The Human RFID Implants Introduce a New Level of Human-Computer Interaction: Twitter Topic Detection Gauges Consumer Opinions

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ABSTRACT

Human subcutaneous implants are being made available as the new level of human-computer interaction as well as a convenient way to streamline everyday routines. The reception of this new idea is varied: in Sweden it is possible to pay train fares with implanted chip vs. in the USA some states are using legislation to ensure that residents cannot be implanted without their consent. Despite the resistance to this application of technology, the signs for major digital transformation are already evident. Industries like banking, health care and security should be closely monitoring the development opportunities implanted devices offer.

The microblogging site Twitter has been linked to the younger, more affluent, and pro-technology users. This makes Twitter feed an excellent opportunity to gauge population opinions regarding human subcutaneous chip implants. The KNIME software was used for unsupervised topic detection with Latent Dirichlet Allocation (LDA) algorithm to identify the key issues engaging the tweeting public.

Keywords: Human chipping, RFID, Twitter, KNIME, Topic detection

INTRODUCTION

This paper explores the emerging trend of people implanting themselves with a Radio Frequency Identification (RFID) and, to lesser extent, the implantation of the more advanced Near Field Communication (NFC) devices for health monitoring, fun or convenience since currently these implants offer very limited added value to our daily lives. The idea for under skin implants for humans rose from the chaos of the 9/11 where first responders were seen writing identification details on their skin with permanent marker pens: perhaps we needed a way to identify people at crisis situation (Kumar et al., 2019)? More commonly, RFID identification of humans is based on tags that are worn in e.g. hospital bracelets or RFID embedded identity cards (Gilleson et al., 2019; Rotter, Daskala & Compano 2008; Smith, 2008). The subcutaneous implantation of RFID chips is a new challenge for the human psyche.

VeriChip was the first RFID device approved for human implantation by the U.S. Food and Drug Administration in 2004. Although the argument for an approval to implant humans with a RFID device was based on employee security, the initial uses for these implants were actually in a nightclub VIP programme (Baja Beach Club chain) (Fowler, 2019, Kiourti 2018, Kumar et al., 2019, Michael et al., 2017, Ray et al., 2016).

As the objective of this paper is to explore how people respond to the idea of subcutaneous human chip implants, the technology, per se, is not explained here. The benefits of implanting humans with RFID chips can be classified under continuous health monitoring, security and authentication of transaction, convenience as well as for the security of minors or e.g. dementia sufferers (Fowler, 2019; Marr, 2019; Masters & Michael, 2007; Rotter et al., 2008; Voas and Kshetri, 2017). The structure of this paper is as follows: the implications of human subcutaneous chip implantation is discussed first to identify key future application routes: health care, convenience and control. Next the challenges facing large scale human chip implantation are explored, highlighting privacy and ethical concerns. Using Twitter data to gauge public opinion is outlined which is followed by explanation of the text mining process adopted. The findings identify the volume of both original content and re-tweets, identifies that content that was most re-tweeted (sign of engagement) as well as the seven key topics emerging from this data. The discussion and conclusions map out also future development prognosis.

IMPLICATIONS FOR IMPLANTING HUMANS

The notion of integrating technology into the human body is not new as many individuals already rely on pacemakers, implants for blood sugar level monitoring or deep brain stimulation implants benefitting Parkisons patients. The market for wearable and implantable electronics is growing fast with potential for future applications in health care (e.g. Mehrali et al., 2018), monitoring of minors, military and even smart home use (Kiourti, 2018; Michael et al., 2017). The general willingness to get implanted is slowly rising and the willingness to obtain RFID implants is at its highest when such implant performs in a lifesaving capacity of e.g. heart monitoring (Rotter et al., 2008; Schwartz, 2019b; Seo, 2019; Strohmeier, Honne & von Cyborg, 2016; Werber, Baggia & Znidarsic, 2018).

The discussion of human RFID device implants identifies clear arguments for and against these implants, these are outlined under the subheadings of human RFID implants for health, convenience and control. At times, the RFID implant may offer convenience as well as control benefits (e.g. security for financial transactions).

