Evaluation Of The Reliability Of Using The Prototype Ppmark - A Tool To Support The Computer Human Interaction In Readings The Privacy Policies - Using The GQM And TAM Models

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Abstract

For the past years, a number of researches have shown that most users do not have a habit of reading privacy policies. This fact may occur due to the time spent on reading these policies technical or even users' lack of interest. On a previous work, in order to facilitate the presentation of privacy policies from online services, a prototype called PPMark was developed in order to read policy texts and show what kind of data was being collected and to what end are were presented in a privacy label format. The goal of this work is to assess the users' confidence on the information extracted by this prototype. Given the results, the prototype proved that it is easy to use, it can decrease the time spent on reading policies and that users trust the information extracted, thus facilitating the computer human interaction (user x privacy policies).

Keywords

Privacy-policies, Users, Confidence, Usability, Accessibility, PPmark.

Introduction

There are directives for online services to provide a privacy policy for their users. These policies define how data is collected, stored and/or shared with partner companies. Most online services present their privacy policies in textual format, which makes users to read through it all if they want to know how their data is handled. According to McDonald and Cranor (2008), this reading is time consuming and demotivates users to read every policy from every service they use.

To make it easier for users to read privacy policies, Kelly et al. (2009) proposed to present the policies' contents not in a textual, but rather in a tabular way, similar to how nutrition facts are presented. The tabular format can make privacy policies more understandable because they are presented in a more objective manner. This makes it possible for the users to quickly grasp on how their data is handled.

De Pontes and Zorzo (2016) developed a mechanism able to process privacy policies written in natural language and extract information about data collection and usage and present this information in label format to users. The authors got a high precision when extracting information from privacy policy texts.

This paper is an extension of what was proposed in De Pontes and Zorzo (2016); here, we conduct a study to assess user confidence in the automatic extraction of data collection and sharing information from privacy policies by the PPMark tool, thus filling in the gaps left in previous works (de Pontes and Zorzo 2016; Zorzo et al. 2016) where the authors assessed only the precision of the PPMark tool to recover information about data collection and usage (de Pontes and Zorzo 2016) and if users prefer a textual format or an alternative one (Zorzo et al. 2016).

In the following section we present works related to this paper. In section Methodology For Reliability And Usability Evaluation, we present the methodology used to assess the prototype. In section Data Collection, data and results are shown. An interpretation of the results is presented in section Data Interpretation and, finally, conclusions and future works are presented in section Conclusions And Future Work.

Related Works

The works related to this paper are about the automatic generation of an alternative format to present privacy policies in order to make users better understand their content. In (de Pontes and Zorzo 2016) and (Zorzo et al. 2016) the authors already approached these topics; this paper aims to improve the PPMark tool (de Pontes and Zorzo 2016). Since it has been shown that privacy labels can improve the users' understanding of privacy policies (Zorzo et al. 2016), we conducted an experiment to assess how much users trusted the PPMark tool. De Pontes and Zorzo (2016) developed a prototype of a tool called PPMark that is able to analyze a privacy policy written in natural language and use pattern matching and frequent words to automatically present the policy content in a more friendly and understandable way, as originally proposed by Kelly et al. (2009). An assessment on the tool's capability to recover information was made and the results suggested a high accuracy.

Zorzo et al. (2016) proposed a few changes in the privacy label created by Kelley et al. (2009) and conducted an experiment to verify if the labels could really improve the users' understandability of policy terms. The work presented results that demonstrated that the alternative format can help the users' understanding. This work made changes to the interface of the prototype of De Pontes and Zorzo (2016) and extended the experiment conducted by (Zorzo et al. 2016) in order to assess the level of trust users had in the PPMark tool.

Aïmeur et al. (2016) conducted a study similar to (Kelley et al. 2010), presenting different privacy policy formats to users. They also proposed a framework to negotiate privacy terms where users can decide if whether or not they want to provide specific information. This negotiation is a key point for users, but it raises an important question: how willing are companies to negotiate a user's privacy?

