Corona Contact Tracing App

This is an analysis of the Dutch corona contact tracing app (Coronamelder). The app is a mobile application that helps to map corona infections. The app works on the basis of bluetooth. Whenever your phone (with the app) is near another phone (with the app), a digital 'handshake' follows. If you become infected later, everyone who has been in your area during a certain period can be notified.

The app works completely anonymously. A random number is generated and shared, numbers are deleted after a certain period of time.

You can only indicate that you are infected with a special code from the health service (GGD).

The data is collected centrally to be able to send reports and analyze patterns.

The purpose of the app is to further slow down the spread of the virus (while awaiting a vaccine or effective treatment) and thus safeguard the limits of the health care capacity.

The app is part of a large set of measures like washing your hands, 1.5 meters, getting tested and staying at home when you have symptoms.

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Impact on society
What impact is expected from your technology?

What is exactly the problem? Is it really a problem? Are you sure?
There is a corona crisis. A new virus leads to a disease that affects many people, as many people are susceptible to it. The disease is deadly for a small group of people. In most cases these are elderly and / or vulnerable people. Because the disease spreads quickly, many people end up in hospital and in ICU, leading to an overload of the care system and - in the worst case - a situation where not everyone receives the care they deserve. This has to be prevented.

It is therefore important to ensure that the disease is limited and spread in a controlled manner so that the pressure on the health care system does not become too great. This can be done through a so-called lockdown (people have to stay at home, schools and companies close), but this leads to major economic and social costs.

People with the disease caused by the corona virus (Covid-19) often have mild symptoms that allow them to walk around with their disease for a while and infect others without their or others knowing. The app therefore keeps track of all contacts via bluetooth, so that anyone who uses the app and is potentially infected can be informed and can take measures.

In this way, it is easier to find a balance between 'normal life' on the one hand and preventing overburdening of care on the other.

The app is part of a large set of measures, such as extensive testing and staying at home if you have symptoms.

The app is in no way a solution. It is part of the solution.

Are you sure that this technology is solving the RIGHT problem?
The real solution is a vaccine and / or an effective treatment. The app addresses the problem of limiting / controlling the spread with the aim of not overburdening care.

The app is part of a broader package of measures, such as the cancellation of major events and the 1.5 meter distance rule.

This is how the app should be seen: not as the solution, but as part of a set of measures.

The contact tracing investigations are now done by Dutch health care institutions (GGD), the app can help relieve some work pressure.

The app can provide data that results in better understanding of the spread of the virus.

How is this technology going to solve the problem?
There is a corona crisis. The corona virus spreads through infected people, especially people who show symptoms, but also just before they show symptoms. If infected people have been in contact with other people, those other people should be informed so that they can prevent themselves from infecting other people in turn (stay at home, get tested if you have symptoms, be aware!).

The idea is that a bluetooth connection keeps track of which other phones you have been in contact with (and for how long). That way, the owners of those other phones can be notified if they have been in contact with an infected person for 15 minutes or longer. This must prevent the spread because those people then can take measures (stay at home, get tested if you have symptoms).

The app works better if (1) many people from all age groups use the app. In the Dutch version there is no minimal number of people that should install the app, because the app is just part of a set of measures.

For some foreign apps it was estimated that 60% of people should install the app for it to be effective. But even in countries with a great deal of experience with infectious diseases and technology, such as Singapore, only 20% installed the app.

It is also unclear where the 60% comes from. After all, with the much-discussed 60% penetration of the app, the chance that random person X has the app is 0.6 and the chance that random person Y has the app as well. The chance that a contact can be successfully logged when XY (i.e. their devices) meet is then (only) 0.6x0.6 = 0.36. If only 40% installs the app, effectivity becomes only 0.16.

This is like rolling a dice. On the other hand, if it helps a little bit, it still helps!

Options are to make it mandatory or to use radical strategies, such as, link it to an app that everyone already has (Whatsapp, for example). However, these strategies have other major drawbacks.

