Humans and Robots in Times of Quarantine Based on First-Hand Accounts

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ABSTRACT

A quarantine is an effective measure in order to contain a disease and it is needed to be used more often in current times. Quarantine forces people to have minimal to no social contact with other humans for a certain period of time. Past work says this isolation can have a serious psychological impact on people's lives, which can have dramatic consequences. Research can help find the positive and negative experiences of people in quarantine, in order to determine their needs. But how do people respond to quarantine according to their own self accounts? We look to a video platform as a unique opportunity to explore this question. Robots can be used in times of quarantine so isolation can be maintained. However, these robots should be matching the actual needs of the people in quarantine in order to have an effect. This research will use a content analysis of first-hand accounts of people in quarantine in order to find their experiences and needs. After that, there will be an analysis of robots that are used in times of quarantine. Lastly, these two analyses will be used to find out if the robots match the needs of the people in quarantine. We report on two major components to first-hand social media quarantine accounts: emotional response and procedural explanations provided by detainees, and explore potential reasons for them choosing to share these types of content. On top of that, we report on robots that are mentioned by social media, the tasks that they do, and the needs they fulfill. This research will expand on the current knowledge domain of needs in quarantine and will also add to the knowledge domain of the effectiveness of robots in quarantine.

Keywords

Quarantine, first-hand account, YouTube, robots, needs, content analysis

1. INTRODUCTION

During a global disease outbreak, containing the spread of a disease is very important in order to save lives. In these times quarantine measures can be put into place to minimize the contact that people have. This will prevent a virus from spreading [1] to other people quickly and it can prevent the hospitals from overflowing. However, being in quarantine can have several effects on people. It is useful to investigate these effects and how people cope with them. Some research has already been done about the experiences of people in quarantine [8, 9, 11, 24, 33]. These studies have interviewed people in retrospect and asked them questions about their feelings, either positive or negative. With a significant amount of responses, they could document trends in their data. However, these studies are done after the actual quarantine is over, as it is difficult to have interviews with people when they are quarantined. As people tend to forget their experiences quickly, an interview during their actual quarantine can give a better perspective of the actual experiences that people have during the quarantine. Effects such as false recognition and aging memory lead to people misrepresenting their actual experiences [28] of a quarantine when the research is done after the intended quarantine is over. This is why analyzing first-hand account videos of people during quarantine can give a better perspective of the actual experiences and needs. Social media has been used before in different fields to research news topics. YouTube has been used in prior epidemics [2, 12], or for content analysis about self-driving cars [7]. This led to the following research question.

- What feelings and needs does one experience in quarantine according to first-hand accounts?

Next to that a quarantine due to a pandemic brings other difficulties. As diseases are often transmitted during direct or indirect contact, human-to-human contact should be prevented as much as possible. This is however difficult in some situations, as humans are often used to doing certain tasks, due to tradition or formality. A quarantine situation can change these norms, as normal contact is not allowed anymore. This is where robots can be of help. As robots are becoming smarter over time, they can be used in a quarantine to replace human tasks and prevent extra contact and cross-contamination[19]. The use of robots in quarantine is not researched that much, as these situations do not happen often. This led to the following research question.

- How are robots used in quarantine situations?

Although some research has been conducted in the field of the effect of a quarantine, the studying of patients during quarantine itself has lacked.[5] It may be possible to increase acceptance of healthcare robots by properly assessing the needs of the human user and then matching the robot's role, appearance, and behavior to these needs. This paper will analyze first-hand accounts of people in quarantine to see what their experience/reaction is and what their basic needs are, and will also look into the reported robots that are used in quarantine. These analyses

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will be combined in order to see whether these robots fulfill the needs of people in quarantine times. This led to the following research question.

- In what sense does the use of robots match the needs of someone in quarantine?

The three research questions will allow us to answer the main research question.

What matches can be found between the reaction and needs of people in quarantine and robots that are currently used in quarantine situations using publicly available videos as reference material?

In this research, I will use content analysis to study videos of people and robots in quarantine, found on the video platform YouTube. These videos will be reviewed by the researcher, who will make notes based on some basic categories. An example of a category can be "uncertainty over procedures". These first-hand account videos can give a better insight into how people are responding to the quarantine, what needs they have, and how robots fulfill certain purposes. The main focus of this research will be on the Coronavirus pandemic, as the current situation highly favors these videos over previous epidemics [10].