Tsai et al. (2011) wanted to check if e-commerce companies provided a more friendly and easy-to-understand policies it could interfere with the users' decision making process of choosing a given e-commerce. In other words, they wanted to verify if a service clearly states how they handle their users' data would affect how users choose these services. The authors also investigated if the way users' data is handled can be used as leverage for publicity by highlighting how secure their data is with a given company.

Methodology For Reliability And Usability Evaluation

Every new proposed technology, whether it is a methodology, technique, tool or app, must be evaluated before it is released to the general public (Green et al. 1996). Some of the most important aspects that must be assessed are (i) reliability and (ii) usability (Wasserman 2010). This paper focuses on (i) and we used the TAM (Technology Acceptance Model) to perform the evaluation (Davis 1993).

The TAM model proposed by Davis (1993) defines two main determinants in the following way: (i) hypothesis (questions) about usability usefulness (how much a person believes using a certain system may improve his/her performance); and (ii) hypothesis (questions) about the usability ease (how much a person believes using a certain system will be effortless).

In order to create these questions, the authors also associated to the TAM model the Goal, Question, Metric (GQM) paradigm. This paradigm indicated the questions about the matter should be divided into

three categories: (i) goal, where we must define the goals of the study; (ii) question, that indicates which questions should be asked in order to reach the goal; and (iii) metric, that indicates which metric should be used to assess the questions (Basili 1993; Caldiera and Rombach 1994; Green et al. 1996; Solingen and Berghout 1999). A Likerd scale (Everitt 1982) was used to calculate the metrics.

The whole methodology regarding goals, questions and metrics was planned according to the two main determinants of the TAM model associated with the GQM paradigm. The participants were Computer Science and Electrical Engineering undergraduate students of the Pontifical Catholic University of Minas Gerais – Poços de Caldas campus.

Planning and Definition

The GQM model was created to assess the users' reliability regarding the PPMark prototype and had three goals: (i) analyze the users' understanding of privacy policies presented in textual form; (ii) analyze the prototype usability; and (iii) analyze the users' reliability on the prototype. The goal of (i) is related to the users' concern about privacy policy texts; goals (ii) and (iii) are related to the prototype's usability and reliability, which is covered by the TAM model. An overview of the model is shown in Figure 1.

According to Figure 1, twelve questions were made were inspired on the study presented in Laitenberger and Dreyer (1998) and Hernandes et al. (2012) which are shown in Table 1. Four questions (Q1 – Q4) were about the first goal, three questions (Q5 – Q7) were about the second goal and finally five questions regarded the third goal (Q8 – Q12). To use the GQM model, we must define metrics for the questions we asked. More than one metric can be related with one or all questions, as shown in Figure 1. The metrics we used are shown in Table 2. The GQM requires a model to interpret the metrics. Such model relates the questions with their metrics to assess if the goal was reached. The interpretation model is shown in Table 3.

Sampling And Selection Of Participants

The size of the participants sample was based on the Central Limit Theorem (CLT) (Hans 2011). The theorem says that every large sample with $n>30$, where n is the number of elements, the sample distribution of the mean sample converges to a normal distribution, regardless of the population distribution itself. According to the theorem, a sample with more than 30 elements may represent a whole population. We decided to use the CLT because previous studies already defined values of mean and standard deviation of a population, which are required for using the CLT (Bittencourt and Viali 2006). Also, some past studies defined that many problems that are likely to occur in a population may be identified with only 5 participants (Leon et al. 2012).

