A Novel Approach to Combat a Novel Virus – Global Solution for Contact Tracing using Bluetooth and Intelligent Analytics

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EXECUTIVE SUMMARY

BACKGROUND: Novel Coronavirus (also known as COVID-19) has taken the world by surprise with over 3.2 million cases and more than 233 thousand deaths across the world (as of the date of the publication). Countries have closed their borders, businesses, schools resulting in significant global economic impact. The International Monetary Fund (IMF) predicted the recession could be worse than the 2008 financial crisis or even the 1930s great depression.

CURRENT SOLUTIONS: Without a vaccination for COVID-19, the only tools available to government authorities are social distancing and contact tracing. In response to this, countries around the world are in a race to build a digital solution to track and trace every infected person. In the last few weeks, Apple and Google, Europe & Australia (PEPP-PT), Singapore, India (Aarogya Sethu) and Oxford University in the UK have all come up with their own solutions.

All these concepts propose the usage of Bluetooth technology coupled with Keys/IDs to anonymize the identity of people and dispatch alerts when a person in the contact network is infected. Most of these solutions, however, are in the form of concepts or ideas with implementation details not available to the public yet. Our extensive literature survey reveals that all of these solutions have drawbacks as discussed below.

1. Unrealistically, the current proposals are under the assumption that all people in the contact network are carrying mobile phones. Day-to-day situations (pet walking, jogging, flights, concerts, museums, etc.) where people are equipped with Bluetooth devices (headphones, fit-bit, smart-watches, etc.) rather than phones are not considered.
2. With current apps, **indirect contact tracing is not possible**. Individuals who have been in direct contact with an infected person are alerted and warned. However, the undeniable fact that potentially infected people could also spread the virus, is ignored.
3. Existing proposals use Bluetooth **RSSI signal**, which is **highly unreliable and device-dependent**, to measure the distance. Bluetooth RSSI signal unreliability issues are not addressed.
4. Current proposals do not consider contact context such as a person's state (walking, driving, etc.) or surroundings, therefore, there is a high possibility for triggering **false alerts** to users.
5. Rather than being global, solutions are created exclusively for specific countries. With local or **country-specific solutions**:
    (a) expertise is spread locally, looking solely at country-level data,
    (b) global disease spreading patterns can easily be overlooked,
    (c) weaknesses could start to appear if countries begin cutting corners for financial reasons.

OUR SOLUTION: Our philosophy is to combat the virus by designing a **globally centralized solution** managed by trusted world organizations. Therefore, addressing the above fundamental issues, we propose:

1. An **end-to-end solution** that includes conceptual architecture, a mobile app, hardware simulations, analytical models, and easy-to-understand data visualization of collected data) for effective global contact network tracing.
2. Our solution works not only with phones but with **ANY Bluetooth enabled device.**
3. To address RSSI unreliability issues, we propose **a primitive regression model** to calculate the distance.
4. We combined Bluetooth& GPS technology with **effective analytics and visualization techniques** to infer deeper context details from the proximity data. This is crucial to narrow down the **true contact tracing list**. Using analytics, we can find out:
    (a) the distance between people
    (b) duration spent in proximity
    (c) an infected **person's state** (walking, running, driving or on public transportation)
    (d) whether an infected person is in a **crowded** or **uncrowded** place
    (e) complete chain of **direct and indirect contacts**
5. The questions of ethics and data privacy are not new, these are age-old questions with no easy answers. If policy-makers assure that the data would be used solely for disease control and managed by global organizations such as the WHO, then people would come forward out of civic duty to share their location information.

CONCLUSIONS: Our experiments and results show that, if we rely entirely on Bluetooth for contact tracing there is significant potential for false alerts due to Bluetooth unreliability. Therefore, contact tracing requires deeper context around how the contact occurred (time duration, distance, surroundings, status). Through experiments and visualizations of collected data, we proved that deeper contact context can be achieved if we combine RSSI modeling with analytics.

DEMO: A short 4 minutes video of our end-to-end solution: https://youtu.be/jWSwdXZg17U