2. RELATED WORK

In order to gather literature related to the research domain Scopus, Google Scholar, and IEEE were used. With search terms such as "quarantine", "human experience" and "robots" several studies were found that have done research in either the field of human experiences and needs in quarantine, or robots used in quarantine situations, or robots matching society needs. When looking at papers concerning people in quarantine, we only included papers that were researching people's opinion about experiences regarding quarantine, or feelings towards quarantine. In papers about robots used in quarantine situations, we only used papers that tried researching robots that could be used in such situations. For research about robots matching society needs, we only used papers that researched the acceptance of robots in a society, and how this could be improved.

When we look to the opinions of people concerning forced quarantine, we see that the vast majority of people across the globe support this measure when it is necessary for containing the spread of a disease during an outbreak. [31] This study showed that 94% of the respondents found that quarantine was a good way to stop the spread of infectious diseases. Also, a vast majority were in favor of legal penalties against absconders. Other papers also found that the public opinion was in favor of a quarantine, where [3] found that there was 93% acceptance of quarantine of US-residents, and [4] found an acceptance of 74% of US-citizens. However, this paper also showed that the acceptance was higher in other countries, which might indicate that the level of acceptance is also dependent on the cultural differences. Although the percentages differ depending on the research, we can still conclude that overall, the vast majority of people agree with a quarantine as a measure.

In the field of human experience and needs in times of quarantine, a lot of research has been done so far. The research can be divided into 2 main categories: Cross-sectional [3, 11, 14, 22, 26, 30, 32] or qualitative research [8, 11, 27, 33].

The research was focused on the experiences of the people who were in quarantine, while some also included the experiences of people who were not quarantined [22, 30].

A useful review of these papers was [6]. This review analyzed the aforementioned research and drew some conclusions. This work can be used in the comparison between the data of the first-hand accounts and the literature. The review showed that in a lot of research similar positive and negative feelings were found. The research reported negative feelings such as confusion, fear, anger, stress, low mood, and a sense of isolation. Positive feelings that were reported were happiness or relief, but these were reported on way less, in about 5% of the cases [26].

Other papers that were not included in the review showed similar emotions. The paper of Lin [20] found external and internal struggles. External struggles were things like uncomfortable surroundings or lack of in-person family support, while internal struggles were emotional turmoil such as anger, and the possibility of a positive test was also difficult for the patients. Another paper [13] showed that the loss of control due to quarantine lead to distress and depression. On top of that patients experienced stigmatization.

In the field of robots used in quarantine, there is not a lot of research done. There have been papers on a robot that could be used in such a situation [19] and papers on how this robot can be improved [21, 23, 34]. One study also showed that the public opinion about the occupation of robots also shifts towards robots doing jobs that require memorization and service-orientation, instead of only dull jobs.[29] There has been one paper that looks into the performance of a robot when it includes either audio or video channels or both [18]. Lastly, there is one research [16] used that looked into the use of medical robots in biothreat situations. This research developed several methods that could potentially be useful in a healthcare situation. These studies can be used for a basic understanding of robots and how they can be used in quarantine situations. However, none of this scientific research answers the question if the robots fulfill the needs of the people in quarantine.

Lastly, in the field of robots matching social needs, some papers were found to be useful. There has been research done to see the acceptance of robots under the elderly. It was found that a careful assessment of the needs of people could result in a higher acceptance rate of the robots. [17] Robots should thus be closely adapted to the needs of people, in order to make them successful and accepted. Another paper also showed this through their research. They concluded that robot technology should be developed tailored to the individual, and it should be able to adapt based on the information it gathers. [25] When the needs of people are not properly assessed, it can even lead to the failure of projects. In order to predict this, there are models developed that can predict the acceptance of robots and can explain that. An example of this is the Almere Model [15].

3. METHODS

There were several steps in this research. Firstly, a literature review has been done on both the experiences of people in quarantine and robots used in quarantine. This leads to a basic understanding of what to take into account when doing content analysis. Earlier research has also looked into emotions that people had in quarantine, which helps to focus on the correct points during the analysis. Earlier research about quarantine robots helps getting

to know what these robots are used for in the past, and what they were capable of doing then.