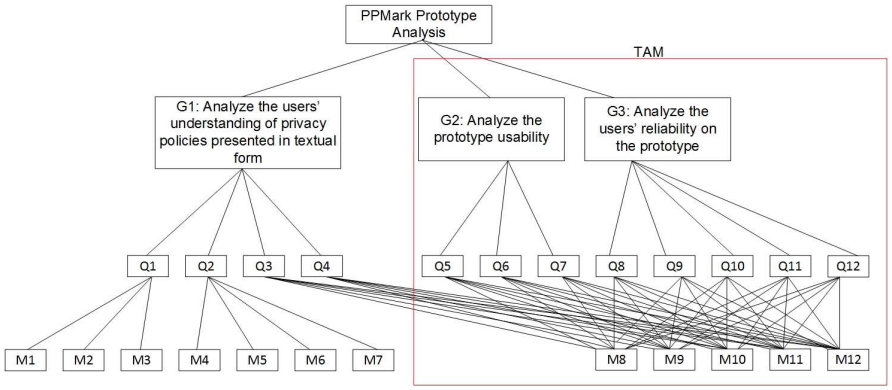

Figure 1: GQM model for PPMark evaluation.

Following the CLT definitions, we selected 40 Computer Science and Electrical Engineering undergraduate students, with age ranging from 19 to 30 years old from the Pontifical Catholic University of Minas Gerais – Poços de Caldas campus out of 60 students, thus satisfying the condition $n>30$. The choice for such 40 students was randomly made.

Question	Description
Q1	I have a habit of reading every privacy policy of every online service I use.
Q2	I do not read privacy policy from online services because:
Q3	I always accept the privacy policy terms from online services I use even when I do not read them.
Q4	If privacy policies were presented in simpler way that would not require much of my time to know which data is being collected and why I would pay more attention to which services I use.
Q5	It was easy to use the PPMark tool.
Q6	My interaction with the interface was pleasant.
Q7	I was able to identify, using the privacy label, which of my data is collected and/or shared.
Q8	Comparing the labels with the privacy policy texts, I felt confident that the information shown by the labels was correct.
Q9	The PPMark tool reduced the reading time of privacy policies.
Q10	The PPMark tool improved my insight and understanding of terms regarding data sharing and collection.
Q11	I consider the PPMark tool reliable to make decisions given a privacy policy.
Q12	I consider the PPMark a useful tool that can be used on a daily basis.

Table 1: Questionnaire using the GQM model.

Data Collection

Data collection was made using an online questionnaire, which had three sections: (i) "Consent term", where users had to decide whether or not they wanted to be a part of the experiment; (ii) data collection from participants, such as name, age, undergraduate course and period; and (iii) questions described in Section Planning and Definition used to assess the PPMark prototype. The prototype was made available to the participants as well as the instructions for the experiment: (i) access online services of the user's choosing; (ii) locate and visualize the services' privacy policies; (iii) access the same services using the prototype; and (iv) answer the third section of the questionnaire. An overview of the data is shown in the Figure 2 and next tables.

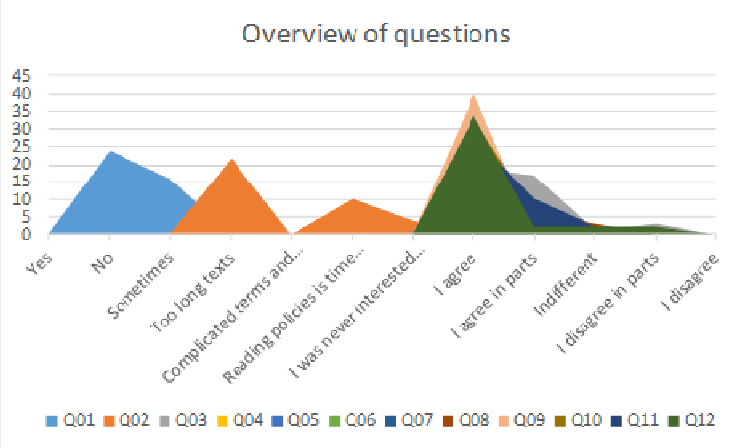

Figure 2: Overview of the data.

The table 4 shows question 1 and its answers (metrics). Table 5 shows question 2 and its answers with metrics M4, M5, M6 and M7.

