low Energy (BLE) to alert users who have potential to expose. The app was recommended by Virginia Department of Health. The app allows phones to exchange anonymous keys of nearby devices in the local areas. COVIDWISE offers community alerts and warning to stay ahead of potential resurgent risks. When reported positive cases, the signals from the users will search for other app users who share the signals. The Virginia Department of Health exert strong influence on the privacy control, the personal data and location will not be tracked within the app.

TousAntiCovid

France president Macron announced a home lockdown from 17 March 2020. Then, as part of the French government's deconfinement plan, the application named StopCovid was available since 2 June 2020 on the iphone and android. This app's objective is to break the chains of coronavirus (Covid-19) transmission by rapidly isolating those at risk. The app allows contact-tracking via Bluetooth when two telephones have been closed for a period of time. If a positive case occurs, the app could inform other users who have been closed that person. On the ethical side, The French National Commission for Information Technology and Liberties (CNIL) considers that this app is useful for health and data protection (Légifrance, 2020). Nevertheless, the General of Health direction reported 2.3 million

downloads of the app after three months, but only 103 notifications were sent. Later, the Ministry of Solidarity and Health released a new version of StopCovid on 22 October 2020, named TousAntiCovid. The tagline for this app is “I protect myself, I protect others”. The new app version optimized ergonomic design and visual environment. It also adds some new functions, such as instant information related to the epidemic, the Covid testing centers map, and the digital certificate to go out (Ministère des Solidarités et de la Santé, 2020). At the beginning of installation, the app informs users that they could alert in case of a positive test on the server managed by the Ministry of Solidarity and Health; The app will not show the origin of the positive case alert; The personal data is stored on the user’s phone; both data on the phone and the server are automatically erased after 14 days (Ministère des Solidarités et de la Santé, 2020). On 29 October, Secretary of State for Digital Transition and Electronic Communications Cédric O, informs in LinkedIn that more than 6 million people have already downloaded TousAntiCovid app.

Koronavilkku

The app of Koronavilkku is developed by the Finnish Institute of Health and Wealfare (THL) (Martin et al., 2020). The techniques used by Koronavilkku are based on an anonymous contact diary to assigns a random code to each phone. When each phone close to each other, Koronavilkku swap codes through Bluetooth signals. The app was uploaded to Google Play store, Apple App Store and official website by 31st August 2020. At beginning of launching the app, there are both Finnish and Swedish version. Global English version was launch in the later 2020. The use of Koronavilkku is free and voluntary, and personal identification data is strongly protected according to the official website (https://koronavilkku.fi/en/#yksityisyys). When people tested with coronavirus for positive, a healthcare professional will offer a key code to enter in Koronavilkku. Close contact person with the usage of the app will be warned of potential exposure from the app.

AliPay

China’s health code is a digital epidemic prevention measure. According to the user’s self-declaration information and epidemic prevention information, the back-end system operated by the local government automatically audits and generates the QR code that belongs to the individual, and implements dynamic management through red, yellow, and green. The relevant personal declaration information must be confirmed by the applicant, while third-party platforms such as AliPay are responsible for providing the declaration portal and displaying the QR code information. Thus, the pass is eclecticized through digital technology. At present, the health code system has formed a set of standards, which can be quickly launched according to the needs of different regions, combined with the needs of local epidemic prevention and control. On February 7, 2020, the first health code, the Yuhang Green Code, was born in Hangzhou, and on February 11, the Hangzhou Health Code was the first to go online in AliPay. After checking the data of the "4 categories of personnel" in the provincial epidemic prevention database, the health codes of the corresponding colors will be issued: green codes will be issued to those who have not inquired about the epidemic; yellow code will be issued to those whose records are found to be in close contact with the epidemic; red codes will be issued to those who have confirmed cases, suspected cases, febrile cases and asymptomatic infections. For people in low-risk areas, the code will be assigned within 4 hours after applying the health code; for people in medium-risk areas, the code will be assigned within 12 hours; for people in high-risk areas, the code will be assigned within 24 hours. The health code will be converted according to personal health condition. If it is