Secondly, data is collected for first-hand accounts of people in quarantine and of robots used in quarantine. In order to gather first-hand accounts of people in quarantine, there is a need to collect online videos. There will only be clips collected that are direct experiences of people in quarantine, either through an interview or through a self-upload. Online collections of third-party videos on YouTube can be a great source of getting a first-hand account of people during quarantine. These clips are reviewed and structurally broken down to the main information of the clips. For robots used in quarantine, videos are gathered in a similar sense. Thirdly, the videos were analyzed. The videos of first-hand accounts were all put in a document. After that, the videos were looked at and certain highlights of each video were logged. Some of the interesting points this research looked at were: the reason for quarantine, negative and positive feelings, procedure. This was documented in such a way that similarities and trends could be found in the dataset. With the documentation of positive experiences, negative experiences, and the feelings towards the procedures in quarantine, basic needs could be found for the quarantined people. The videos of robots in quarantine were also put in a document. These videos were analyzed, and the following interesting points were looked at: purpose, country, morphology and social role. When a robot was categorized as 'social', the social interaction it had with people, such as touch or gesture, was also documented. With this structured documenting, trends could be found in all of these categories. These trends were then documented, in order to show the similarities and what the differences were between the sets. Some statistics were also used to show the difference in finding a social or a non-social robot.

Lastly, the final research question is answered by comparing the two datasets. We will look at the needs that detained people expressed, and the needs that quarantine robots fulfill. Then we compared the two in order to see whether there were similarities between the two. After this, we also looked at what robots did not match the needs, and why this might be the case.

4. RESULTS

4.1 People in Quarantine

Sharing information to deal with uncertainty.

After looking for videos about people in quarantine, a dataset of 22 videos was constructed. In the clips people are often seen in their quarantine environment, which is either a hospital room or a room at home. The people share information to deal with the uncertainties they experienced. The videos show thus the surroundings of the people, and often it becomes clear how the people themselves are feeling from the videos. They sometimes show equipment that they are hooked up to, or talk about the care they receive. Most videos had a small emotional component, but this was not the focus as the clips were more in a self-help or interview style. There are two types of information sharing in the videos: explanation of symptoms and of procedures. The dataset can be found in Supplemental material A.

Explanation of Symptoms.

Most people want to be informative about the disease to the public by talking about the symptoms they had. They mention symptoms that forced them into quarantine, as one mentioned to Bloomberg (#1): "I think the bar to separate people from the group was 37.5 degrees Celsius of fever, and I got exactly 37.5" Or as someone said to The Quint (#11): "I coincidentally had a sore throat, and [the nurse] told me, You need to go for a checkup to a hospital." These accounts give information about what symptoms could get you quarantined. On top of that there are also accounts that show the seriousness of the disease. One patient says to Insider about getting the symptoms (#13): "I started getting short of breath [...] that was one of the worst symptoms, because I woke up in the middle of the night, I was disoriented, I wasn't able to breathe."

Emotions regarding symptoms.

When talking about the symptoms people expressed their emotions based on the severity of their symptoms. Looking through all the videos it becomes clear that people who have mild symptoms are grateful that they only have mild complaints. One US resident told Fox News (#14): "I feel fine. This virus for me was pretty light, equal to a very, very mild cold." However, in clips where there are more severe complaints people also were positive, as they were often recovering and feeling better. In an interview with CGTN one patient mentions (#8): "Everyone here is getting better day by day. We don't need to panic, as long as we follow the doctor's instructions." Although most people talk about their symptoms in all of the videos, the focus lies more on the actual explanation of the symptoms rather than the emotional aspect of getting sick. This is in line with the informative character that these videos have, where the main focus is informing others and explaining situations, rather than having an emotional interview. A patient also mentioned the mental aspect to Insider (#13): "You start sitting down and having a conversation with yourself, like, OK, this is it for me. This is it for me and my children. I won't ever see them again-type of thing."

Explanation of Procedures.

Next to that the actual procedurals of testing and checking are talked about by a lot of people in order to share information about the actual procedures there are in quarantine. The checking is mentioned by many of the persons in the clips. A person quarantined on a cruise ship mentions to RNZ (#3) : "The doctors that come in [...] check my vitals, blood pressure, lungs, and heart rate, and they do that several times a day." He also mentioned: "They test with a swap that goes deep up into each nostril and one down the throat." Or another patient mentions to CNN (#16): "I have bust my lungs, I have fluid in my lungs, so they have been giving me medication for this." These explanations can help other people giving an insight in what they can expect when they get hospitalized with either mild or heavy symptoms.

Uncertainty in procedures.

In the clips people are talking about different experiences in the procedures of quarantine. There are several reasons why people are talking about the procedures. Quarantine is a new situation for many people, so the main goal of these videos is setting an expectation. This is why in all of the videos at least some part of the process is explained in such a way that people can gain information from it, so they are prepared for these procedures themselves.

