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Why Corona Virus mitigation apps will not impact the spread

There has been much talk lately about Corona virus related apps to help prevent the spread of the Covid-19 virus, but unfortunately the hype does not reflect what is technically feasible.

The apps fall into two categories: **Contact Tracing** and **Social Distancing**. The social distancing apps are **forward looking** and simply help you **avoid** crowded areas, whereas contact tracing apps look into **the past** and **notify** you that you might have been infected by another person. A contact tracing app could potentially warn people in real-time that they are in proximity of an infected person which would be the modern-day equivalent of attaching a bell to the infected person's neck.

Contact Tracing App

The aim of such an app is to notify the user that he or she recently (within 14 days) came into proximity with someone who has just been diagnosed with Covid-19. Once notified the user is then expected to self-isolate for 14 days then get tested. The idea for this app sounds reminiscent of the dating app **happn (www.happn.com)** which matches the user with people they have "crossed paths with".

To date there are 43 apps published in 23 countries[1)] with Singapore (TraceTogether) claiming to lead the way. Many other countries are racing to develop their own apps such as StopCovid in France and, CovidSafe in Australia. Germany has very recently abandoned its own effort and decided to back the Swiss based PEPP-PT development effort.

Much of this development is probably a wasted effort as there are several problems with such an app: technical feasibility, participation, privacy concerns, and adherence to the rules.

Technical feasibility:

The main technical challenge is to assess when people come within 2 meters of each other. Contrary to popular perception, GPS is not the answer as GPS is only accurate to about 10 to 20 metres due to clouds, buildings, and other signal interference. (Vehicle navigation apps give you the illusion of high accuracy because the clever software assumes you are on a road and therefore attempts to correct the location error by plotting the driver on the closest road). The other disadvantage of using GPS is that it

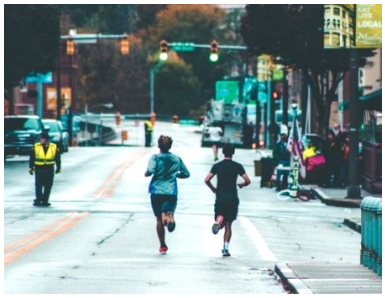
is power hungry and likely to drain a phone battery in less than 2 hours if constantly on, which such an app would require. (You could program the app to have GPS triggered only if the motion sensors in the phone detect movement, but continually listening to the motion sensors is also a drain on battery).

Alternatively, a smartphone can also work out your location by triangulating your position based on the closest cellular network phone masts. Unfortunately, accuracy varies wildly depending on where you are in the country (Central London will be more accurate that the highlands of Scotland) and is at best 100 metres accurate and at worst several kilometres.

Another geo-location technology is the use of Bluetooth beacons which could be accurate within the required 2 metre threshold. Unfortunately, this requires a network of beacons for every 2x2 metre sized cell. That equates to 392 million beacons for greater London alone. This figure could be reduced by using trilateration to perhaps 16 million but this is still unfeasibly high. Furthermore, these figures do not factor the need for beacons on every floor of every building because proximity should be a 3-dimensional measure not 2-dimensional (this problem also applies to GPS).

An alternative to geo-location is to program a proximity detector using a phone's Bluetooth radio or its Wi-Fi radio. Bluetooth would be better than Wi-Fi because it has shorter range and consumes less battery power. Apple and Google are working on a solution based on Bluetooth LE technology. However, neither of these technologies can measure distance, they can only measure signal strength which in practice turns out to be useless for estimating distance in a normal everyday environment[2]. Bluetooth LE has a range of up to 100 meters if there are no obstructions, and about 10 to 20 meters through walls of a building. Trying to measure a 2 metre distance within such performance parameters will lead to many false-positives if people are say 20 meters apart or even just 2 meters apart but safely separated by a sealed barrier such as a wall.