This is all not relevant for the Dutch app, because the CCTA is positioned as part of a larger set of measures. If it helps a little it is succesful.

In addition (2) it is important that people take action if they are potentially infected according to the app. The question is whether people actually do that. What prevents them from quickly removing the app in those cases? Or

ignoring the message?

What (3) does not help is that it is very unclear how well the system works via bluetooth. There is a good chance that the technology will give (many) false positives and negatives. Bluetooth goes through walls and glasses. If your neighbor is infected, there is a good chance that you will receive a warning, while that is not correct. This reinforces itself. If an app does not work, trust will disappear and the app will be used even less.

Options other than bluetooth are not obvious. Location via telephone towers, GPS and WIFI all have major disadvantages, such as accuracy, coverage and / or not working indoors. And then there is privacy, of course.

In addition, setting a specific contact time (15 minutes) leads to false results. After all, you can give a kiss in a few seconds and you can also sit with someone for an hour with glass in between. Or outdoors with 1.5 meters in between.

And what if you (think you've) already had corona? Don't / shouldn't you use the app? If you have been around someone who has been infected, and your status goes to potentially infected, is that not justified? Can you ignore it ?

The app is completely anonymous. However, this is at odds with the quality of the report. If you have more data, you can better estimate the probability of whether you are really potentially infected.

In addition, the technology only works well if people actually take measures after the app has determined that they are potentially infected. That is not part of the app, and can only become part if the anonymity is (partially) released.

However, when the corona app is positioned as a measure that allows people to take their own responsibility, that is no problem.

From a technical point of view, it is likely that the app - with bluetooth - drains the battery a little bit more (3-6%).

What negative effects do you expect from this technology?

There are many negative effects that can be imagined. For example, people who do not want to install the app can experience negative (social) consequences.

'Gentle' coercion can become part of our daily life. Are people going to ask each other to show that they have installed the app?

Of course by law this is not permitted.

You can not show the status of the app, because the message that you are potentially infected disappears. This is a good thing. Otherwise there would be a risk that showing the status would become normal in public life and / or between friends? Or with retailers, schools, hairdressers that demand that you first show the status of your app before you can enter?

The anonymity of the app also offers opportunities to harm other people. Say you are infected and you decide to inform other people (you can do that with a special code you get from the 'GGD'). Because you know who you have been in contact with during the previous period, you can start shaming people.

For example, you have been to the hairdresser. A few days later you are infected. You choose to let other people know. So, you know the hairdresser will get a warning and if he/or she does not go into quarantine you can shame him for being irresponsible and/or not using the app.

Maybe some people will be forced to use the app this way even if the law says you can not force them.

This brings us to another point. People who have vital professions are often more active in society or are more in contact with risk groups. This applies to healthcare personnel, but also supermarket personnel, parcel deliverers, etc.

Chances are they will become potentially infected pretty fast. That is precisely not the intention of the app: keeping the economy open.

And there is a flipside, namely that people feel (incorrectly) safe if they have no symptoms and their app say that they have not been near an infected person. After all, this means nothing, certainly not with smaller numbers of users.

It is also expected that certain groups, with enough money, attention and digital skills, will use the app much faster than other groups, turning a digital divide into a biological one.

In what way is this technology contributing to a world you want to live in?
The technical shortcomings and the potential negative effects prove that - without letting go of anonymity - it is almost impossible to design a reliable app.

That sounds bad, but actually is a good thing.

It means that the app can only be used as part of a set of measures and that the app only works if people take their own responsibility as a result of the extra information. Just like you have to stay home now when you have

symptoms, or know someone who has symptoms, the app adds information to that. The app makes you more aware of symptoms for example.

That's a world we want to live in. A world in which people are empowered to make informed decisions.

Still, even with the anonymous app there are ways to shame other people. This is exactly the world we do not want to live in.