Uncertainties in the procedures give quarantined people result in frustration, nervousness, and angriness. This un-

certainty gives people several emotions, and in many clips they commented about this. One woman explains to the Kenya Citizen TV (#21): "After landing, [...] we were with more than 200 people in one space waiting to be cleared. There was no clear direction in where we were supposed to go. I thought I could go to my apartment and self-quarantine. I had already done the shopping and asked someone to drop everything and clean the apartment" Or as a man from India mentions after they asked when he was going to be tested in order to see who should be put into quarantine (#23): "He said: What test? There is no test. You will all be put into quarantine straightaway for 14 days. [...] Then he made some calls and then he said: I am sorry I got the wrong information as soon as you will be reaching the quarantine facility you will be tested there." This obviously leads to frustration as it is unclear for people what to do, what to expect and what to prepare for. Another interviewed person said to NBC: "We don't know... we know the federal government is shipping us to a base, we don't know where... what that atmosphere will be like... are we going to be in a huge open room?". As many people have these uncertainties when looking at quarantine situations, the first-hand accounts of these people help them prepare for the possible actions they might need to take.

Sanitary state.

In some clips the sanitary state of the isolation ward or the hospital is explicitly mentioned. This state is always mentioned for specific reasons, either to encourage people to visit the wards when they have complaints, or warn people about the bad state of the isolation facility they were in. One quarantined person said in an interview with the Quint (#11):

"The first thing I noticed when I entered the ward was that it was super clean. [...] The next thing that I noticed was the bathrooms, the bathrooms were so clean, which I did not expect."

Or another person in an interview with India Today (#12):

"The isolation ward that I was kept in was spotlessly clean. it was so clean that it just struck me, like, oh my god. You know this kind of cleanliness... none of our homes are as clean. We might go around infecting and using phenyl and all of that, but the hospital and isolation ward, those guys are professionals, they know their jobs right. So, there is no way an infection can catch you there."

These accounts were both positive and encouraging for people who hesitate about going to the hospital. However, there were also negative accounts of isolation wards: One Indian resident tells India Today (#23): "So, when we reached our accommodation, we saw there were many bedsheets which were stained. The cupboard had rotten vegetables with flies on them, the washrooms were not up to the mark, the water was clogged in the washrooms. There was no sanitization, proper sanitization, the urinals there were all soaked with peaks of pond." Or as a Nigerian resident tells Kenya Citizen TV (#21): "It is no quarantine, really. Breakfast is served in the common area. [...] So tomorrow morning, we have to share the same spoons when they are serving breakfast with other people from other countries."

These accounts are very negative and try to either warn people about the worse conditions, or try to get attention to the problem in order to get the government to react to it.

Internal and External struggle.

Lin [20] categorized internal and external struggles. In this paper, internal or external struggles are found in most of the participants. They either experience only internal or external struggles, or both. Lin coded whether a struggle was experienced, which allowed us to do the same for our dataset. Internal struggles are struggles related to the person itself, like their emotions, possible diagnosis or being quarantined. External struggles are related to things that stand outside of their own, like their surroundings, opinions of others, or support they get from others. To give an example, video #18 was coded with internal struggle, because the quarantined person experienced emotional turmoil, and video #7 was coded with external struggle, because the quarantined person was separated from their husband, which meant she does not have support from him. In order to see whether there is an association between the two, we documented the accounts of internal and external struggles people commented on in the videos. There were 9 videos with both internal/external struggles, 6 with only internal, 3 with only external, and 5 with no struggles. We ran McNemar test on both coded variables from the single group. McNemar's chi-square statistic: $\chi^2(1) = 0.44$, N = 23, p = 0.51, which suggests that there is not a statistically significant difference in the proportion of videos coded internal and the proportion of videos in the external group.

4.2 Quarantine Robots

In our research we found 26 videos of robots in quarantine. The complete documentation can be found in Supplemental material B. Some of the photos of robots can be found in this research. All photos of robots can be found in Supplemental material C. There are 3 places where robots in the dataset are used, namely in public spaces, in hospitals, or in a home evironment.

4.2.1 Robots used in public spaces

There are a lot of robots that are used in the public space. As their tasks vary, we have grouped the robots to certain tasks and described their way of handling these tasks and other interesting points.

Spreading awareness.

Spreading awareness is done in public places. This is so most people that are in this public space can be aware of the rules that are put into place, so they can more easily obey the rules. Robots are used for this specific purpose as they can work for long times, and it is safer for a robot to interact with a lot of different humans as it cannot get infected. The way of spreading information differs with these robots. Some of the robots used in the corona pandemic spread information in a playful way. The robot covered by South China Morning Post is a nice example of this. This robot had an interactive element and let people passing by fill in a quick questionnaire to see if they have any symptoms regarding a virus. Another robot, reported on by the Hindustan Times, also shows a robot that spreads information about the disease, and it is able to hand out mouth masks and hand sanitization. These robots both have the morphology of humans.

