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Location-based Services: An Examination of User Attitudes and Socio-Ethical Scenarios

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Abstract

The location-based services (LBS) industry is characterised by a multitude of vendors, all of whom assume a vital role in the provision of location solutions to their respective customer base. An attractive target audience is Gen Y consumers, recognised as being early adopters of the latest (mobile) technologies and possessing an influential role in family purchasing decisions. This paper presents and examines the outcomes of an observational study centred on the compilation of GPS data logs and accompanying diary entries for the aforementioned participant group. The emergent scenarios are reviewed, as are the attitudes of the participants. While the data logging devices were initially perceived as a novelty by participants, significant concerns emerged after further consideration and extensive utilisation of the devices. Such anxieties are specifically attributed to location and time inconsistencies, technological and device implementation issues, and general feelings of unease concerning the prospect of drawing inferences about individuals based on incomplete and inaccurate data sets. Suggested means of overcoming the ensuing issues are also considered.

Keywords: location-based services, LBS, GPS data, scenarios, Gen Y

1. Introduction

Location-based services (LBS) are capable of utilising the position of a person or object in manner which provides value, and require a complex system of interactions between multiple stakeholders in order to deliver services to the customer. An attractive target audience is the Gen Y segment, recognised as being early adopters of the latest (mobile) technologies and possessing an influential role in family purchasing decisions. The intention of this paper is to conduct an observational study centred on the compilation of GPS data logs and accompanying diary entries, in order to examine user attitudes and extract a set of socio-ethical scenarios, based on thematic analysis, in which the social

implications of LBS are explored. The social consequences, and other issues encountered during the study, are investigated, as are suggested techniques for overcoming the issues from the participants' perspectives.

2. Background to the study

Prior to evaluating consumer perceptions and socio-ethical scenarios, it is important to recognise the present situation and context in which location technologies are being implemented and utilised in Australia, specifically within the consumer segment. Technological advancements in various domains have resulted in the inevitable integration of location capabilities or infrastructures with current services and devices. The LBS environment in Australia is described in relation to such developments and the accessibility of LBS to the consumer market.

2.1. LBS technologies in the consumer domain

Location-based services (LBS) are technologies capable of providing the geographic location of a person or object in manner which provides value to the customer, predominantly through the exploitation of GPS and mobile technologies. As such, the proliferation of LBS can be accredited to advances in mobile communications [1], the commercialisation of GPS [2, 3], and the convergence of mobile, internet and location devices and services. Mobile communications have progressed since their inception in the 1970s from the 1G network capable of transmitting solely voice communications, to the 2G and 2.5G networks which integrate data capabilities, and the current 3G network supporting voice, data and multimedia content [1]. Furthermore, GPS was open for commercial or industry use in the 1980s, resulting in the adoption and integration of the technology in a vast array of devices and services [2]. The intersection of these major technological developments has encouraged and facilitated the use of LBS by the consumer segment, given the availability and ease of access to LBS applications in consumer-oriented devices such the mobile phone. For instance, modern mobile handsets such as the Nokia N97

[4] are by default equipped with mapping and navigation software, while also granting users the potential to download and install additional LBS applications, a prime example of which are mobile social networking tools, such as Google Latitude [5] and Vodafone Pocket Life [6].

Additional examples of prominent consumer LBS applications include personal in-car and mobile navigation systems, friend-finder and mobile social networking applications, and GPS data logging devices, the latter of which are enabling unprecedented uses in the consumer space. This is particularly pertinent in the policing realm, for instance, where covertly deployed GPS data loggers are enabling community members to independently carry out policing practices for personal and/or other motivations, effectively assuming the role of law enforcement agencies. While such LBS technologies have demonstrated positive uses, applications and benefits, LBS literature calls for caution to be exercised with respect to the undesirable social implications that are likely to surface. Specific attention is required regarding the social/ethical [1, 2-10] and legal [3, 7] repercussions associated with LBS usage. The enabling and empowering aspect of LBS in the consumer setting is further demonstrated given the potential of the tools to be adopted and implemented for secondary purposes, deviating from the original intention of the technology. The secondary purposes and scenarios will be explored throughout this paper, following an examination of the significance of the consumer segment to this study.

