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Abstract

This paper investigates the possibility of introducing subcutaneous microchip radio frequency identification device (RFID) as a substitute for personal documents and credit cards. Microchips are used for many years for different purposes in production and sale, medicine and also to identify some domestic animals. In the study we were interested in whether people in Slovenia would be willing to use subcutaneous microchip and under what conditions. As an alternative solution multisystem smart card was suggested. This paper presents the preliminary results of study carried out from January 21 to February 16 2014. The results show that there is potential for commercial use of RFID implantable microchip also in Slovenia. The attitude of respondents toward adoption of microchips depends on their characteristics, characteristic of microchip and field of usage. Most of respondents would use RFID for healthcare issues, personal identification, and their home environment and at least for shopping and payments. Some discussion for future development of RFID is given.

Keywords: eHealt, eCommerce, implanted microchip, RFID, identification

1 Introduction

Two years ago we were attending 25th Bled eConference in Slovenia where we discussed about smart health care cards suitability in Australia (Cripps et al., 2012). Many pros and cons were discussed and then the idea of RFID (radio frequency identification device) microchip implants was raised. We fantasize about our vacation at sea in the future where we wouldn't need a wallet, since we could be identified, make payments and unlocked the doors of hotel rooms with the help of the subcutaneous microchip. If we would need health assistance, they would simply read our health care security number from microchip and checked our prior health issues. Is it possible? Why not?

At the end of last year we notice announcement from Dangerous Things (2014) that they want to introduce the first fully NFC (Near Field Communication) compliant implantable RFID tag. NFC is used as a set of short-range wireless technologies, mostly used in smartphones, typically requiring a distance of 10 cm or less. The owner of campaign Amal Graafstra implanted his first microchip in 2005. They claimed that they successfully prototyped and tested the world's first implantable NFC technology - they call it the xNT. The xNT is a 2mm x 12mm, fully NFC Type 2 compliant RFID tag encased in a cylindrical Schott 8625 bio-glass ampule and sterilized in ethylene oxide gas. The price for pre-loaded xNT into injection system is 99$. The campaign gets their goal of 8000$ in one week. Till March 2014, they gathered 30,619$. Recently, May 2014, first comments on successful shipment of the xNT were posted. We should wait for a while to see if this is yet another scam or indeed will these individuals be able to push the use of the RFID implantable devices in private field.

What about the problem of daily used payment cards, credit cards, club cards, profit cards, parking cards, business cards for identification etc. Why must we have on average more than ten cards in our thick wallet? Can all that be replaced by one microchip? Or at least, can all that be replaced by one multifunction card? This and similar questions from eHealth, eGoverment, eCommerce inspired us to conduct research in Slovenia on use of the RFID microchip implant in human for various fields of use.

2 Literature review

2.1 RFID

The first use of RFID technology is considered in the Second World War, when the Allies in this way recognize allied aircraft (Smith, 2008). Later, the use of RFID was used for tracking of radioactive materials and animals. This was followed by the extensive use of RFID systems for tracking products and raw materials in the systems acquisition, sales and storage.

The first subcutaneous microchip was in August 1998 tested by the researcher Prof. Warwick of Reading University, USA (Witt, 1999). It was a small RFID microchip in a glass capsule size 23 x 3 mm inserted in his left arm above the elbow. In this way, with the help of computer and automation, he opened the doors without touching it, activated lights and broadcast messages. The test lasted for 9 days in order to avoid possible health complications due to the time of battery life.

In medicine the use of microchips has led to incredible opportunities. Already in 1998 biosensors based on microchips were able to operate with specialized devices by thought (Bauer, 2007). They allowed persons who are unable to communicate (disabled speech, movement of the limbs), to communicate through these devices.

As early as 1997, the control of blood pressure and heart function due to the small size wireless biosensor directly in the heart was possible. Of course, this also allows monitoring its status remotely via an Internet connection. The use of microchips and GPS system for tracking lost pets is known for many years.

Similar system was used as the possibility of locating elderly or children in the case of their uncontrolled departure from home (Alzheimer's disease, kidnapping,..). RFID system is also used in hospitals for tracing the distribution of medicines, equipment, healing procedures, patient movements, but in these cases the RFID labels were attached or fixed to observed item (Mehrjerdi, 2011).