Cleaning.

Secondly there are robots that are designed to clean a bigger area in a quick way. This robot is shown in a report of South China Morning Post. This robot has wheels to drive around and has a cannon on the front which can

Figure 1. Awareness robot reported on by Hindustan Times

shoot disinfect spray. This robot is able to disinfect 10000 square feet in one hour. To get this efficiency we see that the morphology completely changed. As these robots need to clean big part of the public space in a relatively small amount of time, the robots are equipped with wheels in order to move around quickly, and have a morphology that results in the biggest efficiency, equipped with a tank-like barrel.

There are robots that are used in public spaces while people are still using the place. These robots need to have a different morphology in order for it to operate safely. This is clearly visible, as these robots look like standard cleaning machines. These robots can autonomously clean big parts of the floor, without getting a cleaner exposed to many other people.

Telepresence robots.

Telepresence robots are robots with a live audio/video connection, and the ability to let someone control the movement of the robot from their home. These robots can be used for people to attend gatherings and roam freely without actually leaving their houses.

The first case of the use of a telepresence robot in times of quarantine is a video of South China Morning Post. In this video, telepresence robots are used for Japanese students of the University of Tokyo. They graduated, but they were not allowed to join the ceremony of receiving their diploma. This is when telepresence robots were used to give students to opportunity to still be present at the ceremony, being able to drive around their own robot and receive their diploma in a novel way.

The second video is of VOA News, where a father was not able to visit his daughter's wedding due to being in quarantine. This led to the family purchasing a telepresence robot, allowing the father to see the wedding and drive around himself.

The last video is about a telecommunication robot that is used in Belgian elderly homes. These elderlies were not allowed to go outside to communicate with their family, so the telecommunication robot could be used to still have contact with their family. The robot has an audio/video connection and can walk around. The robot has the morphology of a small child, with a screen as a face.

Food.

In a quarantine situation, you are not allowed to leave the house. The robots reported on by CGTN is a small robot that does groceries for people. It is able to ask for certain products, negotiate prices and make e-payments. It has the form of a small animal, with a shopping cart attached where the goods can be put into.

Figure 2. Telepresence robot reported on by VOA News

The second robot is a cooking robot that can prepare complete meals for people. It can make a dish called clay-pot and it only needs the food stock to be refilled once in a while, and can then cook the dish at the spot when it is requested. It has the shape of a food cart, but no chefs are needed for this.

Patrolling.

Thirdly, there are patrolling robots. These robots can be used in public spaces in order to effectively save human labor and avoid cross infection. The robot can patrol the streets and look for people breaking rules. The first robot is one put into public places in order to measure body temperatures. This robot is equipped with a heat sensitive camera. It can check the temperatures of up to 10 people at once and can also check if someone is wearing a mask. This robot is also equipped with a speaker, so it can warn if someone has a high temperature, or if someone is not wearing a mask. It has the morphology of a armoured tank.

Another robot that is used in Singapore to patrol the streets is robot dog SPOT. This robot has a speaker which tells people to keep social distance. This robot also has the ability to enforce this rule as it walks in the middle of paths in order to separate people on paths better. We see that with the change of tasks and social role has come with a change in morphology. The robot now has a morphology of a dog. This robot is equipped with cameras and sensors in order to properly do its task of rule enforcing.

Figure 3. Robot dog SPOT reported on by CNA

Another robot that also had the task of patrolling, the P-Guard robots used in Singapore, reported on by Ruptly. This robot is also a rule enforcer, and basically replaces a police officer. This robot roams around the streets, spreading the message to stay inside with a loudspeaker. On top of that it is equipped with cameras and sensors that can register its environment. It is controlled by security officers, and it can ask people to show their permits to be allowed outside to the robot. This robot has also had a big change in morphology, having a more car-like shape, equipped with lights too.

We see that robots in public spaces are mainly used for the purpose of either spreading information or for enforcing rules. All these robots do have something in common, namely preventing workers from being in the open and

being able to catch the disease. It thereby also prevents cross-contamination. The robots all spread information about either the disease or the rules, informing unknowing residents with them. Only some of them are also able to enforce the law. The morphology changes when the robot gets more authority.

4.2.2 Robots used in hospitals

Some people who get infected by a disease end up in a hospital. This means that in hospitals or isolation wards there is a increased chance for nurses or doctors to get infected themselves. This is not desired as these people are desperately needed in these times, so a doctor being sick is something that needs to be prevented. This is done by using robots to replace certain tasks that were done by humans before.

Delivery.