Now that you have thought hard about the impact of this technology on society (by filling out the questions above), what improvements would you like to make to the technology? List them below.
The app is new. Maybe, given the above, the temptation could be great to tinker with anonymity. That should therefore be made impossible by design. Also shaming with the app or forcing people to use the app is something that should be closely watched even if it is regulated. Finally if you are potentially infected, you should be empowered to make good decisions, like when and how you need to be tested (easier, faster!).

Hateful and criminal actors
What can bad actors do with your technology?

In which way can the technology be used to break the law or avoid the consequences of breaking the law?
In the app you can change your status to infected but only with a certified code. If you hack the code you can use that to get other people into trouble. You can go to shops, hairdressers, you can stand near people, hang out in front of their houses, etc ... to also give other people the status of infected. Also if you are infected, and you choose to let people know about it via the app, then you know who knows. So you can shame other people for not going into quarantine or not using the app.

Or maybe someone will build a super 'infected' bluetooth transmitter to potentially infect as many people as possible in one go.

If it is possible, I am afraid it will happen.

Can fakers, thieves or scammers abuse the technology?
What if you refuse to install the app? What if you don't have your phone with you all the time? What if someone asks to show you your phone, to show that you are using the app, and you don't want to? What if shops start asking if you want to show your phone first? Maybe that's not allowed at all, but that doesn't mean it's not going to happen!

Show us you use the app! Especially if you have are a hairdresser, waiter, dentist, etc..

In any case, you can say that using the app or not is already very sensitive information, luckily there is no status (infected or not) only a message that will disappear. But what if someone hacks into that and can read the messages?

Does Apple or Google know who is using / has downloaded the app and who did not?

What if someone is smart enough to develop a different app that spies on your corona app on your phone or sees messages?

Can the technology be used against certain (ethnic) groups or (social) classes?
We don't immediately see any way the app can be used to discriminate, except between groups who use the app and those who don't (see below).

However if you have a contact occupation (hairdresser) than chances are large that you will be potentially infected, so will you use the app?

Another question that must be answered is: Will children also (have to) use this app and if so, from what age?

In which way can bad actors use this technology to pit certain groups against each other? These groups can be, but are not constrained to, ethnic, social, political or religious groups.
It is conceivable that the app will lead to tensions between different groups. Namely those who use the app and those who refuse to use the app. It has already been mentioned that people may force each other to show that they use the app.

You already notice a conviction of people who do not (sufficiently) adhere to the lockdown rules, but what if people do not use the app? Will they also be blamed and shamed?

Maybe there will be a social media hashtag #showustheapp!

How could bad actors use this technology to subvert or attack the truth?
Fake News is lurking, as always.

Are there fake apps that give wrong information? Will there be manipulated images of people who are (unjustly) potentially infected? Or from people who don't use the app, when that's not true (or vice versa?)

Now that you have thought hard about how bad actors can impact this technology, what improvements would you like to make? List them below.
If you can find a way to change your own status to infected you can start 'digitally contaminating' other people. This can be very harmful. This has to be a very secure process. In this way you reduce the chance of wrongfully 'digitally contaminating' others. Given the sensitivity, it is very important to take extra measures that make it (virtually) impossible to hack, spoof, manipulate the app, etc. But also prevent people from knowing if you are using the app or if you have downloaded it.

Also if you are infected you can know who knows and you can start shaming people for not using the app or - even worse - not going into quarantine. This should be outlawed.

Privacy
Are you considering the privacy & personal data of the users of your technology?

Does the technology register personal data? If yes, what personal data?
No, it does not. The app registers with which other phones you have been in contact (via bluetooth). This is done by randomly generated numbers. There is no data on persons, location or other things that can be traced back.The data is stored anonymously and used for research into the spread of the corona virus. The app is downloaded via Apple and Google, it is unclear if and how this information is registered. Using/downloading the app is also very personal sensitive information.

Do you think the technology invades the privacy of the stakeholders? If yes, in what way?
Certainly.

Although the data is anonymous, privacy is something else completely. The corona app tells you that you have been in contact with an infected person, that you are therefore potentially infected and the advice is to take measures, such as stay at home! That is indeed an invasion of your privacy. It can also be invasive for your roommates or family even if they are not using the app.