inconvenient for the elderly, minors, disabled and other special groups to apply for the health code, guardians or other family members can apply for the code and present it when traveling. If it is impossible to apply for a health code, the health monitoring certificate issued by the local village (community) should be used for the trip, and the localities should provide access facilities. In just two weeks, the health code originated from Hangzhou has been officially launched in more than 200 cities and 25 provinces (Liang, 2020), covering ten major scenes such as public transportation, subway, community, office buildings, medical insurance payment, shopping malls and supermarkets, airport stations, etc. At present, many places are expanding the application of the health code. Zhejiang Province has the widest range of application scenarios, and the number of code recipients is also far ahead. In Hangzhou alone, the number of daily visits to the health code exceeds 10 million. According to a press conference on epidemic prevention and control in Zhejiang Province, 50.47 million health codes had been issued by noon on February 24.

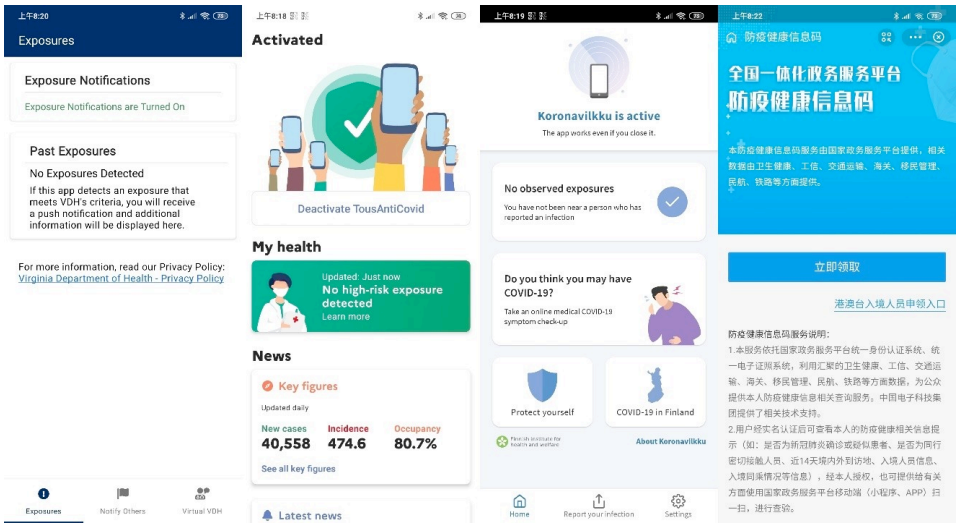

Figure 1: Interface of the selected apps

Related Work

Mobile apps for digital tracing contact during pandemic COVID-19 offer location-based technique solutions for crisis management, especially from a group of users. The contact tracing apps provide ability for communities to alert and response from pandemic situations (Boon et al., 2012), which is the sustained community resilience for social sustainability and adaptability.

Community resilience is a process for adaptive capacities which utilize various resources for disturbance or adversity such as pandemic crisis (Norris et al., 2008). Formulate policy to cooperate with pandemic crisis requires considerably attention (Ayah et al., 2014; Bulmer, 1982), such as rediscovery of resilient pathway and preventing high level of loss of resilience at community level (Wilson, 2013). Social capital and networks consist the core of community resilience to battle against crisis and disaster survival(Aldrich and Meyer, 2015), in order to build collective community resilience, local capitals (citizens) and organizations could encourage and provide flexible support, decision-making skills, and trusted sources of information (Norris et al., 2008) which can be regarded as best practices in a community approach, including the use of contact tracing apps, to perform community resilience as a

cooperation of health organizations and citizens (Linnell, 2014). The innovative contact tracing apps triggers the practices of collaboration in utilizing of digital devices.