Another problem with this approach is that if you sit in a moving car (or a train), the app will ping hundreds of app users per minute travelling in the opposite direction who all come within Bluetooth range but pose no viral threat. An app developer could consider solving this problem by setting a speed limit (by measuring rate of change of GPS coordinates), but then this will fail to capture the train passenger travelling at speed who is in proximity to others in his wagon. Another solution that could be considered would be to set a minimum time for proximity of say 5 seconds[3], but this will fail to capture events such as two joggers running past each other. Many existing apps are in fact on a 5-minute cycle, so they will fail capture to capture many proximity encounters, which translates to a high false negative rate. There will be many other false negatives as the Bluetooth radio signal is not 100% reliable.



Compatibility

Such an app would need to be compatible across different platforms: iPhone, Android and Microsoft. This is a challenge for developers to overcome, although the recent co-operation between Apple and Google might solve this. It turns out that the contact-tracing app developed in Singapore suffered this very problem. If your app does not detect half the population because the other half uses a different operating system, then the whole endeavour fails.

Participation

Regardless of the location technology used, all the above technologies would require that the vast majority, 80% of the population[4], have the same (or compatible) apps running continuously when they go outside. No existing app has such a high level of penetration, the government would have to mandate the installation and operation of the app. Bearing in mind that only 95% of US adults own a smartphone, and only 88% of smartphones have Bluetooth LE, this is looking like an unachievable target for most countries. Even if it was achievable, the government would need to carry out spot checks that people have the app installed and running; this is a very slippery slope towards a surveillance society.

Privacy

All the above technology solutions will require centralised processing to communicate to users that they have recently been in close proximity with someone diagnosed with the virus. Google/Apple and about half of the existing apps claim to have measures to increase privacy through encryption and decentralisation, but these are naïve measures that will only hinder third parties obtaining the data. All this has obvious privacy implications, but then most people are blissfully ignorant of how much data Google and Apple have on them already.

Adherence

Technology aside, the app can only be of use if the general public uses it and abides by the rules. Will everybody follow through with self-isolation if instructed to do so by the app? If a small proportion of the population fails to do so, then mission creep will lead to enforcement by the State. Catching the virus might be a more attractive option.

Social Distancing apps

Social distancing apps have a different approach: instead of tracking your movements, they help you avoid crowded areas that you are considering visiting.

At the time of writing there seems to be only one app that is actually published under the banner of "social distancing": **crowdless** (www.crowdlessapp.co). Published very recently on the 16th of April 2020, this app helps a user decide **where** to go shopping as it publishes real-time score of 1 to 100 of how crowded local supermarkets are. This app therefore does not affect the user's privacy and will have minimal impact on the battery charge, however it will not inform the user if he or she has been in proximity with an infected person. Crowd data is apparently sourced from Google Maps, although it would ideally need to be cross-referenced with the surface area of the shops to get an accurate measure of crowd density, but it does calculate a ratio to maximum historical occupancy

Although such an app may reduce the user's chances of catching the virus by avoiding more crowded places on a particular day, I believe it will **not** reduce the spread of the virus in the total population over time. This is because, by diverting people from their intended destination to an alternative destination, the app will increase social mixing. Why? Because, to hinder the spread of a virus: it is better to come into proximity with the same hundred people every day than to come into proximity with a different set of 50 people every day. That said, people will be tempted to use this app as it represents the classic "prisoner's dilemma". To address this, the developers of the app report that they are working on a forecasting feature to help people select a time to visit a particular store instead of selecting a store.

In conclusion, the less ambitious social distancing apps may add some value to their users but contact tracing apps are very likely to be unfit for purpose as they face too many barriers, not just technological. No doubt there will be a continued frenzy to develop such apps in many countries, due to government pressures and well-intentioned marketing executives, but slowly the majority of these will be dropped for the reasons listed above and those that are already published will be reviewed in a year's time as having been ineffective.

Marc de Gentile-Williams

1) source: https://www.top10vpn.com/news/surveillance/covid-19-digital-rights-tracker/
2) distance estimation based on signal strength can work under laboratory conditions, but will fail in everyday situations because of factors like different handsets being used, handset orientation, environment etc.
3) a double ping from another handset is unlikely to take less than 5 seconds due to operating system constraints.
4) some sources claim 60% would be enough, however we have seen measles re-appear when vaccination rates drop below 80%.