Metrics	Description
M1	Number of people who chose "Yes"
M2	Number of people who chose "No"
M3	Number of people who chose "Sometimes"
M4	Number of people who chose "Too long texts"
M5	Number of people who chose "Complicated terms and technical jargons"
M6	Number of people who chose "Reading policies is time consuming"
M7	Number of people who chose "I was never interested in reading privacy policies"
M8	Number of people who chose "I agree"
M9	Number of people who chose "I agree in parts"
M10	Number of people who chose "Indifferent"
M11	Number of people who chose "I disagree in parts"
M12	Number of people who chose "I disagree"

Table 2: Metrics used in the GQM model.

In the following sections we present the analysis of the collected data and the interpretation of the metrics of the GQM model. Finally, Table 6 shows the answers for questions 3 to 12 related to the TAM model.

#	Expression	Interpretation		#	Expression	Interpretation
1	M1 > M_i; i = 2 and 3	Regardless of format, users are concerned about privacy policies of services they use.		8	For Q_i, i = 5 to 7: M11 + M12 > M8 + M9	The PPMark prototype is hard to use.
2	M2 > Mi; i = 1 and 3	Users are not concerned about privacy policies of services they use.		9	For Q_i, i = 8 to 10: M8 + M9 > M10 + M11 + M12	The PPMark prototype can encourage and facilitate the reading of privacy policies.
3	M3 > Mi; i = 1 and 2	Users are indifferent about reading privacy policies.		10	For Q_i, i = 8 to 10: M10 > M8 + M9 + M11 + M12	The user feels indifferent about using the prototype. His/her concern about privacy policies remains the same.
4	Mi >= Mj, for i = 4, 5, 6 and 7; and j = 2 and 3	Users have trouble reading privacy policies.		11	For Q_i, i = 8 to 10: M11 + M12 > M8 + M9	The prototype output was harder to understand than the actual privacy policy text.
5	For Q3: M8 + M9 > M10 + M11 + M12	Users have no encouragement to read privacy policies. Their intention is always just to use the service.		12	For Q_i: i = 11 and i = 12: M8 + M9 > M10 + M11 + M12	The prototype is reliable in the decision making process and it is useful on a daily basis.
6	For Q4: M8 + M9 > M10 + M11 + M12	Users would pay more attention to privacy policies if a simpler format to present them were available.		13	For Q_i: i = 11 and i = 12: M11 + M12 > M8 + M9	The prototype is not reliable in the decision making process and useless on a daily basis.
7	For Q_i, i = 5 to 7: M8 + M9 > M10 + M11 + M12	The PPMark prototype is easy to use.		14	For Q_i, i = 5 to 7: M11 + M12 > M8 + M9	The PPMark prototype is hard to use.

Table 3: GQM interpretation model.

Question	M1	M2	M3
Q1	0	24	16

Table 4: Data collected from the questionnaire (Question: 1).

Question	M4	M5	M6	M7
Q2	22	0	10	4

Table 5: Data collected from the questionnaire (Question: 2).

Results

The following data analysis aims to assess the users' concern about privacy policies, to verify what is the users' main difficulty when reading privacy policies texts (Kelley et al. 2010), to check if the PPMark prototype can make it easier for the user to understand the policies and, if it does, if users think the prototype is reliable or not.

Users And Privacy Policies

The first question of the questionnaire checked if users had a habit of reading privacy policies. According to data from Table 4, it became evident that most users are not used to reading privacy policies since 60% stated that they do not read policies and 40% stated that sometimes they read them. We also verified that no user said he/she has a habit of reading privacy policies. These results are shown in Figure 3.

The main causes for different answers in Figure 3 is that privacy policies texts are long; therefore, reading them is time consuming. Figure 4 shows the reasons why users are not used to reading policies.

Considering that privacy policies are long and time consuming, according to users, they always accept the terms without reading them. This finding is shown in Figure 4.

Question	M8	M9	M10	M11	M12		Question	M8	M9	M10	M11	M12
Q3	19	17	1	3	0		Q8	30	7	3	0	0
Q4	36	3	1	0	0		Q9	40	0	0	0	0
Q5	36	4	0	0	0		Q10	33	6	1	0	0
Q6	32	6	2	0	0		Q11	28	10	2	0	0
Q7	35	4	1	0	0		Q12	34	2	2	2	0

Table 6: Data collected from the questionnaire (Questions: 3-12).