The first human task that is done by robots is delivering food or medicine to patients in quarantine. This is a task that was normally done by nurses, but robots are also able to maneuver around in an isolation ward or a hospital to bring certain goods to patients. In the videos that were found, we can see multiple implementations of delivering food or medicine. Most of these robots were similar to the robot reported on by New China TV. These robots have a tray system where stuff can be put onto, and a touch panel where people can indicate whether they have grabbed the food from the tray. Furthermore, these robots are equipped with sensors to not bump into anything.

Figure 4. Delivery robot reported on by New China TV

However, as some medicine are valuable there is also a different design that is used in a hospital, reported on by CGTN. This design has a closed cabinet which can open and close its doors automatically. This robot is also able to take the elevator autonomously, which gives it a bigger reach in the hospital. These robots are put into place to reduce the pressure on doctors and nurses and to prevent cross-contamination.

Cleaning.

The second task is cleaning. As cleaning is necessary to reduce the spread of infection, this needs to be done often and thoroughly. Robots can be used in this process, as they can't get infected themselves. There are different cleaning robots that were used. The first one is a disinfecting and germ zapping robot which ABC13 reports on. This robot uses ultraviolet light that kills the pathogens that cause infection. These robots can be used as main cleaning devices, or as an addition to the normal cleaning. The robot has a morphology of a stick with a round piece on top.

Monitoring.

Lastly there are robots that are used for monitoring patients. This is also normally done by doctors or nurses, but a robot with a camera can also monitor the patients. The robots that are used in a hospital have the size and figure of a small child. The robots can be controlled by a doctor and can be rolled into a room where people who are infected are lying. The cameras on the robot can then be used to look at the monitors to see if everything is going well with the patients. This limits the number of masks and gowns that staff need to use. These robots have the morphology of a small human.

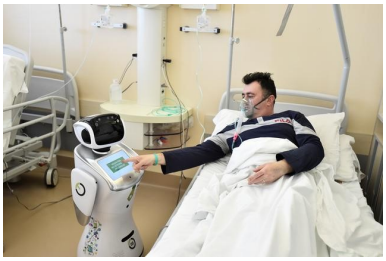

Figure 5. Monitoring robot reported on by Yahoo Finance, image by Reuters

Testing.

Robots can also be used in ways that can help testing patients. These robots either replace human interaction or elaborate testing. This can speed up the process and also prevent cross-contamination.

The first robot used for testing purposes is a robotic arm reported on by TRT World. This arm is placed on a platform that can move itself and can drive to patients. It can do ultrasound sound scans of the lungs, which is where respiratory diseases are often located. The machine does not need any human interaction and it can disinfect itself. It looks like a robotic arm on a trolley.

The second robot that is used is a giant testing robot for testing samples of potential infected people automatically, reported on by US Davis Health. The machine allows them to do a total of 1000 tests per day, whereas before results for 20 samples took about 5 hours. The machine starts pipetting samples and adding reagents, breaking open the virus and yielding the RNA, all automatically. It allows the facility to do more with less people. It has a morphology of a big box.

Lastly there are robots used for entertainment. This can be either for the user itself, or for the audience the robot is for. These robots are interactive in such a way that they can entertain people for an amount of time.

4.2.3 Robots used in home environment

There was one robot found that was used for entertainment. This robot interacted with a real person, having conversations. The person used the robot for entertainment for herselve, but also to make a comedic video for her audience. The person is cutting the hair of the robot, while the robot is angry and trying to stop it from happening with foul language. The robot talks and looks like a human, but it does not have a body attached.

4.2.4 Results

We gathered a total of 26 quarantine robots on YouTube. After documenting these robots it becomes clear that most of the quarantine robots in the dataset have a primarily

social role. A total of 19 (73%) robots had a high social function and 7 (27%) had a low social function. This suggest that most quarantine-related robots on YouTube were focused on having a social element in order to interact with other people.

Among the high social coded robots, we found the following distribution of 7 different functions: 7 delivery robots, 3 tele-presence robots, 3 information robots, 2 monitoring robots, 2 patrolling robots, 1 buying robot and 1 entertaining robot. Among the low social coded robots, we found the following distribution of 3 different functions: 4 cleaning robots, 1 food production robot and 2 testing robots.

The quarantine robots in the dataset come from different parts in the world. The most videos come from Asia, with 16 videos (62%). From these videos there are 12 videos from China, 1 from Hong-Kong, 1 from India, 1 from Japan and 1 from Singapore. There are 6 videos (23%) from the USA. There are 3 videos (12%) from Europe, from which 2 are from Italy and 1 from Belgium. There is 1 video (4%) from Africa, which is a video from Tunisia. This suggests that China uses quarantine robots the most.