The latest discoveries are really extraordinary. It is no longer science fiction (Baker, 2013) that the child who was born deaf, hears again with the help of cochlear implants, a microchip implant, which stimulates the auditory nerve inside the ear. We know that there exist microchip devices that can take brain signals and send them to robotic limbs. So can amputees' thoughts control their movements. We read news about the first success in the introduction of computer-assisted vision by the attachment of microchips in the retina, according to which some blind perceive light (Baker, 2013).

Otologic surgeon Konstantin Stankovic at the Massachusetts Eye and Ear Infirmary, and others from MIT, have succeed in building a device 'bio-battery' that could power implants from the inside. They tested the device in guinea pigs, which has hearing hardware functions similar to humans. Electrodes on either side of a natural membrane powered an on-board chip that was able to transmit a signal of indication of the inner ear potential (Hewitt, 2012). The development is still in the beginning phase so many years of research is still needed to take its full potential.

Bio-batteries are useful in the brain (glucose fuel cells) and as pacemakers supplied based on the movements of the heart.

Burke and Rutherglen (2010) discuss the possibilities of RFID system based on a single microchip. According to their paper, at least three companies managed to produce built-in glucose and blood pressure sensors based on single microchip. Hitachi company with Usama and his colleagues have in the year 2007 succeed in development of technology for nano RFID microchip production size of 0,05mm X 0,05 mm (Burke in Rutherglen, 2010). Currently, the problem is the size of the antenna, which is required in such a system and is sized 1 X 1 mm.

In the year 2012 first results of wirelessly controlled drug delivery microchip testing were published (Farra et al., 2012). The test was conducted with eight female patients with osteoporosis who have received medicine by implanted RFID drug delivery microchip device with twenty doses of medicines size 53mm X 31mm X 11mm. Dates and quantities of drugs are programmed and controlled using a wireless metering device management. In this way, patients are deprived to 20 painful stitches of classical injection.

The U.S. Department of Food and Drug Administration (FDA) in October 2004 approved the company Applied Digital Solutions use of implantable RFID microchip in a glass capsule for identification even in humans (Swartz, 2005). This is a company that previously produced VeriChip, the size of a grain of rice, to identify the lost domestic animals and livestock. This is for the first time in the United States that the use of the device was approved on humans for medical purposes. The microchip was inserted in the arm or hand of the patient by use of a local anaesthetic in a few minutes. The patient has been allocated 16 digit identification code which can be together by appropriate scanning equipment used to identify and gain an insight into his medical recorded data such as known allergies, blood type, previous treatments. The advantage of this system lies in the case of patient critical health situations when he is not able to provide the necessary information. According to the press in Mexico microchips were inserted in more than 1000 patients. Of course, such microchip can be also used for other purposes. Mexican Attorney General, Rafael Macedo de la Concha and his 160 law enforcement officials was inserted microchips in their hands in order to increase safe access to the premises to confidential documents on the drug cartels in Mexico (Atkins, 2004, Swartz, 2005).

The use of microchips also brings some risks such as safety of device, privacy of patients' records and coercion to consent to the implantation of the devices. Additional there is a social and ethical risk. There are several groups of mostly catholic people that see the devil in the microchip (Monahan and Fisher, 2010). They are afraid of unauthorized human control and tracking of people and their actions. In addition, there are also possibilities of discrimination between patients during medical procedures and reduce of the patient's confidence in microchips and the health system.

In the empirical research of Monahan and Fisher (2010) in 23 U.S. hospitals between March 2007 and December 2009, patients were monitored with embedded microchips during medical procedures. They found that the patients with microchips had advantages over others, because they avoided queuing, since the data on patient were transferred by reading the microchip. During interviews of patients they found out that some patients have inserted the microchip based on misconceptions about the benefits of them. They also detected the danger of bureaucratization, where data in microchip system, despite potential human errors in the entry, were more relevant as a statement of the patient them self. This could lead to a health risk of patients (Monahan and Fisher, 2010).

2.2 Smart cards

Smart cards with embedded microprocessor were developed in the early 1970s (Cripps et all. 2012). They used them mostly for transportation, secure buildings access and offices, and for electronic payments. One of the distinct features of smart cards is integrated encryption key that help prevent fraud. The smart cards are also equipped with limited memory that can be manipulated.