Methodology

In the method chapter, it descripts how the data was collected and how the analysis was conducted. The data was collected from Google Play open source reviews, from the account of COVIDWISE (ID=gov.vdh.exposurenotification); Koronavilkku (ID=fi.thl.koronahaavi); TousAntiCovid (ID=fr.gouv.android.stopcovid); and AliPay (ID=com.eg.android.AlipayGphone). English reviews were targeted to proceed the sentiment analysis and opinion mining features. The date of collection was conducted in November 2020. Because the purpose is to extract features of the contents from the Google Play reviews, reviews are divided into sentences to perform the sentiment analysis (Bonta et al., 2019), and count sum of scores to indicate the frequency of sentiments.

In the process of opinion mining, specific features of the reviews are extracted into polarities which include positive, neutral, and negative. According to Hu and Hui (2004), mining opinion features illustrate ways of analysis from commented reviews. Deeply, data mining and natural language processing methods are utilized to extract for mining opinion features, from Part-of-Speech Tagging, Frequent Feature extraction, pruning, opinion extraction, and most frequency noun phrases (NPs). TextBlob (https://textblob.readthedo cs.io/en/dev/) is used to explore NPs of each sentence. After removing irrelevant punctuations and stopwords. The frequency of NPs is extracted to mine the opinion features. The threshold of the selected NPs is set as 24, which represents top 24 NPs of the features.

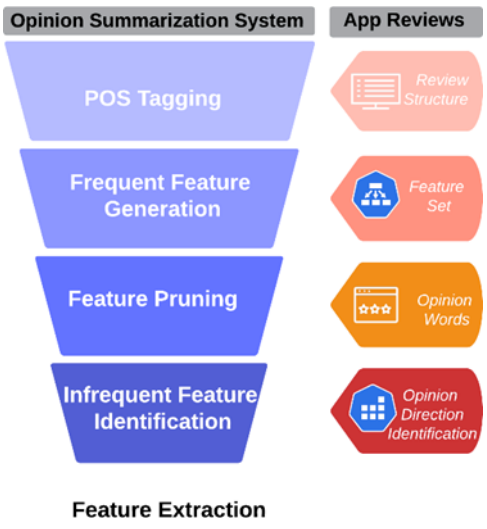

Figure 2: The Opinion Summarization System (Hu & Hui, 2004)

Analysis

In this section, each contact tracing app was analyzed with the top 24 opinion mining features. To keep the discussion concise, each individual feature was interpreted into specific issue, in order to further analyze the efficient of apps. For example, the noun phrase “exposure check” represents the issue of “Software”; the noun phrase “real name” represents “Identification information”. Additionally, we discuss about the pros and cons of each individual apps.

Below table address the opinion mining features extracted from the selected contact tracking apps. The features are majority noun phrases from the apps' reviews. To complement the analysis of the features, sentiment analysis of each noun phrases is also extracted by marking up P = positive polarity score of the noun phrase; N = negative polarity score of the noun phrase; empty area represents the sentiment score is zero. In order to contextualize the features, we interpreted each individual noun phrases with a specific issue.

COVIDWISE	TousAntiCovid	Koronavilkku	AliPay
exposure checks	wont activate	exposure check	terrible apps reset password (N=0.508)
home asleep	good citizen (P=0.744)	battery	wrong password (N=0.765)
search google	crash crash (N=1.000)	finland	password vault
exposure notifications	restart crash crash (N=0.844)	phone	mainland china
error message (N=0.73)	dont work error (P=0.530)	useless application (N=0.737)	terrible application (N=0.765)
enable notifications	contact cest	simple	shows system
cell phones	google covid apis	battery drains	error message (N=0.730)
american people	beau travail les gars	location services	real name
seems	ces notifications constantes	error code (N=0.730)	passport picture
additional work	error null (N=0.730)	slightest option	customer service
enable notification	good idea (P=744)	gps	exact password
internal error (N=0.73)	robert error (N=0.730)	pretty useless app (P=0.057)	reset language
battery life	discrete notification	expose people (N=0.615)	general language i
government hoax scare covid (N=0.726)	persistent notification	typically finland	local citizen
phones front camera	notification tap	whole phone	china citizen
novel family virus (P=0.535)	notification categories	phone supports (P=0.714)	clear way (P=0.722)
public health major	place auraije les notifications	power settings	help section (P=0.730)
full network access	good translation (P=0.744)	means battery consumption	verification process
internal error message (N=0.574)	google play store (P=0.545)	battery consumption level	verification server
virus	good purpose (P=0.744)	statistics finland suggests	great step backward (P=0.672)
sends information	open source	power usage settings	language setting
wont track	great interface (P=0.804)	sucks battery (N=0.714)	help function (P=0.730)
great idea (P=0.804)	clear instructions (P=0.722)	good intention	special service (P=0.730)
peoples phones	davoir les key figures	bad application name (N=0.636)	real name verification