2.2. Role of the consumer or users in the LBS value chain/net

The delivery of a location-based service to an individual relies on an interconnected network of stakeholders who form the LBS value chain or net, with each participant assuming a unique role in the provision of the service. The term value chain signifies both a chain of stakeholders, activities and competencies [11], in addition to a network of related, non-sequential interactions between actors [12]. The composition of the value chain is dependent on the nature of the service being offered, as the selection of stakeholders is a strategic, business process in its own right [11, 12], employed by LBS providers to afford clients with attractive and marketable value-added services. Typically, the value chain is comprised of both operational and non-operational actors, whose roles span technical and non-technical (or supportive) functions respectively [13]. The mobile customer a non-operational entity existing at the completion of the chain, and is importantly the recipient of the service.

Specifically, all efforts and activities performed within the network are directed towards the delivery of value to the customer. With respect to the consumer segment, value and motives are represented by convenience, time-saving, money-saving and being affiliated with a particular group [14]. In the context of this study, the consumers of interest are those belonging to the Gen Y category.

2.3. The Gen Y LBS consumer

Gen Y, also termed the “Net Generation”, refers to individuals born between January 1977 and December 1997 [15: p. 16]. Individuals within this age bracket are regarded an attractive target audience, recognised as being early adopters of the latest (mobile) technologies and possessing an influential role in family purchasing decisions [16]. This generation embodies ideals such as freedom of choice, the need for personalisation and speed, and the desire for high levels of collaboration, and are generally perceived as trendsetters seeking the latest gadgets and innovative employment [15]. They are therefore expected to engage in LBS at a substantially higher rate than other segments given their tendency to focus on personalisation and customisation, their love of collaboration, and their desire to engage in and adopt innovative technologies, all of which satisfied through location-based services.

3. LBS Observational Study

Given the above discussion, the current study concentrates strictly on the Gen Y consumer, in an attempt to gauge perceptions regarding a particular type of LBS device, the GPS data logger. This device possesses a number of distinguishing features in that it: relies on GPS technology; does not contain a user interface with a real-time representation of location data; is powered through multiple means (battery, car, rechargeable lithium); can be deployed in an overt (open) or covert (discrete) manner; can be disabled at any time by the user; and comes in the form of either a handheld or in-car device.

The location data captured by both types of devices can be: downloaded using the corresponding software; viewed graphically using mapping applications; and be exported into multiple formats. Essentially, the data is available to the individual who possesses the device or location files, as there are no restrictions, passwords or checks for instance, that are enforced to validate the user's status as owner of the unit. Based on the aforementioned characteristics, the GPS data logger is therefore an ideal and representative example of a location-based service that is readily and commercially attainable. Thus, it is

adopted throughout this study as a vehicle to uncover socio-ethical issues in a practical setting.

An observational study was consequently conducted with the intention of conveying the social implications of LBS technology from the perspective of Gen Y users, paralleling the positive and negative implications, while reporting on the emergent scenarios as described by participants. The primary objective of the study was to implement GPS data logging devices for a predefined period of time (28 days), and report on participant experiences and attitudes regarding this exercise in the form of a daily diary entry. The diary entry was structured in nature, requiring participants to adhere to a template, which prompted individuals to: (a) identify their location on an hourly basis throughout the day, (b) report on any issues encountered with the device from a technology perspective, (c) discuss whether utilising the device was restrictive in carrying out daily activities, and (d) share any general feelings, opinions and thoughts. The results included diary entries in document form based on the provided template, and GPS data logs in CSV format or alternatively the native format of the device. Specifically, the GPS data logs contain geo-information such as date, time, latitude, longitude, altitude, temperature, status (speed), course, GPS fix and signal, and can be analysed to reveal discrepancies between location information in the diary entries and the corresponding electronic version. In conducting this study, a systematic process was employed in order to approach and inform participants, summarised in Figure 1.

In the qualitative, thematic analysis of the results, the diary entries are superimposed with the corresponding GPS data logs, allowing a set of socio-ethical scenarios and examples to surface, in which the perceptions of individuals occupy a focal role. While the data has the potential to be analysed spatially, this paper concentrates exclusively on thematic analysis, embedded within a societal relationships taxonomy that defines the different interactions that occur within any social network. This method of classification, adapted from [17], provides structure in analysing the results, and determining how socio-ethical considerations may be viewed depending on an individual's relationship with others. The classifications in this instance include partners, family members, friends, employers and strangers. This form of thematic analysis will allow the socio-ethical scenarios and major, recurring themes to emerge from the data.