According to data collected from question 3 and shown in Figure 5, the expression number 5 of the GQM model, as shown in Table 3, is satisfied, thus stating that indeed there is a need to encourage users to read the policies. To back up the claim that users have no incentive to read privacy policies, question 4 proved that if the policies were presented in an alternative way, with a not so overwhelming reading, users would pay more attention to the terms of data collection and sharing. This claim is backed up by results shown in Figure 6. Since users do have a difficulty regarding privacy policies, as shown in this subsection and previous works (Zorzo et al. 2016), the PPMark prototype was developed to facilitate/improve the user interaction with privacy policies. Subsection Usability assessment of the PPMark Prototype presents the results for the prototype usability.

Usability assessment of the PPMark Prototype

After analyzing the behavior of users regarding privacy policies, the users used our prototype and answered questions 5, 6 and 7 to assess its usability. Question 5 was about the prototype's ease of use. As shown in Figure 7, 90% of users agreed that it is easy to use. Question 6 assessed if the interaction with the prototype was pleasant. As shown in Figure 8, 80% of the users said it was indeed pleasant. Finally, question 7 was made in order to find out if users could understand policy terms presented in table form. As shown in Figure 9, 87% of the users were able to easily understand information about data collection and sharing when presented in table form.

Given the results of this subsection, it is possible to say that the PPMark tool fills all the usability terms according to users. An overview about usability questions is shown in Figure 10. In subsection Usability assessment of the PPMark Prototype we analyze data about user reliability on our prototype.

PPMark prototype reliability assessment

After analyzing the user's perception of privacy policies and the PPMark usability, questions 8, 9, 10, 11 and 12 were made to assess if our prototype is reliable to be used in a decision making process regarding privacy policies from the user point of view.

The goal of question 8 was to check if the user trusted the information extracted by the prototype. Question 9 assessed if using the prototype decreased the amount of time spent on reading policies. Question 10 tried to identify if the prototype was able to improve the understanding of data collection and sharing terms. Question 11 asked if the prototype was reliable enough for a decision making scenario, and finally question 12 asked if the user would use the prototype on a daily basis. As shown in Figure 11, all of these questions were answered positively, which indicates that the prototype is reliable and can be used on a daily basis.

Given the data collected from the questionnaire and analyzed in this subsection, section Data Interpretation presents the interpretation of this same data using the GQM model defined in Table 3.

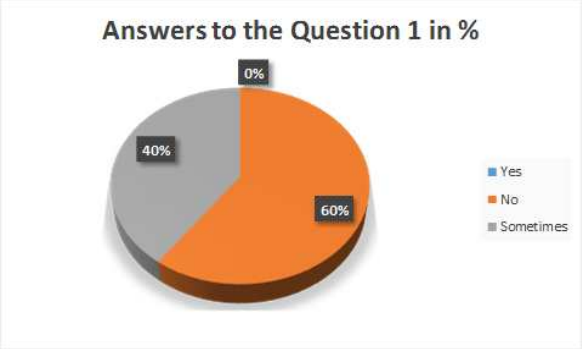

Figure 3: Users' concern about reading privacy policies.

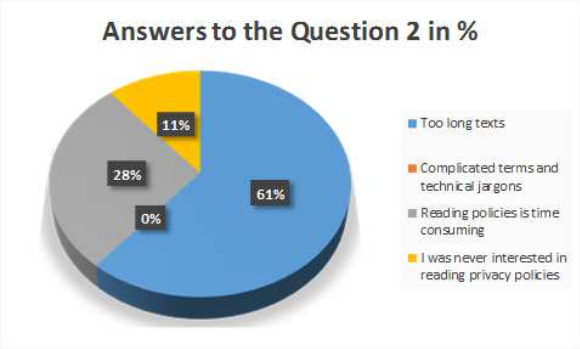

Figure 4: Main difficulties when reading privacy policies.