Health Care Based Human RFID Implants

RFID chips (wearable or implanted) would work best at electro-chemical biosensing of bodily functions like monitoring glucose or cholesterol levels as well as body temperature or heart function (care context) (Masters & Michael, 2007; Xiang et al.2022, p. 7). The early potential for wider adaptation of the implanted devices clearly comes from medical field and especially for emergency response situations where the patient cannot verbalize underlying medical conditions. The highest acceptance levels for RFID implantations are indeed in the lifesaving applications (Heffernan et al., 2017; Nicholls, 2017; Rotter et al., 2008; Schwartz, 2019b; Smith, 2008

Convenience Based Human RFID Implants

Convenience and security are strong reasons for adopting the RFID implant too e.g. to cope with the endless list of passcodes, keys and tickets (Schwartz, 2019b; Smith 2008). Moreover, when the RFID implants are incorporated with a sensor rich environment we can also control Internet-of-Things (IoT) devices with simple wave of hand.

The additional convenience (and security) implanted devices can offer for financial transactions are easy to imagine. The UK Lloyd's bank 2015 survey indicates that approximately 7 % of the UK consumers would be willing to acquire an implant to facilitate electronic payments (JP Morgan, 2020; Michael et al., 2017; Voas & Kshetri, 2017).

Control Based Human RFID Implants

The next undisputable benefit from subcutaneous RFID device implants arises from identity and verification; an extreme example of this comes from Mexico where in 2004 the Attorney General and his 160 staff members were implanted as a security to restrict access to documents used to prepare for a drug cartel trial (Gillenson et al. 2019; Masters & Michael, 2007; Rodriguez 2018; Rotter et al., 2008; Voas and Kshetri, 2017); or from police where a weapon is programmed to only function if the trigger is pressed by a hand with corresponding implant (e.g. Heffernan et al., 2017; Nicholls, 2017; Rotter et al., 2008).

The additional security required at military of policing work is easy to appreciate, but how about the employers introducing RFID chipping in the (regular) workplace? News of organizations hosting employee chipping events (Epicentre in Stockhom, Sweden in 2015; Three Square Market in Wisconsin, USA in 2017) fuel public concerns of potentially unintended uses of the implanted devices.

Companies selling the human microchip implant technology are in talks with several large legal and financial service organizations in the UK- and the trade unions are concerned. The variety of data available from implants is also open to misuse where employers may use the data to e.g. micromanage tardiness (Fowler, 2019; Gillesons et al., 2019; Kollewe, 2018; Schwartz 2019; Voas & Kshetri, 2017). In other words, 'the potential number of [RFID] workplace uses – not to mention off-site uses - is limited only by an employer's lack of imagination' (Rodriguez, 2018, p. 1598), thus creating a significant power asymmetry. Rodriguez (2018) further explores the implications of getting employees RFID chipped for workplace protocols and concludes that the current legislation would not protect employees from pressure to become implanted for the sake of e.g. career progression.

CHALLENGES FOR LARGE SCALE HUMAN RFID IMPLANTATION

'While RFID usage is booming and expanding, human microchip implants have not yet reached a level of widespread appeal or acceptance' (Rodriguez, 2018, 1600). The challenges of implanting functioning communication devices in the human body are numerous: the implant needs power to operate and an antenna to communicate with devices outside the human body. This is where the

RFID chips prove useful as they have a small size and due to the passive interaction with a Reader there is no need for power supply or large antennas (Kiourti, 2018; Nicholls, 2017). Linking RFID devices to smartphones is probably the most actionable way to harness the low energy capacity of implants in the future (Xiang et al., 2022, 3). The RFID chip is not without its implementation problems either: the cost of creating a whole RFID chip - Reader - essential support database where detailed information is stored is only exasperated by the different standards of RFID technology in use (Gillenson et al., 2019; Masters & Michael, 2007; Mehali et al., 2018; Rodriguez, 2018; Xiang et al., 2022). Furthermore, consumer hesitance of being tracked as well as the lack of obvious future application opportunities offered by RFID implants hinder RFID implant adoption.

The legal, regulatory and ethical considerations surrounding the human implantation with RFID devices are significant, especially when the debate focuses on the 'opportunities' RFID implants could offer for military, the surveillance of convicted pedophiles or for the 'safety' of infants and dementia sufferers. In all these situations, the decision to be implanted is not made by the individual who will be implanted (Michael et al., 2017; Nicholls, 2017).

