



Coronavirus Outbreak Control

Summary

Quarantine decisions and infection suspicions must factor in the probability of contagion. Currently, back-tracking exposure is completely manual detective work. We have built, and will distribute, a mobile app which enables de-identified contact/exposure information to be collected, infection decisions to be confirmed by medical personnel, and propagated to app holders.

After a case is diagnosed, it's very difficult, expensive and time consuming to backtrack all the patient's interactions. This is currently done manually, often alerting only people in the patient social circle (family, friends, colleagues). This does not scale as the number of infections grows. Instead, if backtracking fails, it leads to large groups of people, towns, regions or even entire countries being put in quarantine.

Proposed solution

Covid Anonymous Tracker anonymously monitors the devices that get near you.

If you have been close to an infected person you will be notified and get clear instructions on the next steps to follow.

How it works:

1. Every mobile device has a unique and anonymous numeric ID, that can be read at distance using the Bluetooth technology.
2. Covid Anonymous Tracker continuously scans your surroundings and collects the IDs of the phones near you, storing them in a secure centralized cloud database. No interactions between the users and the app are needed.
3. Our network of certified doctors daily updates the database with the IDs of the devices belonging to confirmed Coronavirus infected individuals.
4. If you have been in the proximity of an infected person during the last 14 days you will be notified and get clear instruction on the next steps to follow, also depending from the time of exposure to the virus.

Impact

The aim of the Coronavirus Outbreak Control project is to give authorities the right tools to execute the best strategy to limit the outbreaks of the Coronavirus and potential future outbreaks, by allowing them to deploy solutions at scale and mass and personalised communication through mobile devices.

This translates in the short term ability to promptly tackle the current Coronavirus outbreak by a precise and clear communication to people at risk. It will also allow institutions to quickly identify new potential future outbreaks once the quarantine will be released. Our end goal is to create a new protocol adopted worldwide by governments to face emergencies like this.

Supported by:

- Stefano Quintarelli - Member of the AI High Level Expert Group at European Commission
- Gian Paolo Manzella, Under Secretary of State for Economic Development, Ministry of Economy, Italy
- Raffaele Perego, Head of the High Performance Computing Lab of CNR
- Stefano Leonardi, Professor at Sapienza University of Rome
- Vania, Head of the Computer Science Graduate Program at Universidade Federal de Santa Catarina (UFSC) - Brazil

An official government endorsement is both necessary for Google Play Store and Apple Store upload, and a very strong promotion tool.

Stage of development

The solutions on the market are using GPS technology, with a precision of 10~60 meters; instead, we use high-precision short-distance measuring technology based on Bluetooth LE, to obtain high precision on distances shorter than ~3 meters. This is an excellent fit with the physical contagion radius.

The service is composed of

- mobile applications for citizens
- mobile application for doctors
- backend exposing APIs
- scalable infrastructure
- website

The existing infrastructure (TRL¹ 7) has already been tested with a simulated load of 15 millions devices.

Although there were several difficulties we faced in the process, we managed to overcome them. From the technological perspective, assuring anonymity and being GDPR compliant is a priority. No personal and sensitive data from the users are collected.

Knowing that a similar service in South Korea² - that was relying on GPS technology - crashed after 1 million downloads, we focused on the high scalability of the service while maintaining low cost of deployment. The current test on the infrastructure showed that the cost to support the devices from 15 million devices is estimated to be lower than €10.000/month.

Not only is the Bluetooth technology more precise to measure short distances among devices, it allows the solution to trace interactions on highly dense population environments where no GPS nor Internet connection is available, such as concerts, indoor events, public events, public transport like busses and underground tubes.

¹ https://en.wikipedia.org/wiki/Technology_readiness_level

² <https://www.digitalic.it/news/coronavirus/quarantena-per-coronavirus-cina-e-corea-del-sud-utilizzano-app-di-monitoraggio>. South Korean app “Corona 100 meters” did more than 500K downloads/month.

We faced practicality issues as well: the whole team was in quarantine while developing the service, while in Italy, Germany, Portugal and the UK. We coordinated among us anyway and developed the service in a few weeks working remotely.

Our connections with key people in the Government and Health institutions in Italy will allow them to connect with the medical staff and create a new protocol to detect and deploy a rapid and operative response to future potential outbreaks related, but not limited to, Coronavirus.

Project leadership team

Luca Mastrostefano, Lead Machine Learning Engineer at InReach Ventures

Luca has built his career applying Machine Learning to problems at global scales.

He leads the development of the intelligent core of InReach Ventures, the AI-powered investment firm focused on early-stage European startups.

At Translated, Luca led the development of the most used Translation Memory service in the translation industry and he proposed and delivered Modern Machine Translation, the world's first Neural Adaptive Machine Translation.

Previously, at Translated he led a team of 10 people from different EU companies writing a public call for funding granted by the EU Commission and consequently winning as the best proposal of the batch. This allowed the team to design brand new ML algorithms for contextualized text translation, with the goal to substitute Google Translate in the professional translation services.

Antonio Romano, Head of Engineering at Rebrandly

Antonio has 6 years of extensive experience with different technologies and large scale data. The capacity to adapt to new technologies, the will to discover and accept new challenges brought Antonio to lead the technology team at Rebrandly.

Prior to this, he created the iOS framework and the first android version of GeoUniq, a GPS based tracking application.

Building schools in Nicaragua taught him that his motivation to help the society has no borders.

Domenico Lupinetti, Head of Software Development at Translated

Domenico has 15 years of experience in distributed architectures, mission critical softwares. He contributed to create the binary protocol for an established open source Graph Database technology. He works together with international partners like Airbnb, Google and Microsoft.