Thematic analysis is characterised by the need to: (a) identify, code and categorise patterns in data, (b) record recurring and dominant themes, and (c) compare and contrast participant responses, and is ideal in situations where rich textual data has been gathered [18]. In order to maintain the integrity and context of the diary entries, thematic analysis will be used to codify the diaries, while

allowing themes to emerge as they are being suggested by participants using excerpts to describe various scenarios and concepts. The results of the study are examined in the following section.

Figure 1. Process used to collect data

4. Results: emergent socio-ethical scenarios

This section offers the reflections of Gen Y participants concerning the potential uses of LBS, based on each individual's engagement with the devices and related applications. The scenarios are the product of a thematic analysis, and offer a consolidated representation of participant perceptions and attitudes. Through this analysis, it is apparent that the Gen Y participant group view the benefits and concerns of LBS based on their usage of the device, and specifically daily, personal experiences with parties they directly engage with. The results of the study are thus organised using the categories within societal relationships taxonomy, introduced above, notably partners, family members, friends, employers and strangers. This ensures consistency in the analysis of participant diary entries, facilitating the investigation of the socio-ethical scenarios. Provided below are the emergent scenarios, highlighting the cases in which LBS (specifically GPS data logging devices) can be applied and the associated possibilities resulting from each application. The possibilities are supported and described

by representative excerpts from the participant diary entries.

4.1. Partner

The partner scenario is an interesting case in which participant responses were skewed towards the undesirable consequences resulting from the device being incorrectly (or maliciously) deployed. The following scenarios and possibilities were identified:

(a) Utilising the device in the provision of evidence FOR a given case, such as verifying one's location to a partner – “Today I was supposed to finish work at 9 but being Easter I didn't get out until 10. When I got to my boyfriend's house he questioned me about where I'd been. I was able to say check the [device] if you don't believe me. I then realised that in a situation where you had to prove you had been somewhere, the [device] could be used as evidence.”

(b) Utilising the device in the provision of evidence AGAINST a partner, in covert tracking circumstances for instance – “Last night my boyfriend went to the city and I don't like it because I can't tell where he has been. If the tracker was smaller and thinner, I could put it on him without him knowing, that would be a dangerous thing though because the [device] isn't reliable.”

(c) Unintentional tracking of a partner – “My grandmother was admitted into hospital, and the [device] was accidentally left in the car when I was dropped off at the hospital by my partner...I feel kind of guilty that I know that he went somewhere (he drove a friend to university).”

(d) Reliance on incorrect location details in a husband and wife situation, resulting in the erosion of trust between the partners – “The [device] has the potential to ruin people's lives because it has the potential to give an incorrect location e.g. If a husband were to track his wife's car, she may have gone shopping, but it's showing the location of the car in the street next to the shopping centre, this could cause many trust issues to arise unnecessarily.”

4.2. Family member

Scenarios in which family members are involved appear to be the most sensitive and correlated with factors such as invasion of privacy, trust, guilt, deception and ill feelings amongst family members, although the constructive uses of LBS in child monitoring situations were also highlighted. The following scenarios and possibilities were identified:

(a) Accidental monitoring of family members – “My mother drove my car and it was tracking her journey as well as my own. It felt kind of like an invasion of privacy

to record her data unawares. Although when I explained the situation she had no objections to it.”

(b) Creating unease between family members, if the tracking device is located, including suspicion and apprehension on the part of parents – “Today mum borrowed my car to drive to the local shopping centre. She realised that there was a device in my car and questioned it. This was the first time she'd been in the car, by herself with it. She really wasn't keen on being tracked, and she also thought I was weird at first.”, “This morning I went with my dad to help him at his current worksite in [location name]. I asked him if it was ok to take the unit with us - my father looked at me awkwardly though after having a pause, his said ok.”