Memory cards can be seen as small data storage devices with optional security that can be read, while smart cards with microprocessor can add, delete or change data in its memory on the card (Mohammed et al., 2002). Contact smart cards are inserted into reader while contactless smart cards have an RFID microchip with antenna in it that can communicate in short distance with the reader. Combo card is a combination of aforementioned cards in one with a very high level of security. The available memory and microprocessor on board allows also use of biometrics. That means that biometric features can be used for user identification by fingerprint, retina, voice etc. As stated by Mohammed et al. (2002) decade ago, smart cards could handle multiple tasks for their owners in the future, from providing access to company networks, enabling electronic commerce, storing health care information, providing ticketless airline travel and car rentals, and offering electronic identification for accessing government services such as benefit payments and drivers licenses etc.

3 Methodology

Based on the literature review web questionnaire on adoption of RFID systems and subcutaneous microchips was constructed. We try to examine the opinion of Slovenians on personal use of subcutaneous microchips for healthcare, identification, shopping and payment, and home use purposes.

We expected that the awareness of microchip usage would be low and that its acceptance would depend upon the several factors:

- personal characteristics of participants in the study (age, gender, education, consumer habits, personal specifics, etc.),
- technical characteristics of the microchip (the possibility of tracking, remote control, security, etc.),
- confidence to the provider (state, health care, banks, shops),
- area of the microchip usage (identification, health care, payment, home use).

We set three main research questions:

- R1: Is it possible to introduce commercial use of the RFID subcutaneous microchips in Slovenia?
- R2: What factors influence the decision of subcutaneous microchips use?
- R3: Would a multisystem smart card be accepted as alternative to subcutaneous microchips?

Data for the study were collected through the structured online questionnaire, which was equipped with some facts and image materials about the possibilities of the use of microchips. In order to determine the impact of provided information on the response, we repeated the same questions from the beginning also on at the end of the questionnaire. The questionnaire was fulfilled in about twelve minutes. Invitations to the survey were sent via emails to members of our own social networks, our students and to the several societies and media houses. Invitation to the questionnaire was posted also at the faculty web page.

In the questionnaire, mostly closed-response questions were used. Except for demographic data, respondents either rated statements on a scale from 1 to 5, or responded by grading items according to their importance.

In the time period from January 21 to February 16 2014 we received in total 626 surveys where 21.1% (132) were partially completed surveys and 78.9% (494) were completely fulfilled.

4 Results

4.1 Sample characteristics

The current sample consists of 56,9% of females and 43,1% of males. The majority of respondents (29,4%) have a secondary school, vocational level have 3,7%, while primary school or less have 17,0% of respondents, where we have to emphasize that we include in the research also pupils of the highest grades of primary school. 22,1% of respondents have graduate level within 1st and 2nd Bologna level and 8,9% of the respondents have a title of MSc or PhD.

Among the respondents 6,8% are unemployed, 5,4% are pensioners, 38,5% are students of primary school, high school or university and 49,2 % of them have a status of employed person. The youngest respondents were 12 years old, while the oldest were 90 years old. The average age is 32,5 years with standard deviation 14,9 years. Almost half of the respondents (311 or 49,8%) already heard of RFID. Those respondents were asked to estimate their current knowledge of RFID technology on 5 point scale from very bad (1) to very good (5). The majority of respondents (31,9%) select the neutral answer that their knowledge is neither bad, neither good, while the mean of knowledge estimation of RFID is 2,88 with standard deviation 1,21, therefore we can conclude that self-estimation of RFID knowledge is rather poor.

Number of debit, credit, prepaid and profit cards could be a useful guideline to outline the involvement of a respondent as an active or well-informed eConsumer. We have to emphasize that all data regarding bank and purchase habits presented below are reported with excluded students. Respondents have on average 2,3 debit cards (s=0,72), while only 4% of respondents said that they have no debit card. Average number of credit cards (e.g. Mastercard, Visa, Diners Club,…) is equal to 2,04 (s=0,91). Majority of the respondents (45,9 %) reported that they possess one credit card, while 27,9% do not have any credit card. Prepaid cards such as parking cards, cinema cards, etc. are not so widespread, while 63,0% respondents have no such card and average number is equal to equal to 1,5 (s=0,80). On the other hand the profit cards of food and clothing retail chains, construction shops, pharmacies, and gas stations are much more popular, while respondents reported on average 5,2 profit cards (s=4,37), 7,1% of respondents reported that they have 10 prepaid cards or more.