Table 1: Top 24 opinion mining features of each app

Moreover, below figure represents the sentiment score frequency of contact tracing apps' reviews. The x-axis represents the sentiment score, the y-axis represents the amount (sum) of the reviews are collected. Based on the figure of the sentiment frequent, there are minor

difference. The majority of sentiment score consist mainly neutral polarity in each apps. In the results of TousAntiCovid, the neutral polarity consists most of the reviews. In COVIDWISE, Koronavilkku and AliPay, positive and negative sentiment are more used in commenting reviews.

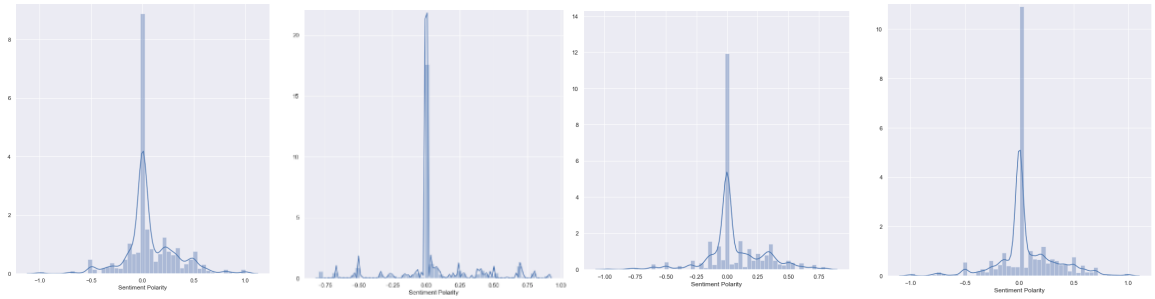

Figure 3: Sentiment analysis of the comments towards the selected apps

Discussion and Conclusion

This research investigates the reviews of the innovative contact tracing apps to battle against COVID-19 pandemic crisis. Specifically, the key challenges facing the contact tracing apps are identified into the below Table 2.

Issues	COVIDWISE	TousAntiCovid	Koronavilkku	Alipay Color Code
Location of usage, and	US, State of Virginia.	France, whole country.	Finland, whole country.	China, regional different functions.
Smartphone usage rate	81% (2020)	95% (2019)	76% (2018)	64% (2020)
Tracking tech	Bluetooth	Bluetooth	Bluetooth	GPS
Privacy Control	Relatively high	Relatively High	Relatively high	Relatively low
Compulsory or Voluntary	Voluntary	Voluntary	Voluntary	Compulsory, transportation control
User experience	Clear single function	Clear single function	Clear single function	Sub-functions of Alipay, multi-tasks compacted software
Responsibility	Virginia Department of Health	INRIA (France) and Fraunhofer (Germany)	National Institute for Health and Welfare in Finland	Alipay (Hangzhou, China) Technology Co. Ltd, cooperate with government.
Transregional and transboundary collaboration	Available in Virginia, also can be used outside	Active in France region, also can be use outside.	Active in Finland, also can be download outside.	Available in China, also can be used outside.
Community Resilience	Individual usage, closeness social network	Individual usage, closeness social	Individual usage, closeness social	Strong local collaboration and coordination

	warning.	network.	network warning	channels.
Hardware	Battery life		Battery life	
Software	Notification issues	Notification error	Less option, Finnish name	Password error, registration and verification, language.