Resistance to chip implantation into humans is likely to come from privacy advocates who paint Orwellian images of 'technologically advanced authoritarian regimes [that can] practice nearly limitless surveillance' (Voas & Kshetri, 2017, p 78) and a future of underground surgeries where chips can be swapped or removed (Ivanov 2018; Evolve 2019; Gilleson et al. 2019; Nguyen & Simkin 2017; Schwartz 2019 & 2019b; Smith 2008). Christian groups also view human implanting as a sign of end-of-days prophecy (Schwartz, 2019b). Naturally, the implant may cause an adverse tissue reaction and the implantation process may result in an infection (Rotter et al., 2008; Smith, 2008). Privacy and ethical implications of the RFID chip implant development are discussed in more detail next.

Privacy

The privacy concern is real since an implanted device would be a permanent (possibly even 'always on') link between the person and their identity: potentially posing a risk 'to human dignity by not respecting the autonomy and rights of individuals' (Rotter et al., 2008, p 26), especially since the implanted RFID devices are not immune to hacking and cloning (Fowler, 2019).

In reality, the present technology does not accommodate any real time surveillance of implanted individuals as the current implants do not simply have enough power to transmit beyond immediate proximity of the implants. However, if the implant is in our hands, as is currently the norm, digital readers in e.g. door handles or workstations are feasible (Voas & Kshetri, 2017).

In a legal exploration of RFID chipping of objects and people Rodriguez (2018) highlights concerns of items and people being tagged without the knowledge of the person who has possession of the item as RFID also enables a mass identification of tagged items potentially used to profile individuals (Rodriguez, 2018). Consumer reluctance for RFID implants could also be linked to control issues: will the implantee be the only one with access to the chip or can a third party also access it (especially without our knowledge) (Masters & Michael, 2007)?

Ethics

It is important to recognize voluntary use of human RFID chipping for vital monitoring of a medical condition or using the RFID chip as an express checkout payment method vs. involuntary chipping of e.g. as a part of a prisoner parole program (control context) (Margulis et al., 2020; Masters & Michael, 2007; Rodriguez 2018)

It is difficult to legislate the future use of technology that has not yet been adopted by consumers. Gillenson et al. (2019) call for guidelines regarding using RFID chips with people (either implanted or worn externally) to guide decision makers. These guidelines should address the motivations of getting chipped, privacy implications, certainty of carrying the external RFID item (e.g. if this is a condition of a parole from prison) and confidence of relying on the RFID chip in identifying individuals (how to stop potential black-market of copied implant identities?) (Rodriguez, 2018).

Informed consent can also be problematic when the RFID chips are worn externally by school age children (Gillenson et al. 2019; Masters & Michael, 2007; Rodriguez 2018). Interestingly, stakeholders in these experiments did not highlight privacy concerns. Another troubling example is the chipping of Alzheimers sufferers (Gillenson et al. 2019; Masters & Michael, 2007). Such ‘lack of objection to external electronic tagging for minors highlights the idea that a national identity system based in implantation is not impossible’ (Masters & Michael, 2007, 31)

The next section outlines our use of Twitter to gauge public opinion of implanting humans with RFID/NFC devices.

WHY USE TWITTER TO GAUGE PUBLIC OPINION OF HUMAN RFID/NFC IMPLANTS

Twitter, the microblogging social media channel is a powerful channel for electronic Word-of-Mouth (eWOM). eWOM as a form of peer-to-peer communication has the power to influence product adoption levels or even national elections (Jansen et al., 2009). Twitter offers several ways of exchanging information from sharing links to news publications to personal opinions. All of this communication is free from spatial and temporal limitations. Twitter also leaves a historical record of communication where the popularity of any topic can be gauged from likes and retweets: individual tweets are not that powerful but an analysis of Twitter feed opens an unprecedented opportunity to track the ‘moods, thoughts and activities of the society at large’ (Guercini, Misopoulos, Mitic, Kapoulas & Karapiperis, 2014, p 708). Furthermore, twitter content has been found to correlate with Dow Jones Industrial Average (DJIA), NASDAQ as well as Standard & Poor 500 stock values (Mao, Wei, Wang & Liu, 2012). Twitter has also been used successfully to predict consumer buying behavior for going to the movies, buying books and music –a natural match to the demographic profile of the Twitter users (Mao et al., 2012). For these reasons, Twitter is an excellent source for research on consumer opinions about innovative new products (Guercini et al., 2014; Jansen, Zhang, Sobel & Chowdury, 2009). Not surprisingly, Twitter users have a positive attitude towards internet related aspects.