Questions on intention to adopt microchip were raised both at the beginning and at the end of the survey in order to investigate the effect of information and pictures presented during the questionnaire. Results are presented as mosaic plots in Figure 1. Among respondents who said that they would use microchip for healthcare issues (upper left part panel in Figure 1) at the beginning of the survey 89,4% respond positively also at the end of the survey, while 10,6% of respondents changed their opinion. Positive shift in the opinion of adoption for healthcare issues was found for 17,5% of respondents (at the beginning they said no and at the end they say yes). The highest negative shift in the opinion of adoption of microchip was found in the case of identification issues where 22,1% of respondents said that they have no intentions to adopt the microchip at the end of the survey, although their opinion at the beginning was quite the opposite (upper right part panel in Figure 1) 5,0% of respondents positively changed their opinion on usage of microchips as shopping and payment gadget (lower left part panel in Figure 1) and 7,3% respondents positively change their opinion on home usage of microchips (lower right part panel in Figure 1).

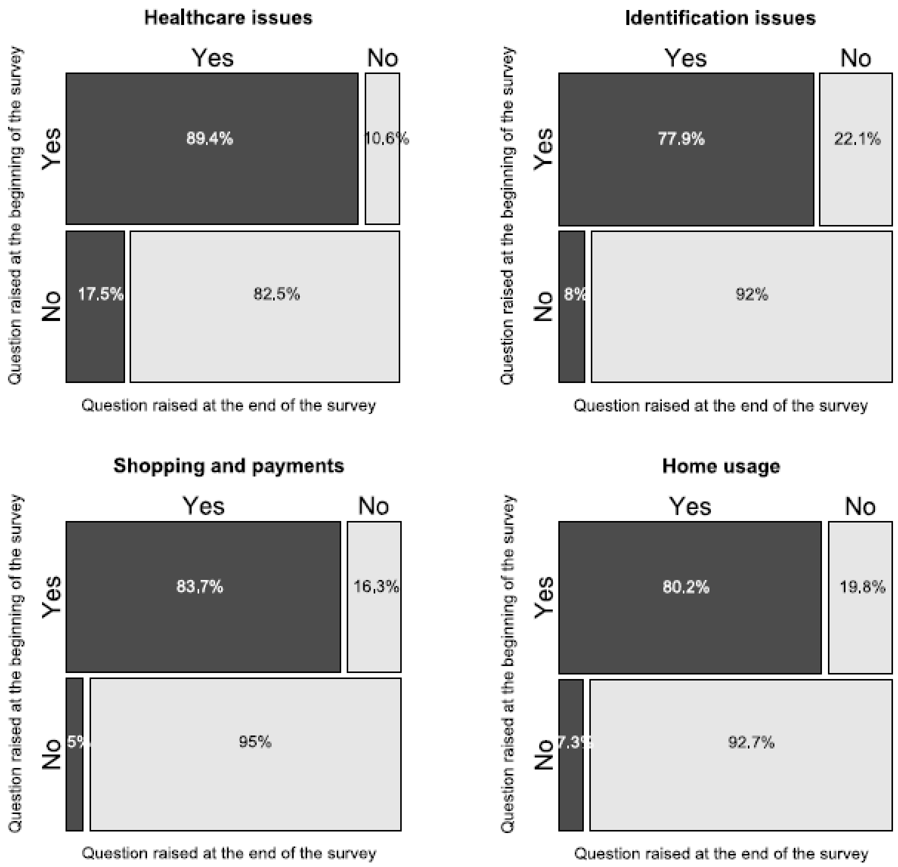

Figure 1: Intentions of adoption of microchips for four different usages according to the time of raised questions

Next we try to find out how characteristics of the respondents influence the intentions for adoption of microchips. Figure 2 presents positive response on seven questions on microchips and smart card adoption according to the status of the respondents. Students are more prone to adopt microchips, while 56,7% would have microchips for healthcare issues, 40.1% for identification purposes, 38,0% for simplified shopping and payments, and 40,1% for usage in home environment. If assurance will be given that microchips do not allow GPS tracking then 46,5% of students will adopt them. 37,8% of students reported that they would adopt a microchip if it will combine of four main scopes of usage; healthcare, identification, payments and home usage. If assurance will be given that microchips do not allow GPS tracking then 46,5% of students will adopt them (Figure 2), while 37,8% of students reported that they would adopt a microchip if it will combine of four main scopes of usage; healthcare, identification, payments and home usage. To understand the level of these results we can compare result of similar research by Smith (2008). Students from Mesa State College, Colorado, were asked “Would you get implanted with an RFID Chip?” and 23,33% of them reported that they would implanted it. If we take into account that there are no big differences in leaving conditions between USA and Slovene students, then we can conclude that in 6 years the number of students who are prepared to use microchips increased almost for twice (37,8%).