We can see a difference in morphology for social and non-social robots in the dataset. Among the robots that are coded as high social, we see that 8 from the 19 (42%) social robots have a human morphology. On top of that there are 4 (21%) shaped like a tray trolley, 2 (11%) as an animal, 2 (11%) as a cabinet, 2 (11%) as a tank and 1 (5%) has the morphology of a tele-presence robot. With robots that are coded as low social function we see 2 shaped like a pole with a round part on top, 2 as a box, 1 cleaning machine, 1 tank and 1 robotic arm. Thus, there is no robot that has a human or animal morphology.

From our results, we spot 3 different types of social interaction a quarantine robot can have. These are Voice, Touch and Gesture. The robots coded as high social function have one or more from these types as social interaction. The most common type of interaction in the social quarantine robots is voice. 16 (84%) robots had this type. Next is touch, with 11 (58%) of the robots having this type. Only 3 (16%) of the social quarantine robots had gesture as a type. This suggest that for social interaction, voice is the main contributor for quarantine robots.

We also coded the functional role of the robots. This was either Locomotion, or Manipulation. With locomotion the quarantine robot was able to move around itself, while with manipulation the robot was able to handle and manipulate an object. 22 (85%) of the robots had locomotion as a functional role, while only 3 (12%) of the robots was able to manipulate objects. There was 1 (4%) robot that was not able to do either of these.

In order to show that there are statistically more social than non-social robots in the dataset we did a binomial test in excel, with the probability of a social robot of 0.5. There were 7 accounts of where a robot was non-social, and there were 19 social robots. This binomial test showed that $p = 0.029$. This is less than the 5% chance that this observed count would happen when the probability of having a social robot being equal to the probability of having a non-social robot (i.e. a 0.5 probability). This shows that there is a statistically significant chance that a video of a social robot posted on YouTube is not equally likely to the chance of a non-social robot to be posted on YouTube. We observed more social robots than non-social robots in our dataset.

4.3 Comparison of the needs of quarantined people and the purposes of quarantine robots

In order to answer the final research question, we need to make the comparison between the two datasets that we have made. After reviewing the dataset of videos of people in quarantine, there are different needs that can be identified. The first need is getting rid of uncertainty. A lot of times people were confronted with situations they were not familiar with and they had little information about what were to happen to them. These uncertainties could be divided into 2 main subjects: Procedures and Symptoms. These two topics were discussed in a lot of the videos, either explaining that they did not know what was going to happen, or an explanation for setting an expectation to others. There was thus a need for information about procedures and symptoms. Next to that the sanitary state of isolation wards was a topic that was mentioned often. This thus is also something people have a need for when going in quarantine.

After analyzing the videos about robots in quarantine, we can identify a lot of different purposes of the robots. Some of these purposes are delivery, cleaning, spreading information, patrolling, and tele-presenting. The robots are deployed in different areas, such as public areas or in hospitals.

Informational robots help in public, but not in hospital.

The information spreading robot can be a solution for two of the needs expressed by quarantined people, namely information about procedures and information about symptoms. We see in the dataset that these robots are used for these purposes. One of the Information spreading robots (#24) was stationed at a square in New York where people could fill in a questionnaire about their health. These questions were related to symptoms of Coronavirus and the robot could give the advice to go to the doctor if the person who filled in the questionnaire said they had certain symptoms. Another information spreading robot (#25) was able to fill the need of spreading information about procedures. This robot walked through a park and was able to see when people are walking too close to each other. When it notices this, it can instruct the people to walk further apart.

Although these robots are spreading information about the needs that the people in quarantine explained, they are not doing this to people who are in quarantine themselves. These robots operate in public spaces, which is a place where people in actual quarantine can wander. These robots still have an impact on the knowledge of people, as they explain some of the procedures and symptoms an infected person might experience. However, these robots fail to explain procedures for when you are in quarantine, for example, the number of times you need to get tested negative in order to be released, how these tests are conducted, where you will be put into quarantine, and so on. This shows that the start of the use of robots for this purpose is good, however, they could be used to explain more specific procedures for quarantine.

For symptoms, the robots are better used. The symptoms are explained to people using robots and this helps them being informed of when they may be infected with the virus. This is thus informative for people when they are not quarantined, so they know what the symptoms are, but also for people who are put into quarantine, as they

have a better knowledge of why only a small indication can already put them into quarantine.

There are 2 testing robots that also provide information to the public. These robots can test samples of potential infected people, or can directly scan a person to see whether they are sick. These can thus be very helpful to a lot of people, as they can exclude people who have symptoms. However, when people are quarantined in hospitals they already are tested positive, which means they do not profit from these robots.