Methodology

The objective for this paper is to explore the subcutaneous human chip implant issues communicated in Twitter. The analysis is based on a weekly collection of tweets between collected tweets between 22 January 2020 and 27 September 2022 to gauge the general topic development for the human chip implant.

Netnography is a research method used to study online communities and cultures. It involves using ethnographic techniques, such as observation and interpretation, to analyze data collected from the internet, such as social media posts, forums, and blogs. The goal of netnography is to understand the social interactions, norms, and behaviors within a particular online community or culture.

Netnography provides a valuable way to study online communities and cultures because it allows researchers to gain a deep understanding of the social dynamics and behaviors within those groups. Because many people share their thoughts, feelings, and experiences online, netnography can provide rich data that can be used to identify patterns and trends in behavior, attitudes, and communication. Additionally, netnography allows researchers to study online communities and cultures in a naturalistic and unobtrusive way, without the need for direct interaction with participants, which can be useful for sensitive or hard-to-reach populations. Overall, netnography can provide insights into the social and cultural aspects of online communities that can be used for various purposes such as marketing, user experience design, and product development.

Overall, by using netnography, researchers can gain a deeper understanding of how RFID technology is being discussed, adopted and used in various fields, and how it is shaping the way we do business and interact with technology. As the human subcutaneous chip implanting is an emerging major innovation, our study aims to answer to this research question: what topics related to the human subcutaneous chip implants are debated in Twitter.

Topic detection aims to identify hidden /latent constructs between documents and words. For topic detection we used Latent Dirichlet Allocation (LDA) algorithm. LDA is a ‘generative unsupervised probabilistic algorithm’ (Bag of Words model) used to identify the top K topics (described by most relevant N words) in the dataset. As a generative model LDA makes no prior statistical assumptions, e.g. the word order nor document order are not important and each word can belong to multiple topics. As an outcome, each topic is characterised by distribution over words where the higher weighted words are of greater indication of what the topic represents. For

LDA, the number of topics must be determined in advance. We utilised the 'elbow method' to determine the ideal number of topics (Blei et al 2003; Tursi and Silipo, 2019, 141).

Data

Utilizing KNIME API connector, a weekly collection of maximum 5000 tweets with search terms of 'human implant AND RFID OR NFC OR microchip OR biochip' resulted in total of 5779 tweets (the 'human implant' limitation was considered essential to exclude the frequent calls for pet owners to get their cats and dogs chipped). 4263 tweets remained after duplicate tweets and non-English language content was removed resulting in 1738 original tweets and 3752 instances of re-tweeting.

This volume of tweets is a fair representation of the early stage of the human RFID implant movement. For example, other recent technological breakthroughs gather the following number of tweets during the first week of February 2020:

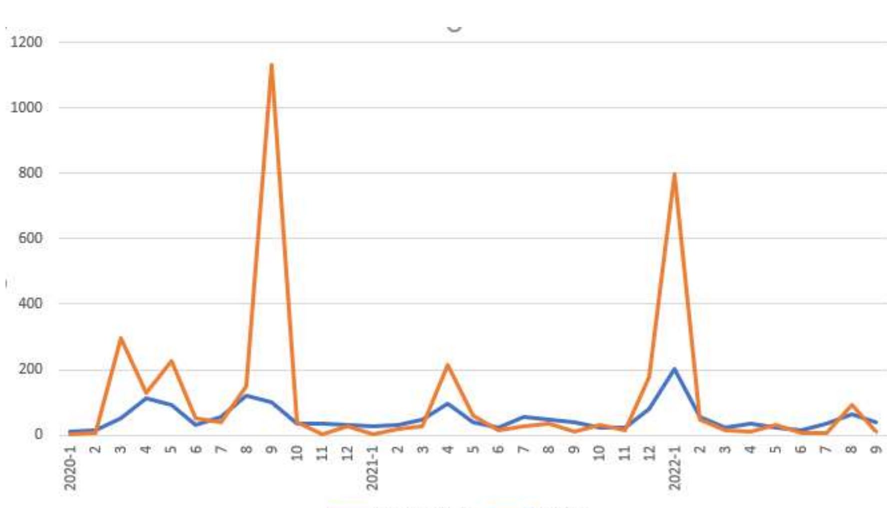
- 'wearables/ wearable technology' over 5000 tweets
- 'voice commerce/smart speakers' over 2200 tweets
- 'human RFID/NFC/chip implants' just 4 tweets