It is true, however, that it can be stated (by the government) that the degree of invasion of privacy is in proportion to the (social) interest (controlling the spread of the virus and relaxing the lockdown measures). In addition, lockdown measures are in themselves also an invasion of privacy.

The app can help prevent a lockdown.

Is the technology is compliant with prevailing privacy and data protection law? Can you indicate why?
The Dutch Privacy Authority is critical. There are three issues.

First of all, no agreements have been made with Apple and Google about the use of their bluetooth technology with which the app works.

Secondly, there must be a law to properly regulate the use of the app, for example that the catering industry or employers may not oblige you to install the app. Work is currently being done on this (update: the law has been approved)

Finally, the servers that the app uses in order to work must actually be secure. They have not yet been checked. We do not the exact status at this moment.

Also, the app is downloaded from the Google and Apple stores. To download you need an account. Are these downloads registered?

Finally, the app only works on smartphones which are in most cases devices that have a problematic relationship with privacy and data protection.

Does the technology mitigate privacy and data protection risks/concerns (privacy by design)? Please indicate how.

The corona contact app uses bluetooth. Therefore, no location data is required, which entails enormous data minimization. It is not necessary to enter data on the corona app and the data that is collected is anonymous (it generates random codes).

However, the anonymity also really harms the functionality of the app. One solution could be to investigate if intensive use of cryptography and / or blockchain architectures, with associated protocols, could create a more functional app.

It is good to establish legally when the app will be deleted.

In which way can you imagine a future impact of the collection of personal data?

The big question is whether the current data in the current app will suffice in the future. What if more data is needed anyway? What if the outbreak gets worse? What if the government decides that the data should be kept for future outbreaks? What if the app is also interesting for other infectious diseases? What if the app can be linked to a biometric device that measures your temperature? What if there is a solution that is almost anonymous?

There is a feeling that the app opens the door to a future in which the (constant) measurement of health becomes normal? This reminds us of a statement by Yuval Noah Harari: "This storm will pass. But the choices we make now could change our lives for years to come"

Now that you have thought hard about privacy and data protection, what improvements would you like to make? List them below.

The app is anonymous. Maybe it is wise to investigate if things like cryptography and blockchain can help create a better, anonymous app.

Also it is interesting to investigate if and how Apple and Google register if you have downloaded the app (or not). Having downloaded the app in itself is

already sensitive information.

Human values
How does the technology affect your human values?

How is the identity of the (intended) users affected by the technology?
The app has a lot of impact on users. People are reduced to a few values: infected, potentially infected or not potentially infected. Or maybe user or 'refuse-to-user'. Because the disease has very variable syndromes and the app will not work perfectly, that is a complicated categorization. Are you infected with severe symptoms or infected and asymptomatic? Are you rightfully potentially infected or not? Are you rightfully potentially not infected or not? Are you responsible. You can not use the app and still be responsible.

The corona app is therefore very prone to stigmatization. Are you infected according to the app, may be the question of the time to come. But it also means that you can begin to see yourself that way. It also means that you are unfairly worried, or unfairly not.

Also people can be reduced to a app-user or someone that is irresponsible because they do not use the app.

The app is actually not nuanced enough, but further nuance is very hard without harming the premise of anonymization.

How does the technology influence the users' autonomy?
The app has a lot of influence on the ability to make your own decisions.

First of all, the app is not mandatory, so you can make the decision whether or not to install the corona app. However, it is not difficult to foresee scenarios in which 'soft' coercion arises from friends, colleagues, school, etc. to install the app.

Second, you can argue that the corona app helps you make better decisions about your isolation / quarantine. After all, you know that you are potentially infected, so you can make better decisions.

On the other hand, you could also say that the corona app makes a decision for you. Can you morally ignore the app's advice? Even if you don't have any symptoms at all and you know the app could be wrong? And what about people that do not use the app but are in close contact with you like co-workers, roommates or family.