Lastly there were also monitoring robots used in environments where the public could profit from. These robots address procedure information needs and thus give information that is useful for the public, but not for the people quarantined in the hospitals themselves, as they do not get this information directly.

Cleaning robots partially address needs.

Having a good sanitary state of isolation wards was also a need expressed in the videos. This is solved with quarantine robots in hospitals and other isolation wards. In hospitals, germ-zapping robots (#16, #18) were used in order to clean a room quickly and without the use of a person, which means that there is a low chance of cross-contamination. Cleaning robots such as #15 are used in public spaces in order to clean large areas quickly and also without human interference. However, some of the sanitary problems experienced by people, for example dirty trays of food, are not solved with the quarantine robots in the dataset.

Transport, telepresence or entertainment robots address unmentioned needs.

Although we see some robots link to the needs expresses by quarantined people, there are several robots that address needs that are not mentioned. A lot of robots have as a main goal reducing human-to-human contact, which lowers the chance of cross-contamination, and limits the use of protective masks and gowns. The delivery robots replace nurses in hospitals, while the patrolling robots replace policemen on the street. Telepresence robots allow quarantined or even sick people to attend meetings and gatherings without having direct contact with other humans, just like the food buying robot allows a person to do groceries without leaving its house. The food-producing robot makes sure chefs do not need to have direct human-to-human contact too. In total there were 7 delivery robots, 2 food robots and 3 tele-present robots. This is thus a total of 12 that could not directly be linked to an expressed need. These all still contribute to getting less people infected, but the needs they fulfill are not recognized by the people in the dataset, while other needs are mentioned by them.

Limitations.

There are some limitations to these results. It can be assumed that robots that are posted to YouTube are not necessarily posted because they link to a need of quarantined people. These robots can also be posted because of their novelty in the field. The fulfillment of human needs does not need to be a strong reason for someone to report and upload a video about a robot to YouTube. This means that the videos found on YouTube do not need to be an accurate representation of all robots used in quarantine. Additionally, robots that are produced can be focused more on tasks that are related to the society as a whole, than an individual. Often, robots in the dataset are put into place to prevent cross-contamination. This is not a need an individual would express often, which means that this leads to a mismatch between the robots and the needs. The quarantined people focused more on urgent needs such as cleaning or getting information, than on less urgent needs, such as attending gatherings through telepresence, or having more operational efficiency.

5. CONCLUSION AND FUTURE WORK

This research showed that there is a match between the expressed needs of people in quarantine, and the robots used in quarantine, based on videos found on YouTube. Some of the robots in the dataset directly link to an expressed need, while others did not link to a specific need. However, this still means that there are similarities between the two.

The first research question found the expressed needs of the people in quarantine. After reviewing the dataset, we concluded that most people gave information about either the procedures or about symptoms. They did this to take away the uncertainties they experienced themselves while being put into quarantine. On top of that, they often mentioned the sanitary state of the isolation facility as an important factor.

The second research question looked into the quarantine robots that could be found using YouTube videos as reference material. We found 2 main places where robots were used: robots used in public spaces and robots used in hospitals. The robots used in public spaces were divided into five categories: robots used for spreading awareness, cleaning robots, telepresence robots, robots for food and patrol robots. Robots in hospitals were divided into 4 categories: delivery robots, cleaning robots, monitoring robots, and testing robots. There was one robot that was used for entertainment. The robots were either social or non-social, and were used at different locations all over the world. They also had different morphologies, as human and animal were used, but other morphologies were also used when it was practical for the purpose of the robot.

The last research question was about the match between the two. We saw that when comparing the expressed needs of the people with the robots that were found, there was a match between the two. There were several robots that directly linked to the needs of the people in quarantine. Examples were the awareness spreading robots, the cleaning robots, and the patrolling robots. However, there were also a lot of robots that did not directly match the expressed needs of people. Examples of these were the delivery robots, the monitoring robots, and the telepresence robots.

For future work, more research can be done in the same field. Both of my datasets consisted of only about 25 videos, which leaves room for a much more elaborate research which would contain a lot more videos. However, the insights the videos of people in quarantine gave during this research was something that was unique in this research field. With further research, this new form of data analysis could give great new extra insights into the field. On top of that, due to the coronavirus being very topical at the time of constructing the dataset, all of the videos were related to the coronavirus. Future research could look into videos that were uploaded for other pandemics, such as SARS. This can give a more diverse view of what people experience in quarantine and what their needs are.

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