The project is led by a dedicated startup under incorporation, Coronavirus Outbreak Control Ltd, which aggregates the combined efforts of the team described below. This company owns the intellectual property which forms the starting point of this WP's development.

Team

The Coronavirus Outbreak Control team consists of 14 people: 3 co-founders and 11 staff, working from four European countries on product development, engineering and operations. The team has a multidisciplinary background: 10+ years of experience in distributed

architectures and mission critical softwares, founders and lead developers already worked together in the past building worldwide solutions for international partners, such as Airbnb, Google and Microsoft.

- Luca Mastrostefano - Management
Luca has built his career applying Machine Learning to problems at global scales. He is managing the execution of the project. Project commitment: 30%
- Gerta Salillari - Management
Gerta is an experienced Data Scientist and thanks to her background in Business Administration she is managing the operations of the project.
- Antonio Romano - Tech Lead
Antonio is leading the technical development of the four mobile applications. Project commitment: 30%
- Domenico Lupinetti - Backend Engineer
Domenico has built the scalable infrastructure to deploy the service at scale. Project commitment: 20%
- Giuseppe Silvano - Backend Engineer
Giuseppe has built the API stack needed for the functionalities of the doctors' applications. Project commitment: 20%
- Francesco Cosentino - iOS Mobile Engineer
Francesco has developed the iOS application to allow doctors to confirm Coronavirus positive patients on the platform. Project commitment: 20%
- Francesco Bonarota - Android Mobile Engineer
Francesco has developed the Android application to allow doctors to confirm Coronavirus positive patients on the platform. Project commitment: 20%
- Chris Villa - Design System Engineer
Chris is managing the infrastructure in order to ensure high scalability. Project commitment: 10%
- Marco Capuano - Android Mobile Engineer
Marco has developed the Android application to anonymously track patients' device interactions. Project commitment: 20%
- José Rodrigues - Lead Product Design
José has designed the UI and UX of all mobile products. Project commitment: 20%
- Neil Kakkar - iOS Mobile Engineer
Neil has developed the iOS application to anonymously track patients' device interactions. Project commitment: 20%
- Elena Martina - Android Mobile Engineer
Elena has developed the Android application to anonymously track patients' device interactions, mainly focusing on the UI. Project commitment: 20%
- Roberta Sgariglia - Communication Project commitment: 5%
- Luca Vallarelli - Communication Project commitment: 5%

Identified risks

- Poor adoption:
 - The team will work to obtain official approval from relevant EU and national authorities.
- Competition:
 - Other competitors (mostly GPS trackers App) could get the approval from the national authorities before us.
- Technical issues:
 - Interference of Bluetooth LE signals in crowded spaces.
 - Infrastructure scalability

Ethics and security

Ensuring anonymity and being GDPR compliant is our priority. No personal and sensitive data from the users are collected.

The system relies on anonymised data, such as a randomly generated user IDs, the duration in seconds of the interaction, the distance in meters of the detected devices, the timestamp of the start of each interaction and the device operating system. No sensitive data are used to run any analysis.

Covid Anonymous Tracker acts in accordance with European principles. The aim of the project is not to allow people to locate infected patients, but rather to give authorities the right tools to execute the best strategy to limit the outbreaks of the Coronavirus and potential future outbreaks, by allowing them to deploy solutions at scale.

We believe that Italy, as the first country in Europe to deal with the Coronavirus problem at scale, has the responsibility to show Europe what is the right way to proceed.

How it works

1. Every mobile device is associated with a unique and anonymous internal ID, that can be read at distance using high-precision low-distance measurement technology.
2. Covid Anonymous Tracker continuously scans the surrounding environment and collects the IDs of the mobile phones close to you, storing them in a secure centralized cloud database.
3. A network of certified doctors daily updates the database with the IDs of the devices belonging to confirmed positive Coronavirus patients.
4. If you have been in the proximity of a Coronavirus confirmed or suspected patient, you will be notified and get clear instructions on the next steps to follow.

Anonymity Protocol

User app protocol:

- During the setup, the app sends to the backend a request to generate a new anonymous internal ID, that will identify the device and will be saved locally on the device itself.
- Subsequently, the device sends to the backend the ID token created from iOS or Android that will allow the reception of the push notifications. The association between the internal ID of the device, generated by our backend, and the token relative to the push notification is saved on our infrastructure. The token generated by iOS or Android is unique for each application installed on the device and cannot

be linked to the user device. Only Apple and Google know the association between the tokens and the devices.

- The devices continuously advertise via Bluetooth LE technology the internal ID.
- The devices continuously scan the surrounding environment and locally store the internal IDs, if they find any, together with other metadata - such as timestamp and RSSI of the Bluetooth signal.
- Periodically, the devices send to the backend the logged interactions.
- The backend stores the interactions as a sequence of internal IDs on a secure cloud database, Amazon AWS - encrypted S3 buckets, which are not publicly accessible.
- The apps display on the mobile screen their own internal ID as a QRCode.

Medical staff app protocol:

- The medical staff can scan the patient's QRCode and send to the backend the scanned internal ID together with the patient's health status - "Confirmed Case of Coronavirus", "Suspected Case of Coronavirus".
- Given a patient's internal ID, the backend retrieves all the internal IDs which it has been interacting with during the previous 14 days. The backend, using the mapping between the internal IDs and the iOS or Android tokens, sends a push notification containing clear instructions to these devices.

All communications use HTTP over Transport Layer Security (TLS), an encrypted connection via asymmetric cryptography. The certificates are handled by Amazon AWS.