Data Interpretation

After analyzing the data, we interpreted it using the GQM model defined in Table 3. The interpretation was done in the following way: we gathered questions and their objectives and then extracted measurements for each model expression and analyzed if their respective conditions were met.

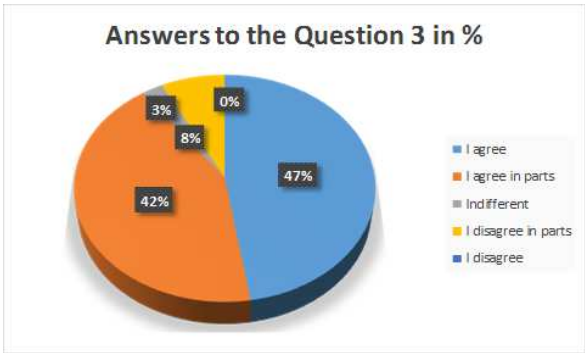

Figure 5: Users always accept the terms without reading them.

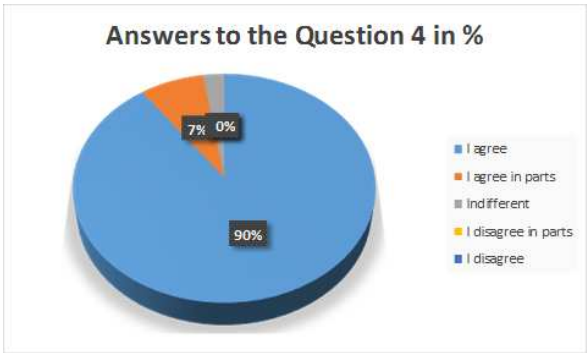

Figure 6: Users' agreement on an alternative way to present privacy policies.

Next we present three tables. Each one is related to a GQM model objective with its respective questions and interpretations. The interpretation of each question was done according to its expression (described in Table 3). The interpretations of goal G1 are shown in Table 7. The goal was to assess the users'

understanding and behaviors regarding privacy policies. Finally, the interpretations of goal G3 are shown in Table 9. The goal was to analyze the prototype's reliability from the user point of view. The interpretation of goal G2 is shown in Table 8. The goal was to assess the prototype's usability.

Conclusions And Future Work

Previous works (Kelley et al. 2010; McDonald and Cranor 2008; Zorzo et al. 2016) have shown that non-textual models used to present privacy policies to users can be more effective. These models can be shorter and gather information only about user data collection and its usage. It was also proven that users are more prone to check which of their data is being collected and why when non-textural models are used. In (Kelley et al. 2010; McDonald and Cranor 2008; Zorzo et al. 2016) the authors analyzed the viability of using a table format to present privacy policies. The table format was initially proposed by Kelley et al. (2009) and was called "Privacy Label". To fill the table cells, the Platform for Privacy Preferences (P3P) was used. However, the P3P platform is no longer supported by most online services since the services did not standardized their policies to comply with the P3P format.

In De Pontes and Zorzo (2016) the authors proposed a mechanism that was able to process a textual, natural language written privacy policy and extract information about user data collection and its usage. This proposed method presented good results regarding information retrieval. Considering the results from previous works (McDonald & Cranor 2008; Kelley et al. 2010; Zorzo et al. 2016) which showed that the privacy label format is a viable and efficient way of presenting information about data collection and its usage and considering that the mechanism proposed by De Pontes and Zorzo (2016) proved to be efficient to extract information to fill the labels, the main contribution of this paper was the assessment of the users' confidence on the PPMark prototype.

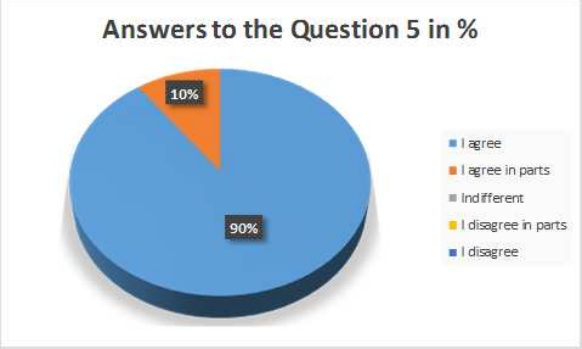

Figure 7: PPMark prototype ease of use.