In KNIME text mining software the tweets were processed as follows: only English language original content was utilized for analysis (the corpus for text mining analysis). In a separate function the original tweets and retweets were identified for cursory exploration (see Figure 1 and Table 1). For the original tweets without duplicates, all symbols, as well as URLs and e-mail addresses were removed (http*, @*, >, and #). The remaining tweet content was converted from Strings to Documents using the OpenNLP English word tokenizer. At the PreProcessing stage, persons and organisations were tagged, word frequencies were used to develop custom dictionaries specific for this data where words like 'elon' and 'musk' were tagged as Known Entity person of 'elon musk' and further, 'obama' and 'trump' were tagged as Known Entity for a person. Equally, 'abc', 'neuralink' and 'darpa' etc. were tagged as Known Entity for an organisation. Next, numbers, punctuation and Stop Words (e.g. 'a', 'the', 'are') were erased. Then all words were converted to lowercase and treated with Snowball Stemmer that reduces each word to its root form, e.g. 'run', 'running', 'runs' all refer to the core word of 'run'. Most common word co-occurrence was explore with NGram creator, most commonly co-occurring words were 'elon musk', 'chip implant', 'brain chip', 'microchip implant' and 'human implant'.

The most active Twitter Users in our data were identified. To protect the privacy of those participating in this tweet conversation, the usernames for individuals and their location are not included here. Most Twitter Users in this datasets posted 2-4 tweets but there were a few usernames that tweeted with a notable volume. We checked the Botometer score (https://botometer.osome.iu.edu/) for most frequent tweeters in this data; there is no single Twitter user (or bot) dominating this discussion.

A frequency distribution of the tweets regarding human chip implantation per month can be seen in Figure 1 identifying the peak Twitter communication on human RFID/NFC implant to be in July 2019 as well as the January/February 2019 periods.

Figure 1: Monthly frequency distribution of human RFID implant tweets between January 2020 and September 2022



As can be seen from Figure 1, there are few notable peaks of re-tweet activity during this data collection period. Which tweets contributed to these peaks is explored, at content level, in Table 1. Exploring Figure 1 and Table 1 together is interesting: 'those dams conspiracy theorist…' tweet with total of 640 retweets are actually divided across two separate timings (September 2020 and May 2021). Equally, with 614 tweets is 'human trials will start this July…' trending first in January/February 2021 and again in January 2022. Both of these re-occurring tweets appear to be supportive and factual about the human chip implant development, even frustrated about the conspiracy theory type content emerging e.g. 341 retweets of tweet that purported COVID-19 as a biological weapon aiming to enslave humans (with anti-Bill Gates sentiment).