People tend to underestimate risks. So there is a good chance that potentially infected will be downplayed (the app will be wrong) and that 'in the clear' will be embraced (we can have a party!)

In addition, it is quite conceivable that there will be people who will 'obey' such a corona app preventively, and go into self-isolation to prevent the app from indicating potentially infected. That's another way the corona app can make a decision for you.

Psychology has already known that if we make cars safer, drivers often behave more recklessly. Better technology then ensures that people take less responsibility because they think that technology will take over from them.

In general, it can be said that it is always not a good thing that there is a responsibly shift to technology.

Finally, the corona contact app does and analyzes all kinds of things via bluetooth. These processes are hidden from the user. They go automatically. It is worth considering to build in an active action ('waving with your phone', as Bart Jakobs) suggested, to make the user an active part of the app.

What is the effect of the technology on the health and/or well-being of users?

The corona app is of course intended to protect the health of the community and therefore indirectly that of the individual user. The corona app itself does not do that for an individual, it is only reactive.

It is quite conceivable that the corona app will lead to continuous unrest among users. It can cause anxiety every time your phone buzzes (maybe you are potentially infected).

Now that you have thought hard about the impact of your technology on human values, what improvements would you like to make to the technology? List them below.

The app has to be surrounded with a lot of extra information, which helps to allay unnecessary worries for people. It may be wise to build in human actions like waving or connecting. In addition, it is very questionable whether an app is desirable in the first place.

After all, an app can be deleted after a crisis, the impact on the population cannot!

Stakeholders
Have you considered all stakeholders?

Who are the main users/targetgroups/stakeholders for this technology? Think about the intended context by answering these questions.

Name of the stakeholder
Corona Contact App User

How is this stakeholder affected?
The user of the app can see whether he / she has been in contact with an infected person. The user of the app (automatically) informs other people if he / she is infected. The user is social towards other people and has better information to make decisions for himself.

Did you consult the stakeholder?
Yes

Are you going to take this stakeholder into account?
Yes

Name of the stakeholder
28/5000 Corona Contact App 'Refusor'

How is this stakeholder affected?
Those who refuse to use the app don't have to worry about privacy and / or false positives either. However, he can feel guilty and runs the risk of being stigmatized and / or excluded from all kinds of social activities.

Did you consult the stakeholder?
Yes

Are you going to take this stakeholder into account?
Yes

Name of the stakeholder
Government (bodies)

How is this stakeholder affected?
The government will want to monitor the effects of the app on the one hand, but also want to analyze the data in the app on the other. In addition, they make the surrounding laws for the use of the app (compulsory / not compulsory? - Can you ask or not?)

Did you consult the stakeholder?
Yes

Are you going to take this stakeholder into account?
Yes

Did you consider all stakeholders, even the ones that might not be a user or target group, but still might be of interest?

Name of the stakeholder
Healthcare

How is this stakeholder affected?
It is quite possible that healthcare will become the authority that can indicate in an app whether someone is infected, depending on the protocol to be chosen. When determining infections, it is therefore also necessary to consider how this will work, even if people are infected who do not have an app.

Did you consult the stakeholder?
Yes

Are you going to take this stakeholder into account?
Yes

Name of the stakeholder
Provider of (social) services

How is this stakeholder affected?
In a one and a half meter economy, retailers, catering providers, etc ... have to ask themselves how they want to use the app. Do they want to allow consumers who do not want to / cannot show the app? Is that allowed just like that?

Did you consult the stakeholder?
Yes

Are you going to take this stakeholder into account?
Yes

Name of the stakeholder
Police

How is this stakeholder affected?

What if people can prove that they are not potentially infected, and thus argue that they can sit together?

Did you consult the stakeholder?
Yes

Are you going to take this stakeholder into account?
Yes

Name of the stakeholder
People with a contact profession

How is this stakeholder affected?
These people have to behave responsible, so install the app. However chances are enormous that it will lead to potentially infected and harm their income.