Table 2: Key challenges with contact-tracing apps

In order to establish systematic and regional coordination for COVID-19 warning, intervention and recovery, many countries have designed different contact tracing apps to battle against coronavirus. Encountering the usage of smartphone, contact tracing apps provide innovative solutions to collaborate between individual, health organizations and governments.

In contrast, the smartphone usage rate in the selected countries is different, ranging from China 64%, Finland 76%, United States 81%, and France 95%. There is the consideration of the aged group population, with less usage of the contact tracing apps, older adults (≥75 years of age) with lower adoption rate to use the apps (Jonker et al., 2020) which remains technical and societal challenges. In community perspective, local capitals and family members could exerted profound in boost the usage of contact tracing apps towards older adults, such as paper format health color code. As to the privacy control, COVIDWISE, TousAntiCovid and Koronavilkku have strict privacy considerations. Comparatively, the health color code in AliPay is combined with identifications for entrances and transportations. The data privacy issues have raised considerable attention on launching the contact tracing apps from public health official and local communities (Chan et al., 2020; Cho et al., 2020; Rowe, 2020). It has raised heated debate between data privacy versus public health towards the usefulness of contact tracing apps (Cho et al., 2020; Fahey and Hino, 2020; Lenert and McSwain, 2020). From the opinion mining features, there is a strong digital privacy concerns from reviews of AliPay, such as “real name”; “passport picture”; “passport vault”. Deeply, in the collaboration with local communities, AliPay health code is regarded as a compulsory health “ticket” to for entrances and transportations, for example, in order to get into the local buses, showing the “green color code” is a must (Kostka and Habich-Sobiegalla, 2020). In the perspective of user experiences, COVIDWISE is a single app with functions concentrated in COVID-19 related concerns, the same as TousAntiCovid and Koronavilkku. But as to AliPay, the using of Health Color Code is sub-function of the app which means that the AliPay is a combination of various functions. Therefore, the collection of app review might not be directly concerning the function of Health Color Code, but in the overall point of view towards the usage of AliPay. The responsibilites of the selected contact tracing apps are in charge by technology companies and local governments, the software codes are open for public examination in COVIDWISE (https://github.com/vdh-oim/COVIDWISE); TousAntiCovid (https://gitlab.inria.fr/stopcovid19/accueil); and Koronavilkku (https://github.com/THLfi/koronavilkku-android). The software codes of AliPay is currently unavailable based on our knowledge. The utilization of the contact tracing apps is recommended by specific locations, all of them can be used outside the recommended locations. Moreover, the collaboration among different regional contact tracing apps require more attention when concerning trans-regional and transboundary travels. Typically, community resilience was conducted efficiently and effectively in China with relative high labor costs, including entrance and transportations. To COVIDWISE, TousAntiCovid, and Koronavilkku, general recommendations are provided in the community perspective, specific

manner policy might be needed when it turns to “after” receiving the alarms, such as, how the quarantine will be done and food supply during quarantine. Moreover, the usability issues of battery consumption called for considerable attention in COVIDWISE and Koronavilkku. In software, AliPay received significant attention in password error, registration and verification, language issues.

In conclusion, the innovative contact tracing apps provides local and national wide epidemic prevention and crisis control. Issues arise when facing the usage of the contact tracing apps in different regions and nations. Typically, the technical solutions behind the apps are similar to each other, using Bluetooth or GPS methods to identify location info, the apps are designed in specific local regions. With the collaboration of local communities, the performance of the contact tracking apps exerts profound impact to reduce epidemic risks. But when it comes to trans-regional and transboundary travel, situations vary a lot from cases to cases. In the ideal situation, the contact tracing apps could work with each other to further reduce epidemic risks which requires joint efforts from international collaborations. Local communities play an active role in battle against coronavirus.

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