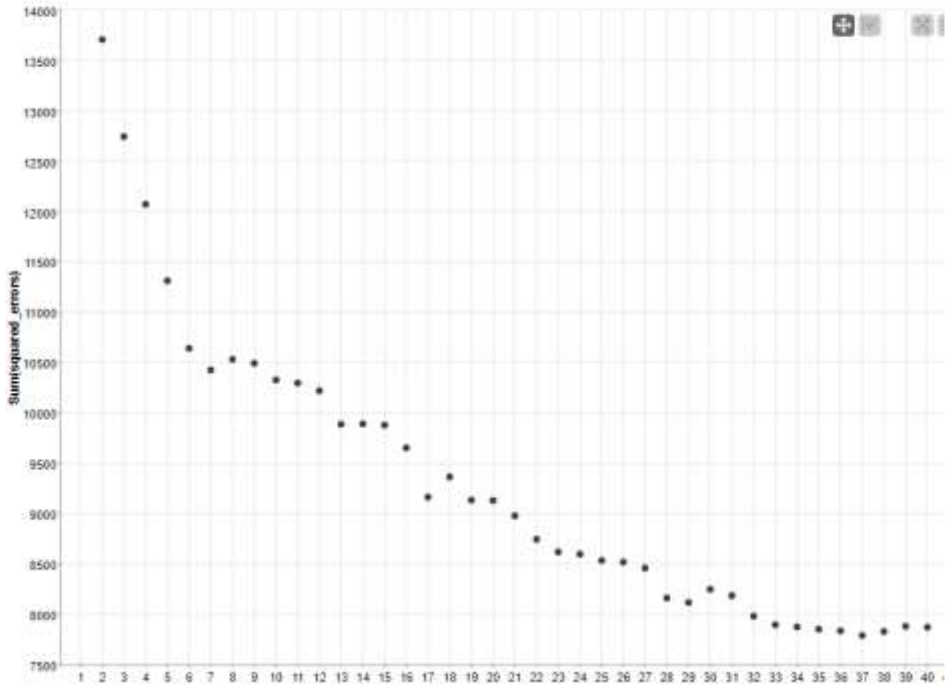
Table 1. Most re-tweeted content (abbreviated to include key content)

no of re-tweets	content	timing
862	Bill Gates wants to track every human being with a microchip implant…	May 2021
640	Those damn conspiracy theorists and their talk of injectable chips... https://t.co/rAVlHt7iJ0	Sept 2020 AND May 2021
614	Human trials will start this July on a micro-chip implant ….. [to] hold your booster status and other information to enable a fast and easy way to access things like shops and events. … Microsoft technology. A very exciting technology.	Jan-Feb 2021 AND Jan 2022
341	Covid 19s main purpose as a bio weapon was not to kill off the human race but to enslave them by introducing vaccines with digital certificate RFID chips… let me make 1 thing quite clear to @BillGates. you can take your mark of the?& shove it. https://t.co/OL3BAd7e8Q	March 2020
154	Pfizer signed an agreement with Microsoft to implant a microchip that will make tracking the data of vaccine recipients easier than ever. This is exactly the Bill Gates/Rockefeller's ID2020 plan. Every human will be controlled. Every human will be a slave https://t.co/hezEjJmzwX	April 2021
132	Neuralink's first implant will allow people with paralysis to use smartphones with their minds faster than someone using their thumbs. CEO Elon Musk tweeted a video, appearing to show a chip-implanted monkey playing Pong with its mind. Human trials may begin later this year. https://t.co/SNiBzMwv8S	April 2021
93	"An experimental new vaccine developed jointly with the US government claims to be able to change human DNA and could be deployed as early as next year through a DARPA-funded, injectable biochip." Everything is fine. https://t.co/mBWmEoY1W8	Sept 2020
85	Bill Gates will use your microchipped body to mine cryptocurrency. The real technology, with a sensor specifically made for detecting and keeping track of human biometrics, is a microchip implant being developed by a Danish Microsoft partner called BEZH International.	May 2020

Topics detected

The LDA algorithm requires prior knowledge of the ideal number of topics to explore. This is commonly achieved through exploration or with the 'Elbow method' that is utilized here. The Elbow method runs 'k-means clustering on input data for a range of values of the number of clusters *k*'. With a 'loop' feature we ran 2-40 iterations and calculated within-cluster Sum of Squared Errors (SSE) for each *k* value (the sum of distances of all data points to their cluster centre). These were plotted on a scatter chart (Figure 2). The best number of clusters is where the SSE value drops, hence the name for the 'elbow' method. In this data, the ideal number of clusters is 7 and due to the limited corpus we set the number of words per cluster at 6 (Hussain and Lee, 2017; Mutanga and Abayomi, 2022; Tursi and Silipo, 2019, 141).