Students have the most positive attitudes towards the adoption of smart cards which would combine all four previously mentioned scopes, while 70,3% reported a positive attitude for adoption (Figure 2). Somewhat unexpected is relatively positive attitude toward adoption of microchips of pensioners, especially in comparison with (un)employed respondents, where 42,3% of pensioners would have a microchip for healthcare issues. One of the possible explanations for those results is that we got answers only from pensioners that are users of internet and are more in favorite of technical innovations than others.

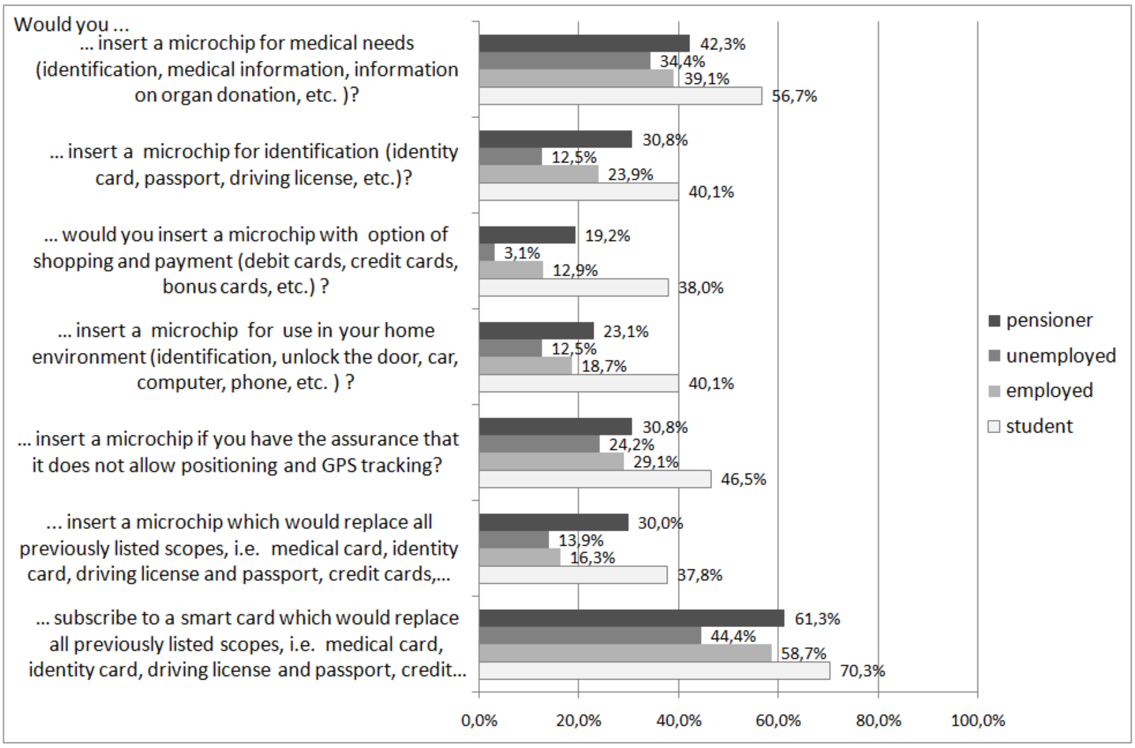

Figure 2: Intentions for adoption on microchips according to respondents' status

Investigation on opinion of microchips adoption according to gender reveals that men have more positive attitude toward their adoption than women (Figure 3). The highest percentage of men would have a microchip for healthcare purposes (47,1%), while among women 42,2% express positive opinion on that question. Around 60% of men and women would have a smart card combining all for main areas of use, while microchip would have 22,7% of men and 18,4% of women. Comparison to Smith (2008) shows similar differences between male (23,91%) and female (11,76%) respondents in favor of male.

