Contact Tracing App for Containing Diseases Spread

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Abstract— **When dealing with diseases spread, infectious epidemiologists play a vital role. To support them, but also to offer a self-protecting tool to everyone in the context of COVID-19 pandemic, we propose a cross platform app to track the infected persons, by using their location history. The paper shortly presents the Covid-19 Contacts Tracker App working principle and technologies, as well as issues related to data privacy and security and how we solve them. We claim that the app might be useful in any diseases spread, not only in the current global situation.**

Keywords— smart app, COVID-19, diseases spread,

I. INTRODUCTION

This year, the humanity was hit by one of the biggest catastrophes of the last 100 years: the COVID-19 pandemic, which led to both human and economic losses. The main effort of the authorities from every country was to limit the transmission of the virus, by isolating the close contacts of the confirmed patients. To do this, pressure was put to infectious epidemiologists all over the world. We propose "COVID-19 contacts tracker", a support tool for them that track the places where a confirmed patient went, so that every person that had contact with him/her can call the authorities or self -isolate. The tool is based on each person social responsibility and willingness to help him/herself and the community. Besides helping epidemiologists and other doctors, the app is extremely useful for self-protection in the context of extensive virus spread.

II. METHODS OF CONTAINING DISEASES SPREAD

Infectious epidemiologists are the so-called "disease detectives" who study the "incidence, distribution and control of diseases and other health-related issues" and have to tackle diseases spread. [1] Of course quantitative methods are applied, but initially data is required. To obtain diseases, spread- related data, two strategies are applied: implementation of a containment method and contact tracing [1, 2]. Technology can highly support the second one, Google Trends being a good example in this regard [3, 4]. Because of COVID-10 occurrence, a lot of IT tools have been developed, many open-source ones, e.g. contract trackers, visualization data tools, even recommender systems to help people discover useful projects in their community [5]. Some proved to be efficient [6], that is why we propose a light app for tracking COVID-19 infected people which can be easily used by anyone and eases the burden on epidemiologists.

III. COVID-19 CONTACTS TRACKER APP

A. Technologies

As cross platform apps became more and more popular, we decided to implement a hybrid architecture of the app: a common responsive interface for both mobile and desktop/laptop users. We decided to create the app using the classical web stack: HTML, CSS, JS, PHP MySQL, with no frameworks. The external libraries and APIs that were used are:

- the Google Maps JS API to represent the marked locations on the map;
- Open Cage Geocoding API to convert an address or the name of a place to coordinates;
- ChartJS to represent the daily number of new cases and the total number of cases.

B. Working Principle

The main features of the app are:
- tracking the cases location;
- geocoding to find the location based on the address, if the patient doesn't have the app installed;
- statistics on the number of new and total cases; user data security and privacy: all the users' data is stored locally, on the phone's internal storage;
- case distance to user calculator;
- nearby cases alerts.

The app runs in the background, saving all the locations where a user has been in the last 14 days locally on the phone, in a JSON file. The file will not be sent to the server unless the user is confirmed with COVID-19. Every time a user opens the app, he/she will see a map on which the locations where the confirmed patients have been in the last 14 days, based on the server's data. The user's device will compare the results from the server with the local ones, and if the user was at the same place, in the same time with a confirmed patient, then he/she will receive a notification. Of course, the success the application is based on each person social responsibility, allowing a doctor to send his/her JSON file with visited locations once he/ she is diagnosed. The workflow of the app is visible in Fig. 1.