Figure 2. Scatter plot to determine the ideal number of clusters



The LDA analysis of tweets referring to human subcutaneous implants of devices identified the following key topics (Table 2)

Table 2. Topics detected

Topic id	Term	Weight
Musk's Implant	brain	236
	chip	227
	implant	206
	human	198
	neuralink	162
	elon musk	144
Religious Objection	implant	71
	human	48
	microchip	38
	chip	33
	mark	19
	hand	18
Implant Conspiracy	human	155
	implant	114
	chip	79
	spy	46
	govern	41
	violat	40
Human Brain Implant Trials Starting	human	220
	implant	211
	chip	200
	brain	193
	neuralink	86
	elon musk	70
DARPA-Funded Chip	human	135
	biochip	134
	implant	117
	new	97
	introduct	88
	microchipavi	86
Uses for Human Chip Implants	implant	204
	human	178
	microchip	110
	chip	90
	bodi	50
	control	50
Implant Can Cause Cancer	implant	182
	microchip	154
	human	106
	develop	63
	cancer	60
	risk	60

The topics detected here support the divided views seen already in the most frequently re-tweeted content: from 'quiet factual' communication to fears about unintended outcomes of chip implants. Elon Musk's Neuralink, DARPA funded research and human trials also gets mentions. Naming of the topics was validated by reading the content of top contributing documents (Aktas-Polat and Polat, 2022). We named the topics to best describe their content as Musk's Implant where content referred to Ellon Musk, Neuralink and a video where a chimp was using implant to play video games; Implant Conspiracy with references to 'foreign country', Illuminati, Covid-19 and bioweapon. The next topic wad clearly dominated by DARPA funded biochip project. In the Implant Can Cause Cancer topic chip injection sites were linked with cancer. The Religious Objections topic was the hardest to name (with low weighting of terms) with some references to Musk's Chimpanze, sarcoma risk as well as God, Holy Spirit and antichrist. The Human Brain Implants Starting topic included references to both DARPA and Neuralink potentially starting human implant trials shortly. The Uses for Human Chip Implant group linked chip implants from cashless society to human traffickers chipping their victims.

DISCUSSION

The idea of human RFID implantation is emerging but lack of knowledge of this possibility and the limited usability of the current applications are hampering this development. Our analysis also suggests that there is a deep-rooted distrust towards the RFID/NFC implant technology as a potential means of tracing (or even controlling) individuals in the future.

The 'success stories' for RFID implanted devices emerge mainly from Sweden. As a wealthy, technologically advanced country with good public health care, Sweden is the ideal location for testing this technology. Moreover, reports from the Swedish successes with the implanted RFID devices are also more likely to be accepted at face value without being labelled as 'fake news' (Schwartz, 2019b). Convincing the Swedish National Rail to accept payment via an implanted RFID device was a major scoop for the human RFID implanting movement: it is the ultimate symbol of trust, functionality and convenience. In other words, the technology is trusted by the national rail organization as well as the banking industry to enable such payments. Further, the functionality of the technology is tested every day and the convenience of such payment methods is frequently demonstrated to fellow passengers.

This situation is similar to the early stages of introducing smartphones to the market when the high-volume demand emerged only after the various productivity and social media applications became popular. At least now our imagination for implanted devices is not limited at the pre-social-media-era thinking. The VivoKey statement that 'developers are welcome to create and deploy their own applications through an easy use API' brings about an uncomfortable déjà vu moment- was it not the liberal API developer access that lead to the Cambridge Analytica scandal? The situation is problematic: without easy API access there will not be the volume of possible applications that would eventually entice the early adopting consumers to get implanted but with the freely available API unexpected harvesting of user data may also occur.

What are the industries most impacted by implanted RFID device?

As contactless payment is already accepted by many consumers, and there is an existing technology to facilitate such transactions, we do see early demand for small payments with the ultimate convenience of RFID implants where customers do not even have to produce smartphones or payment cards at checkouts. Psychologically, a major hurdle has already been crossed with the introduction of contactless payment systems linked to card and smartphone payments. Furthermore, periodically the current contactless payment portals require further authentication for the transaction to proceed. These features make it easier for the average consumer to accept this new payment method.

If the security and access control applications (e.g. access control to buildings, facilities and computer systems) are linked to workplace, we foresee general resistance unless the introduction is transparent and the benefits of the implant technology are clearly demonstrated. The exception to this rule is facilities where extreme security protocols are already followed e.g. the Mexican drug trial preparations. National security institutions, police, emergency responders and the armed forces are likely to be at the forefront of the adoption of the RFID implants. The aftermath of 9/11 already demonstrated the challenge of identifying emergency respondents should they become victims themselves. Professions where weapons are used are likely to see RFID implants as a security measure where a weapon will only fire when matched to the authorized implant. By contrast, the introduction of RFID implants for staff members in the 'average office' is likely to meet with resistance from employees and trade unions. The possibilities of linking RFID implants to productivity measures at work without explicit permission from employees is too frightening a scenario.