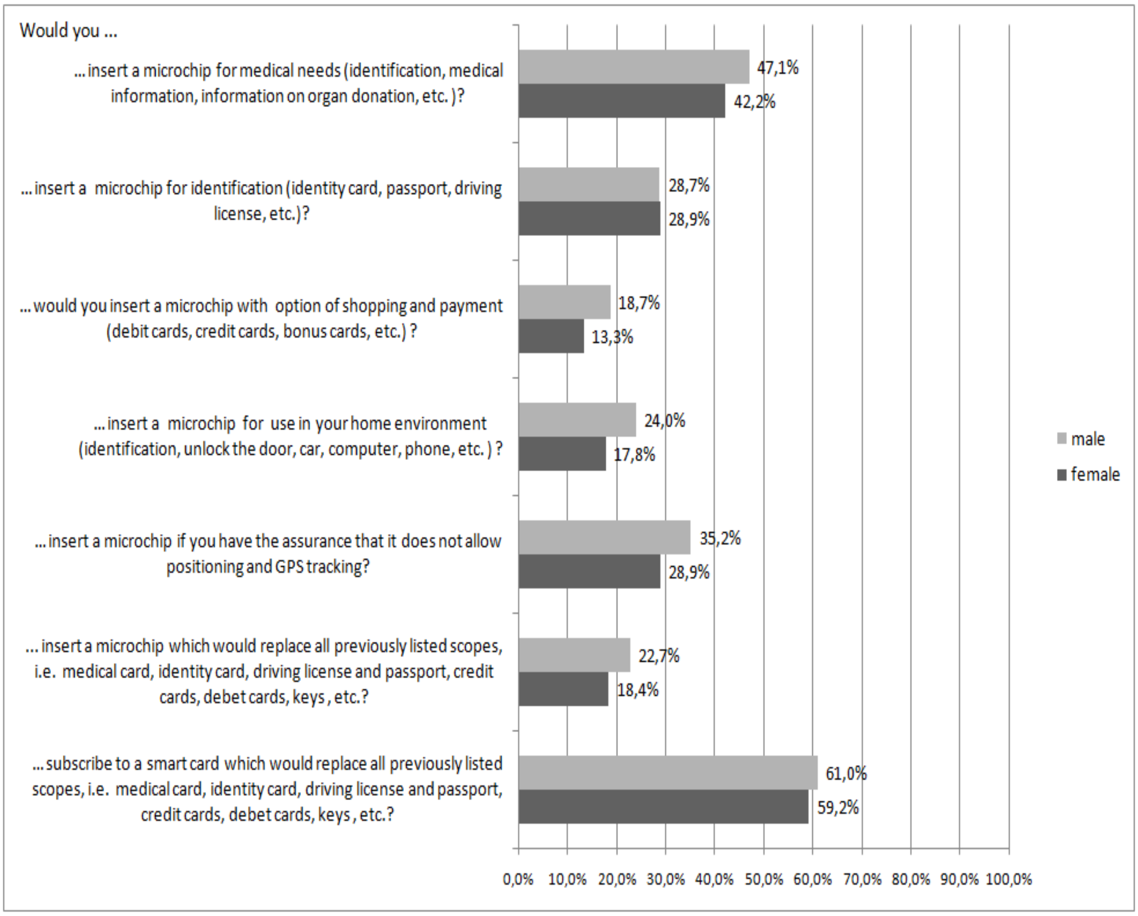

Figure 3: Intentions for adoption on microchips according to gender of the respondents

In addition we combined the answers on four questions (from the end of the questionnaire) on adoption intentions (healthcare, identification, shopping and payments, home usage) into three categories: respondents who do not intend to use microchip in any area, respondents who selected one or two scopes and respondents who selected at least three different fields of microchip usage.

The ANOVAs

In order to find differences in several personal characteristics payment and purchase habits of the respondents according to three categories of microchips usage ANOVAs were performed (Table 1).

There exist statistically significant differences in number of different social networking services (e.g. Facebook, LinkedIn, Twitter, Youtube, etc.) among three groups of respondents according to adoption intentions of microchip (F=5,15, p=0,06) at 5% significance level. Post hoc analysis with Hochberg's GT2 reveals that statistically significant differences in average number of usage of different social networking sites are between group of respondents who would have a microchip for at least three different areas ($\bar{x} = 2{,}20$) in comparison with other two groups ($\bar{x} = 1{,}78, \bar{x} = 1{,}73$) where it can be seen that respondents who would use a microchip for at least three different scopes use on average more social networking sites.