Did you consult the stakeholder?
Yes

Are you going to take this stakeholder into account?
Yes

Name of the stakeholder
People close to app-users

How is this stakeholder affected?
Say you do not want to use the app, but your family, roommate or co-worker does, what does that mean? What if the user is potentially infected?

Did you consult the stakeholder?
No

Are you going to take this stakeholder into account?
Yes

Name of the stakeholder
Unknown

How is this stakeholder affected?
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Did you consult the stakeholder?
No

Are you going to take this stakeholder into account?
No

Now that you have thought hard about all stakeholders, what improvements would you like to make? List them below.
There really should be a discussion on people that refuse to use the app and people in vital or contact professions. In a worstcase scenario the CCTA can lead to more things closing down instead of preventing a lockdown.

Data
Is data in your technology properly used?

Are you familiar with the fundamental shortcomings and pitfalls of data and do you take this sufficiently into account in the technology?
Yes, the limitations are clear. The data that is collected is about proximity to other phones (not people) and it is unclear what barriers exist between the phones. A cashier behind glass, who is infected, can potentially (digitally) infect people all day long, without actually infecting them.

The limitations of the data are deliberate choices, as they contribute to the anonymity of the app.

Also the chosen time period (15 minutes) has its limitations. You can infect someone in seconds (with a kiss) or not infect someone in hours (outdoors with 1.5 meters between you).

How does the technology organize continuous improvement when it comes to the use of data?
The app is temporary. So this is not necessary.

Unless you like the app so much that someone decides that it can also be used in other situations / over a longer period of time. Then what do we do?

In both cases, it is wise to get better at recognizing patterns in the data that is collected.

How will the technology keep the insights that it identifies with data sustainable over time?
These questions are irrelevant, as the corona app will be terminated after the end of the corona crisis, at least we assume that for now.

In what way do you consider the fact that data is collected from the users?
In no way is there a commercial underlying model.

Now that you have thought hard about the impact of data on this technology, what improvements would you like to make? List them below.
It is wise to legally determine when the app will be terminated. It is also important to communicate the shortcomings of the app to the user, so they can make better decisions.

Inclusivity
Is your technology fair for everyone?

Will everyone have access to the technology?
Yes, however, the disease is mainly dangerous for the elderly.

This is precisely the target group that has less affinity with smartphones and apps. However, in principle the app is intended to contain the spread of the virus, not directly protect individuals. Not having access to the app does not have a direct negative influence.

Does this technology have a built-in bias?
There is a strange contradiction in the app. A goal of the corona app is to keep society as 'open' as possible and at the same time prevent the spread of the virus. However, professions that are important for the vital infrastructure, such as people in health care, parcel deliverers, teachers, etc ... are much more in contact with people and have a much higher chance of becoming potentially infected, this - if they then isolate themselves - can have a negative impact on keeping the economy open.

This is unfortunate especially if the isolation does not materialize in disease or symptoms. Also people in contact professions like hairdressers can be really harmed by this app.

Women are more likely to carry their phones in a purse, men on their bodies. Does this affect the reach of the app?

The first studies show that women become less ill and / or die less quickly from corona than men. At the same time, proportionally more women than men work in the healthcare and education sectors. What does that mean?

Does this technology make automatic decisions and how do you account for them?
If someone is infected, all people who have been in contact for a certain period of time are automatically notified. This is an automatic process and it is a calculation using time and vicinity. This calculation is explained.

There is no 'probability-calculation'. It is potentially infected or not,

Is everyone benefitting from the technology or only a a small group? Do you see this as a problem? Why/why not?
In principle, the corona app is designed to benefit everyone as it helps to limit the spread of the virus and keep the economy as open as possible.

The questions that normally apply to technology, about the disruptive impact, are less relevant, since the disruption by the virus is already complete. The corona app rather contributes to normalization.

The most interesting question is how people will be prevented - with wide use - from being classified and assessed on the basis of the status of the app and what that means for the social structures. Especially for some professions.

Does the team that creates the technology represent the diversity of our society?
We do not know.