The RFID implants could also be necessitated by immigration approvals or work permits in a highly desirable destination like the USA or Australia. Such move is reminiscent of the initial introduction of the biometric passports that met with early resistance but are now adopted by most nations in the world.

One of the initial drivers for the development of the human RFID implant was the desire to link heath records to each individual so that emergency responders can get access to accurate and up-to-date health information when treating patients who cannot verbally communicate e.g. allergies to commonly used antibiotics. The linking of each individual to their cloud-based health record was a justification for the initial U.S. Food and Drug Administration VeriChip accreditation in 2004. It is quite possible that in the future, the private health care providers will offer discounts form their health insurance premiums for those who elect to receive their RFID implant. The motivation for the health care providers would be accurate record keeping with immediate access by authorized health care service providers. Health insurance organizations could leverage savings from these protocols as well as effectively reduce fraud. The individual customers could be enticed by the potential savings offered together with the speedier medical response when needed. Furthermore, a 2007 USA study revealed that parents are much more likely to get their children chipped than themselves (Smith 2008). In other words, the RFID tags are likely to be introduced to children first when parent seek for the best and fastest medical response time or security against kidnapping: 'there is no privacy objections because the carriers are children' (Gilleson et al., 2019, p 27).
All analysis of data point to two extreme ends of argument: some tweets recognize the value of research conducted towards further developing the human subcutaneous chip implants vs. content that could be best described as fearmongering with tweets suggesting a future where human thinking is controlled by implanted materials. Some religious content has also been harnessed against human subcutaneous chip implant development.

The majority of consumers are currently not even aware of the human subcutaneous chip implants, yet there are RFID focused tweet exchanges of this topic. This suggests that Twitter is a good source for opinions regarding early product innovations. However, as a text mining corpus, the short communication style used in Twitter does limit the text material available for analysis, especially when URL information cannot be utilized. This is probably why words like 'implant', 'human, and 'microchip' feature in multiple topics identified in our analysis. Concentration around these words can be partly explained also with the Twitter search terms used as only tweets featuring human subcutaneous implants were originally included in the Twitter data harvesting.

CONCLUSIONS

The decision to acquire a body area RFID/NFC implant should not be taken lightly, campaigners warn of potential future privacy issues if hackers develop devices to interact with implanted chips. Rodriguez (2018, 1607) quotes Hannes Sjoblad, the Swedish biohacker: 'It's very easy to hack a chip implant, so my advice is don't put your life secrets on an implant'. Furthermore, questions are also raised about the biocompatibility of the materials used in the production of these implants to avoid potential future fibrosis, inflammation or the body rejecting the implants (Kiourti, 2018).

Currently the human RFID implants are strongly associated with Body Modification or transhumanism counterculture e.g. implanting magnets at fingertips because they are trendy (Strohmeier et al., 2016). Such association is likely to create negative impressions amongst the average consumer reading about the possibility of RFID implants. Furthermore, even the company names of Dangerous Things, Biohax and Dsruptive do not represent trustworthy cause to the average consumer although the Dsruptive association with a Swedish university might help (Schwartz, 2019b).

The human implant RFID technology is still in its infancy but IoT health monitoring would offer great support for e.g. aged care but could RFID implants used in healthcare pave the way for Internet of People (Xiang et al., 2022)? The market for 'wearables' is growing at phenomenal rate (Kiourti, 2018) and many of these health or fitness tracking apps now routinely include the sharing of our own activities amongst the likeminded community. Furthermore, the contactless payment is also gaining popularity. In other words, many consumers are already conditioned to accept many of the features a subcutaneous implant could offer. Unfortunately the human RFID chip implant conversation has also attracted the attention of conspiracy theorists and anti-vaxxers; this could be partly attributed to the global Covid-19 pandemic and heightened pressure for individuals to get vaccinated.

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