The app has two ways of tracking a confirmed patient's visited places:

- automatically- if the patient uses the app, then the doctor can take the JSON file containing the last locations where the user has been from one's phone, and upload it to the server to extract the required data;
- manually- supposing that the confirmed patient does not use the app, the epidemiologist can still add one's locations to the server, manually, through the "Report Case" section of the app; he will either introduce the coordinates, or simply, the address or the name of the visited place (example: "Politehnica University", "Unirii Metro Station", etc) and the geocoding service will automatically retrieve the coordinates.
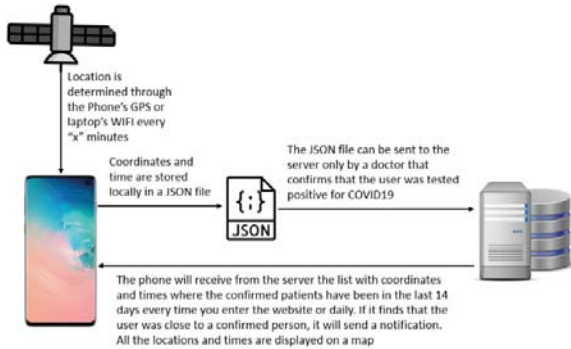

Fig. 1. Workflow of Data in COVID-19 Contacts Tracker App

The app will display all the locations visited by the confirmed patients on the map (red marker) – see Fig. 2. The user's location is automatically detected (blue marker), and the distance to each place is computed. On the left side of the app, the user can see how many places are close to him (less than 1 km), how many are between 1 and 3 km and how many are further away than 3 km. When the user clicks on a marker, the distance toward it, and the time when the confirmed patient was present there are displayed.
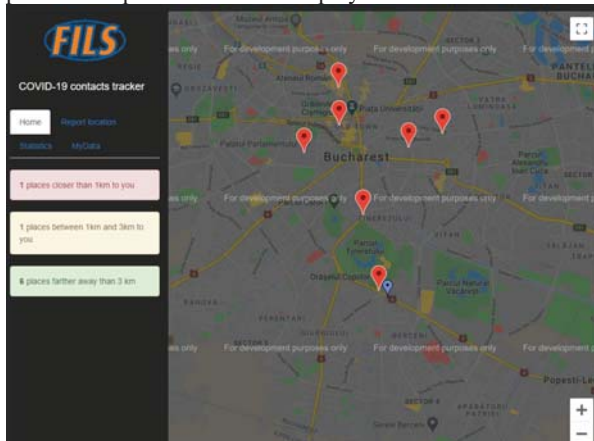

Fig. 2. Confirmed Patients Map

C. Privacy and Security

Because the app handles sensitive data about the users (the location history), we need to be sure that nobody can access this for illegal purposes. This is the main reason why the location history is locally stored and is not sent to any server unless the patient is confirmed. Even when the patient is confirmed, the data is sent anonymously, without any information about the user's name, age or other personal data:

only the coordinates and the time when he/she has visited a certain place are stored. The user can access this local JSON file any time he/she wants, from the "My Data" panel – see Fig. 3, where the app will display the content of the JSON file, as a list.
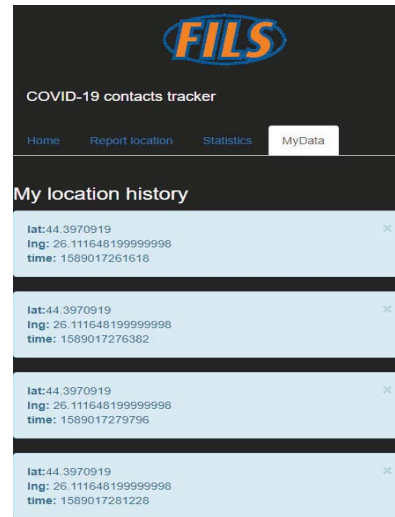

Fig. 3. Location History of Users

IV. CONCLUSIONS

We propose the COVID-19 Contacts Tracker app, which is based on a classical web stack, can be easily used on mobiles, the most famous consumer electronics device nowadays. Although sensitive data about ones' location are the core of our app, strong principles of assuring privacy and security for our users are presented in the paper. The app can be a useful tool for epidemiologists fighting to diminish the virus spread and also for every person fighting to protect oneself and one's community, thus the app has a strong social value. The app can be easily extended to stopping the spread of other diseases as well. For the moment, the app is under consideration by government, as its success depends on its wide us. Average capabilities of smartphones are sufficient for stocking JSON files with user locations.

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