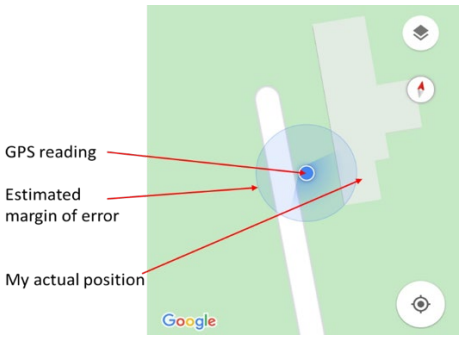
Why Corona Virus mitigation apps will not impact the spread - UPDATE

Following the earlier publication of an article on why Corona related apps will fail to impact the spread of the virus, we have received many queries from readers. Many people questioned the assertions that neither GPS or Bluetooth were accurate enough to measure proximity of 2 metres or less. So instead of providing numerous web links to experts who make similar claims, I will explain how you can test both these technologies on your own device very quickly and reach your own conclusion in less than 5 minutes.

A) GPS is only accurate to about 10 to 20 metres

Using your smartphone:

1. Switch on GPS
2. Google "where am I"
3. In the results you will see a map of your local area. Click on the map and zoom into the blue disk which represents you.



You will notice the following:

- The blue disk is several metres away from the spot where you actually are (if you are exactly on the spot then that is due to luck!)

- There is a bigger transparent blue disk centred on the small blue disk: this represents the estimated margin of error – you are very probably within this bigger disk
- If you stay put and examine the map for a few minutes, the small disk will move around even though you are stationary, and the bigger transparent disk will vary in size. This is a manifestation that the GPS reading is fluctuating
- The diameter of the bigger disk never gets smaller than 20 metres

If you have access to a second phone, do the same exercise and compare the results of both phones. Ideally use different phone models as similar models give similar results.

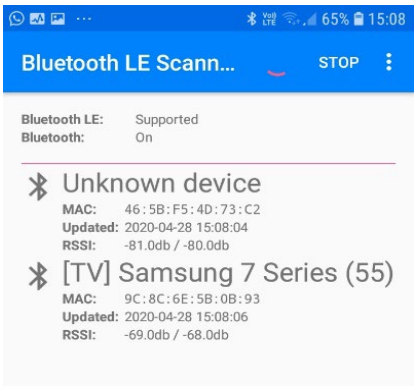
You will conclude that accuracy is very rarely less than 2 metres and is on average about 10 metres.

B) Bluetooth LE cannot measure distance usefully

Ideally you should use two smartphones, but in most cases you test with only one.

1. Make sure Bluetooth is switch on, on (both) your handset(s)
2. Go to the Apple app store or Google play store
3. Search for "Bluetooth signal strength". Several apps will be listed.
4. Pick one of the listed apps and install it. (The app Bluetooth LE Scanner works well)
5. Depending on the app, click scan or start
6. A list of Bluetooth devices will appear. Some will have device names, others will be listed as "unknown".
7. Look at the "RSSI" or signal strength reading. The number is measured in negative db. The smaller the absolute number the stronger the signal. In ideal conditions distance can be estimated based on this reading.
8. If you stay still you will notice that the reading is erratic and will go up or down
9. Try pointing your device in different directions and you will see the reading change
10. If you walk towards the other device, the reading should show a stronger signal, but this does not always happen.

By doing the above and observing the readings you will realise that there are a lot of random variances and that the readings are very unreliable. Consider also that different devices (with different components) will give very different readings and you can conclude that Bluetooth is a very unreliable way for an app to measure proximity under 2 metres.



2 metres or 10 metres, why it matters

It would not matter too much if the apps measured 3 metres instead of 2 (as the experts are not whether 2 metres is a safe distance anyway), but the greater the "capture" radius, the greater the number of people who will be falsely traced. If an app captures people within a 10 metre radius instead of 2 metre radius, that is a surface area 25 times greater and therefore will probably trace 25 times more people: 96% of people traced will be unnecessarily inconvenienced. Not only this will have a huge impact on the economy, but most people will simply refuse to go through the inconvenience of self-isolation if they realised there was a 96% chance that they had not even come within 2 metres of the infected person.