(c) Promoting feelings of guilt and deception due to the need to conceal location details and whereabouts – “I visited a friend that my family disapproves of. So I left the device at home during the visit. Felt bad about visiting my friend, and felt worse knowing if my family found out I would disappoint them, which is why I left the device at home. When I began using the [device], I felt like I would have no problems, as I had nothing to hide. But I guess everyone has something they don't want someone else to know. I now feel that 24 hour surveillance is just a little too extreme.”, “I thought confidently that I would go through the 28 days without needing to turn it off. Though today I had to go to [location name], to a place I did not want to disclose... I decided to turn it off at that point, as it was nearby and I did not want to give away any clues to where I was going...As soon as I left the area, I plugged the unit back in.”

(d) Ensuring safety of children through location chronicles – “I was thinking today, what if a person's behaviour suddenly changes – they don't show up at home on time, or they skip a dinner, etc. and their GPS device is not functioning. A location chronicle built on previous data might assist their friends and family tracking them down with some basic data mining examining locations they visit normally and time of day. Instead of sifting through a child's Facebook account trying to figure out where the underage drinking party is being held, a location chronicle will identify homes they have stopped at in the past to visit a friend and you could make better guesses as to where your child is.”

4.3. Friend

The Gen Y participants' need for collaboration and social inclusion are observable in the friend scenarios. While LBS applications support convenience in social situations, concerns relating to privacy, relationships, social exclusion and stalking overshadow the convenience factor. The following scenarios and possibilities were identified:

(a) Better management of social activities, gatherings and situations – “Day three I have realised that the data collected on my movements really is quite detailed. My speed, duration and time for stops, directions and locations are all recorded and mapped out for me. With some analysis I was able to determine when and where I stopped for petrol, had lunch and bought coffee. If I was using a social networking application and chose to publish details of my stops then it would be easier for nearby friends and family to make those often appreciated surprise visits.”

(b) Invasion of privacy, resulting from the better management of social activities using LBS – “But then my “alone time” could be interrupted. Often you’re at university and make use of solidarity and personal space to de-stress but if you forget to turn off the GPS streaming these visits could turn invasive. So to counter that I decide to switch off the social networking technology and enjoy my coffee, only to be asked by friends whom think I am ignoring them, “Hey, why did you turn off your tracker, I couldn’t find you.”

(c) Seamless integration into daily life, making disengaging with the technology difficult – “If social interaction is facilitated by such frequent random encounters then the technology would be so seamlessly integrated with society that people start to make assumptions and question the reason for deactivating technology, e.g. Person A normally looks for Person B on campus to meet up for lunch or in between classes, but B wants to be left alone today, they have a difficult exam coming up. Person B deactivates their tracking and Person A, whom normally uses the tracking to find their friend rather than by SMS (As this has now become the “norm” in this future day example), sees B alone drinking a coffee and assumes they are being avoided.”

(d) Social exclusion resulting from disengaging with technology – “When you start using a technology, others can become reliant on your uptake. If my friends stopped using mobile phones, I would be rather annoyed and perplexed – a mobile phone has become an essential for contact. Might the GPS social network become essential for face to face meetings?...What if my choice in the future not to participate in GPS tracking for social events and interpersonal was not shared by the group whom has come to rely primarily on location aware social networking services for their “real” / face to face social networking? I will be excluded from the social group...”

(e) Erosion of trust between friends and significant detriment to relationships – “Though actually today, when I arrived at my friends house they questioned my late arrival. One of my friends knows about me having the GPS tracker installed in my vehicle. He joked at the fact that “maybe we should have a look on your GPS tracker and see what it says”. I laughed it off, though now

thinking about it think how this white lie could have broken trust and hurt to a small extent my friendship to them...Sometimes I believe it’s easier to say a white lie than the truth, a lie which doesn’t hurt anyone, and so do most humans. The fact that this unit could complicate and get in between relationships makes me nervous.”

(f) Stalking and secondary tracking of friends and acquaintances, both deliberate and accidental – “I was thinking today, I am being tracked. But what about my friend [name]? He’s walking alongside me, we’re having lunch, he’s buying coffee at the same outlet as me at the same time. We spend two hours of the day together and he was not aware that effectively, he was being tracked too purely by association. I never thought to inform him of this. If you spent enough time around a particular person or mimicked their behaviour, you could be building a location chronicle on them rather than yourself. Your stalking would be taken to entirely new level; it would be “shielded” as tracking of yourself.”