Now that you have thought hard about the inclusivity of the technology, what improvements would you like to make? List them below.
It would be nice if the probability of the potential infection could be indicated, so that it is not an automatic yes / no decision, but rather a scale.

In this way, people can make a better assessment based on a total picture (age, profession, health, symptoms). They can decide when they need to be tested.

Transparency
Are you transparent about how your technology works?

Is it explained to the users/stakeholders how the technology works and how the business model works?
It is important to explain how the technology works. When does someone get infected status? Who does that? When will other users be notified of a potential contamination? What does the status of potential contamination mean? What happens to the collected data? This is all very well explained.

There is no underlying business model.

If the technology makes an (algorithmic) decision, is it explained to the users/stakeholders how the decision was reached?
There is a general explanation on how the app works. There is no specific explanation on individual cases. You do not know where or when you were potentially infected. You do not know how long or how often you have been in the vicinity of an infected person? This is by design (privacy), but not very transparent

And also, there is no feedback loop, so the app can improve over time (i had the status infected, but did not get corona or vice versa).

Is it possible to file a complaint or ask questions/get answers about this technology?
That should certainly be possible. The app is part of an open democratic debate. The source code of the appathon, for example, is now publicly available.

Is the technology (company) clear about possible negative consequences or shortcomings of the technology?
That's really important. There are many possible negative effects and there are false positives. It is good to report this honestly and explicitly in advance.

Now that you have thought hard about the transparency of this technology, what improvements would you like to make? List them below.
The CCTA benefits from transparency and that means that - where possible - it should be as clear as possible how the status of potentially infected has been reached, and what that means.

Sustainability

Is your technology environmentally sustainable?

In what way is the direct and indirect energy use of this technology taken into account?

It is to be expected that the corona app will consume more energy because of the intensive use of bluetooth, which means that phones will have to be charged more often. The data is stored on servers. These also consume energy.

In the light of the current debate, the current crisis and the temporary nature of the corona app, this does not seem very important now.

Do you think alternative materials could have been considered in the technology?

Not relevant

Do you think the lifespan of the technology is realistic?

The intention is to terminate the app once the virus is under control.

What is the hidden impact of the technology in the whole chain?

Not relevant

Now that you have thought hard about the sustainability of this technology, what improvements would you like to make? List them below.

None

Future
Did you consider future impact?

What could possibly happen with this technology in the future?
The best solution is a vaccin, but maybe the corona contact app helps to contain the virus, because it stimulates responsible behavior. It is important to immediately terminate the app after the crisis, or new problems will arise.

Sketch a or some future scenario (s) (20-50 years up front) regarding the technology with the help of storytelling. Start with at least one utopian scenario.
The most utopian scenario in this case is that we do not solve the problems with an app, but with other technologies, such as a vaccine or good treatment methods.

The most utopian scenario consists of a world in which we always have (fast) vaccines and treatment methods so that pandemics do not break out or are no longer a problem.

Apps that determine whether you are (perhaps) infected do not play any role in this.

Sketch a or some future scenario (s) (20-50 years up front) regarding the technology with the help of storytelling. Start with at least one dystopian scenario.
The dystopian scenario is that people everywhere and at all times are classified on the basis of healthy / unhealthy or potentially infected / not potentially infected and that they are continuously measured.

Perhaps people will always wear a biometric device that checks temperature, perhaps blood values are continuously tested with microdrops and this is linked to a conclusion (potentially infected or not). The moment you have infected your potential, you have to isolate yourself. This almost automatically applies to people in your environment.

Whether you isolate yourself is also checked by the app, which acts as an electronic ankle bracelet.

Would you like to live in one of this scenario's? Why? Why not?
We like the utopian scenario.

What happens if the technology (which you have thought of as

ethically well-considered) is bought or taken over by another party?
This is an important point. Is the corona app really terminated when the virus is under control? Are there commercial parties that also have a corona app? Will they continue to use (parts of) the app?

Impact Improvement: Now that you have thought hard about the future impact of the technology, what improvements would you like to make? List them below.
Legally determine when the app will be terminated.