	Number of microchip usages	**Descriptive Statistics**			**Test of Homogenity of Variances**				**ANOVA or Robust Tests[2]**	
		N	Mean	Std. Dev.	Levene Statistic	df1	df2	Sig.	F	Sig.
Num. of different social networking services	none	227	1,78	1,33	2,707	2	470	,068	5,15	,006
	1 or 2	137	1,73	1,15						
	3 or 4	109	2,20	1,27						
Age	none	238	35,18	13,78	2,963	2	482	,053	9,52	,000
	1 or 2	136	30,84	14,28						
	3 or 4	111	28,38	15,98						
Stolen/lost wallet in last 5 years	none	240	0,12	0,37	41,604	2	487	,000	10,70	,000
	1 or 2	138	0,20	0,44						
	3 or 4	112	0,43	0,78						
Car/home/office keys lost in last five years	none	239	0,28	0,81	21,481	2	486	,000	15,96	,000
	1 or 2	138	0,62	1,01						
	3 or 4	112	0,95	1,23						
Number of (personal, work,...) e-mails	none	239	3,67	1,48	,109	2	486	,896	1,06	,348
	1 or 2	138	3,57	1,42						
	3 or 4	112	3,84	1,45						
Proportion of daily purchases paid with debit cards	none	173	55,0	32,8	1,145	2	295	,320	2,71	,068
	1 or 2	77	65,5	31,7						
	3 or 4	48	57,5	34,0						
Num. of group purchases in 2013	none	71	4,76	3,22	7,751	2	139	,001	,52	,595
	1 or 2	42	4,31	2,24						
	3 or 4	29	4,83	2,25						
Number of debit cards	none	172	2,30	0,70	,272	2	294	,762	,32	,730
	1 or 2	77	2,35	0,70						
	3 or 4	48	2,25	0,67						
Number of credit cards	none	173	1,92	0,82	4,744	2	295	,009	4,38	,014
	1 or 2	77	2,30	1,05						
	3 or 4	48	2,21	1,01						
Number of prepaid cards	None	173	1,48	0,83	1,088	2	295	,338	,83	,436
	1 or 2	77	1,42	0,66						
	3 or 4	48	1,60	0,87						
Number of profit cards	None	167	4,62	4,25	,228	2	287	,796	4,65	,010
	1 or 2	76	6,09	4,47						
	3 or 4	47	6,30	4,12						
Amount of stimulative discount to replace debit cards with microchip	None	211	57,63	42,02	43,218	2	272	,000	10,90	,000
	1 or 2	137	45,93	28,92						
	3 or 4	111	34,59	25,11						

[1] Analyses on purchase and payment habits are performed with excluded students (shaded with gray).
[2] If the variances among groups are not statistically significant at 5% significance level ANOVA, otherwise Robust Test of Equality of Means is performed.

Table 1: Differences in personal characteristics, eActivities, and purchase/payments habits among three groups with different intentions of microchips adoption

Similar as seen above when we compare status of the respondents the average age differ statistically significant among three groups of respondent according to the intentions of microchips usage (F=9,52, p=0.000). Respondents in the group who refused to use all microchips is statistically significant older ($\bar{x} = 35{,}18$) than respondents in other two groups ($\bar{x} = 30{,}84, \bar{x} = 28$,38 at 5% significance level.

Stolen or lost wallet with documents and stolen or lost car, home or office keys influence the individual's intentions to use microchips, while there exist statistically significant differences in number of lost/stolen wallets in the last 5 years and number of lost or stolen car, home or office keys in the last 5 years. Respondents who intend to use microchips for at least three different scopes have on average highest number of lost or stolen wallets ($\bar{x} = 0{,}43$) and keys ($\bar{x} = 0{,}95$) in the last five years.

Previously we showed that number of networking sites differ among three groups based on number of intended uses of microchips. On the other hand, number of e-mails do not differ statistically significantly among three groups of respondents (F=1,06, p=0,348). The analyses on purchase and payment habits in Table 1 are presented with excluded students. We found out that there exist no statistically significant differences in proportion of daily purchase paid with debit cards (F=2,71, 0,068), number of so called group purchases (F=0,52, p=0,595), number of debit cards (F=0,32, p=0,730) and number of prepaid cards (F=0,83, p=0,436) at 5% significance level. On the other hand there are statistically significant differences in average number of credit cards (F=4,38, p=0,014) at 5% significance level, where respondents who have no intentions to adopt microchip have on average the lowest number of credit cards ($\bar{x} = 1{,}92$).