4.4. Employer

The employer scenarios were generally not explored in detail by participants, although some diary entries alluded to the concerns, namely whether employees are aware of monitoring in the workplace, the fear of being incorrectly implicated, and the ability for employers to access accurate subordinate information. The following scenarios and possibilities were identified:

(a) Vehicle tracking in a corporate setting, resulting in questions of ethics, privacy and knowledge of being monitored – “While speaking to a lady at University, she mentioned that [company name] uses GPS in all of their company cars, and it got me thinking, I wonder if the staff know they are being tracked, and if they had to sign privacy, or ethics forms beforehand.”

(b) Judging and incriminating employees based on their ‘behaviour’, as represented by the GPS data logs, which are void of contextual information – “Today I attended a Tae Kwon Do competition but was not driving the vehicle I travelled in. I am pretty sure the driver was speeding and made one or two illegal turns. There have been cases where social networking technology has been used by potential employers and colleagues to significant detriment of employees. My past employment contracts specified that I shall not drive in an illegal or irresponsible manner – what if other users of the social networking sites made presumptions of my driving habits based on that day’s data or fired me on the basis of a single day’s driving.”

(c) Ensuring employee accountability, and eliminating the selective provisioning of information by employees regarding their work habits and behaviours – “I am glad that I have the option to turn off the device, and have the

ability to choose when to turn it off.... when this product is used in a commercial sense, employees can't turn off when doing something inappropriate."

4.5. Stranger

The scenarios involving strangers represented more sinister and malicious notions, ranging from theft, forced/compulsory deployments, incrimination, stalking, terrorism-related and surveillance. The following scenarios and possibilities were identified:

(a) Third part interception and monitoring and the threat of unauthorised access – "Thinking about how easily it would be for an outside source, to intercept and monitor the signals your GPS [device] is giving off, is it possible that someone else has your data. Beginning to feel slightly paranoid at who is watching, although I hope I am boring enough that nobody cares what I am doing.", "I thought imagine if someone got hold of all the info on the [device]. As soon as I got home I uploaded it all onto my computer then deleted it so I knew it was safely on my computer.", "...after the device was taken, though my exact identity cannot be established, I was still worried that someone had took MY personal information. They could figure out where I have been, where I live, and where I work. Losing the device gave me a sense of vulnerability, along with the financial implications which come with having such a unit."

(b) Covert monitoring and compulsory installations – "Though I did think about what it would be like if it was compulsory to have such a device installed into your vehicle. Many people probably don't know, though if you have vehicle with an inbuilt GPS system, the authorities can in some instances obtain its data to receive your driving history.", "I believe this ability to still have a sense of privacy is a great feature, though I believe if one day they are to be a permanent installation into a vehicle, this option will not exist, hence we will be tracked against our will."

(c) Incrimination by strangers based on incorrect evidence – "Some log data indicates that I drove through people's front yards, often the coordinates would be out by up to 15 meters (this is a rough estimate)."

(d) Utilising the device with malicious intent, such as terrorism, crime and causing other forms of damage – "I found it scary that I managed to get into one of Sydney's main attractions with no bag check. I was carrying the [device], which looks quite harmless. Although if the signal was connected to a missile targeting system, it could be an easy way for terrorist to maximise the amount of damage, or to pin point positions, for their attacks to cause greater devastation.", "Thought about how dangerous the GPS tracker could be used again, in attacking areas such as hospitals or shopping centres."

(e) Risk of stalking, surveillance and "Big Brother" – "The first day I used the [device], I felt like "big brother" was watching me (like my every move was being monitored)..."

4.6. Additional considerations

While the socio-ethical scenarios introduce major themes from a relationships perspective, such as fear of continual monitoring and the consequences of tracking on family members, it is important to convey the additional concerns expressed throughout the study. Participant diary entries reveal that technical inconsistencies were problematic for various reasons, as presented in the following excerpts:

(a) Incorrect recording of location – "The signal is a big problem as well. Sometimes it just can't receive any signal and sometimes it records that you're in one place when you're not actually there."

(b) Lack of reliability when the device is used extensively (beyond 24 hours), which one participant feels is a concern, given the device is promoted as ideal for situations requiring high levels of accuracy – "...I cannot believe they are targeting the law enforcement and government agencies markets."

(c) Unexpected behaviour – "...the device stalled on a green light and a loud pitch was heard by a few people."

(d) Correct recording, which conflicts with the above accounts – "After checking the readings, I found that the information was mapped correctly which is remarkable."

The discussion section will provide a detailed reflection on the additional considerations, and allude to approaches for addressing the identified concerns.

5. Discussion

The scenarios presented throughout this paper cover themes regarding the implementation of LBS in various situations (refer to Figure 2 for a summary). However, as noted above, additional considerations were also expressed by participants. It is therefore crucial to further reflect on, and review, participants' general perceptions regarding the devices. While the data logging units were initially perceived as a novelty by participants, significant concerns emerged after further consideration and extensive utilisation of the devices. Such concerns were not only linked to the social implications and scenarios, but were rather associated with frustrations regarding the performance of the units, including technical and other faults which prohibited the participant from experiencing the full potential of the LBS tools. Such anxieties are specifically attributed to location and time inconsistencies, technological and device implementation issues, and

general feelings of unease concerning the prospect of drawing inferences about individuals based on incomplete and inaccurate data sets, such as the potential for misrepresentation and incrimination. These concerns, and suggested mechanisms of overcoming them, are briefly discussed below.

Figure 2. Summary of scenarios and possibilities, as identified by participants

5.1. Location and time inconsistencies

A majority of participants suggested that the devices should not be employed in situations that are dependent on highly accurate and reliable information, despite being utilised and promoted as ideal for gathering evidence for or against a given situation. Individuals expressed astonishment that such devices could be considered in emergency implementations, and these concerns are also highly pertinent in scenarios where partners and family members are being tracked and monitored, as location and time inconsistencies may prove detrimental. The accuracy of the GPS readings was reported to be questionable on numerous occasions.

5.2. Technical, aesthetic and device implementation issues

The technical, aesthetic and behavioural characteristics of the devices perhaps caused the highest degree of frustration for participants. All participants were unimpressed with the battery life and power consumption of the units, and questioned the technological capacity of the devices. The technological issues were evidenced in inconsistent recording behaviours, flashing lights and audible technical faults. Additionally, individuals reported that the appearance or “packaging” was problematic, in that the units were bulky, unattractive, and could not be contemplated in covert or discrete deployments.

5.3. Inferences and misrepresentation

A significant anxiety for participants was fear of misrepresentation. Individuals were generally willing to adopt devices in which they possessed complete control over location information, but were reluctant to assign control to third parties. This is principally attributed to the participants’ belief that: the devices are not a source of reliable information, data can be falsified, inferences and patterns may be extracted which incorrectly portray the individual in an undesirable manner, and that the lack of context results in fictitious representations.

5.4. Overcoming the issues

While the literature and previous studies point to the need for addressing the social implications from ethical and regulatory perspectives, the Gen Y participants in this study did not suggest such long-term mechanism for overcoming the identified issues. Rather, the individuals collectively asserted that immediate improvements to the devices were crucial, to increase reliability and improve the uptake of LBS technology. In particular, enhancements are required in the following areas: (a) appearance-related, including the introduction of smaller,

elegant units, (b) battery/power consumption, where alternative power sources must be considered, and (c) technological improvements, to enhance and guarantee reliable readings. Further research is required to comparatively test alternative devices, to determine whether other consumer segments share Gen Y concerns and attitudes, and to build on the socio-ethical scenarios and implications.

6. Conclusion

The proliferation and increased adoption of location-based services is the result of developments in mobile communications and GPS technologies. A highly receptive target audience for LBS is the Gen Y consumer, characterised by high levels of adoption and personalisation of technologies. This paper has presented the outcomes of a qualitative, thematic study, in which GPS data logs and accompanying diary entries were collected, in order to determine the attitudes of Gen Y consumers regarding LBS usage. Participants identified socio-ethical scenarios and possibilities based on interactions with individuals in their social network (partner, family, friend, employer, stranger), and were conscious of the related social implications. The participants also suggested potential areas for improvement, including addressing issues of technological inadequacies and reliability, enhancing the aesthetics of the units, and developing alternative power sources to ensure seamless integration and use of the devices in daily practices. Further research must build on the identified scenarios, and establish long-term techniques to address the social implications.

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