Respondents who are more prone to adopt microchips have on average more prepaid cards ($\bar{x} = 6{,}09$ and $\bar{x} = 6{,}30$) than respondents who do not want to adopt any of microchips ($\bar{x} = 4{,}62$).

Respondents were asked also what amount of discount would be stimulative enough to replace debit cards with microchip. Respondents who decline the use of microchips reported on average higher percentage of stimulative discount ($\bar{x} = 57{,}63$) than respondents who are more in favor of microchips usage ($\bar{x} = 45{,}93$ and $\bar{x} = 34{,}59$).

5 Conclusion

The results of the study show that there is potential of commercial use of RFID implantable microchip also in Slovenia (R1). According to diametrical opinion of respondents, while some of them see this as opportunity and others as threat to their human integrity, no mandatory can ever came in question. When we distinct between different kind of usage in all categories the order of categories is equal. Most of respondents would use RFID for healthcare issues, personal identification, and home environment, and as least for shopping and payments. The number increases when we were searching for those in favorite of untracking RFID. This shows the fear that exists among respondents that microchips will enable tracking their position, movements, shopping habits etc. One of the main results of our research study, as expected, are the findings on multisystem smart card acceptance (R3). It should be viewed as a preparation for the later use of RFID system since the architecture is the same for both. In some USA hospitals the negative aspect or discriminations as result of RFID system use was observed when patients with RFID implantable microchips were processed before regular patients who have to wait in queues before their personal data was found and the details on the form were filled in. When we examined the age of respondents it was expected that younger will be more open to use RFID microchip. As expected additional information and knowledge about RFID usage provided during the questionnaire arise the amount of possible RFID users. Similarly, as we expected respondents that are using different internet possibilities such as social networks are more likely in favorite for RFID use. Also persons with bad experiences with stolen wallet or lost keys see the RFID as opportunity. Women tend to be more cautious than their male colleagues. RFID adoption according to gender reveals that men have more positive attitude toward their adoption than women (R2).

What are the preconditions for new system? Technically there are no limitations at the moment. Smart cards and RFID devices are used for decades so no questions should be on their side. The biggest problem we see is in national and international collaboration and corporations' interests. Strict laws and government regulations must be accepted for personal protection of users and to prohibit potential misuse by government, institutions, banks or traders. The beginner of the new initiative has to be European Union and then the Slovenia and other member states will follow it. Until then, partial solutions will be sold and lot of unnecessary money will be spend for synchronizations of different unnecessary systems. And of course, owners of recent system will be the hardest obstacle to unified system for personal identification, security and health insurance and commerce.

Implication for practice

The main results of our research could practitioners used as market research and study. It seems that there is a large group of potential RFID user whether as implantable microchip or as multifunctional card. The use of the latter was tested in some towns (e.g. EZ-Link in Singapore, Urbana in Ljubljana, Slovenia) where single card if used for multiple purposes (transportation, parking, identification, payment, …). The fears of potential users are known, so the product should not allow position tracking or any other tracking of personal habits. The production cost should not be much higher than from those of recently used smart cards that have already RFID included. It seems that whole new field of RFID and smartphones market will arise. There exist applications for smartphones that can replace RFID cards. For those more conservative users, that do not want to implant microchip under the skin, many alternatives exist in shape of rings, bracelet or pendants with included RFID microchip.

In health care there are numerous examples of RFID good practices varying from inventory, drugs to patient systems that are used for several years' in different countries. The biggest challenge of such system is how to change our rigid systems which are usually even not fully IT supported to new technology which do not allow improvisations.

Limitations

This article presents preliminary and partial results due the time lack between conduction of research and the finalization of presented paper and due the limitation of the paper length. The gathered sample of partially or fully fulfilled questionnaires is adequate, but the numbers of responses from some groups is insufficient. Especially group of unemployed persons and group of pensioners are a little bit poorly represented and probably in further analyses their responses should be weighted to obtain more representative sample. On the other hand those groups are not the main target groups of potential microchip users. Further work is needed in order to answer all questions raised during the discussion in this paper..

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