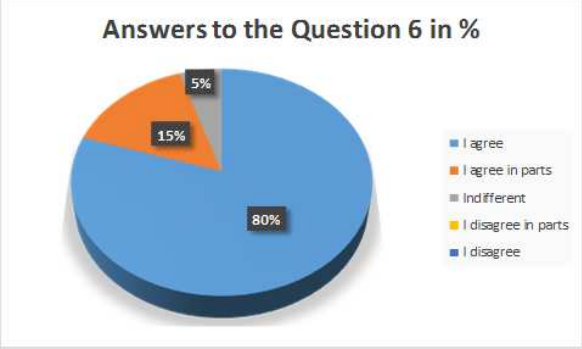

Figure 8: The PPMark tool was pleasant to use.

The results of this research showed that 60% of the users who were interviewed do not read privacy policies from services they use. This is due to the fact that 55% of them think that policy texts are too long and time consuming; this finding goes along with the results of McDonald and Cranor (2008). The interpretation of the results of objective 2, as shown in Table 8, showed that the prototype is easy to use and the results shown in Table 9 indicated that the prototype is reliable and users would use it in decision making situations on a daily basis, as mentioned in sections Data Collection and Data Interpretation.

Finally, given the results and metrics used in this work, the prototype has proven to be useful in the computer human interaction scenario (users x privacy policies), made it easier for users to understand policy terms and encouraged them to pay attention to what is being collected. We believe that given the results presented in this study regarding how satisfactory it was to use the tool, we may now present the PPMark tool to the whole community in order to help users better understand privacy policy terms and conditions.

Given the prototype is now validated by users, as future work we aim to develop a plugin to be used in all browsers and work on accessibility in order to make the prototype useful for users with visual impairment.

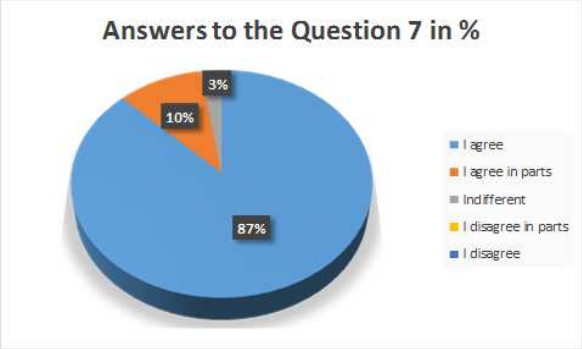

Figure 9: Assessment of presenting policy terms in table format.

Goal G1	
Question	Interpretation given the results
Q1	Users are not concerned about privacy policies of services they use.
Q2	Too long texts.
Q3	Users are not encouraged to read privacy policies.
Q4	Users would pay more attention to privacy policies if they were presented in a simpler format.

Table 7: Results interpretation – G1

On current operating systems there are accessibility tools for this end, but they only read what is on the screen and speak it out loud. We want to work on a tool for the visually impaired in order to decrease the reading time; for each data that is collected and its end, we want the tool to briefly describe it to users.

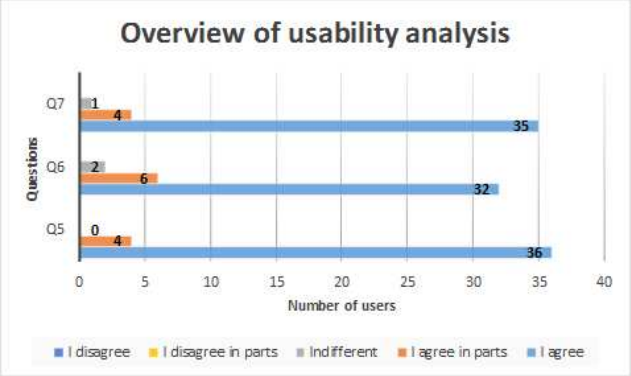

Figure 10: Overview of the usability results.

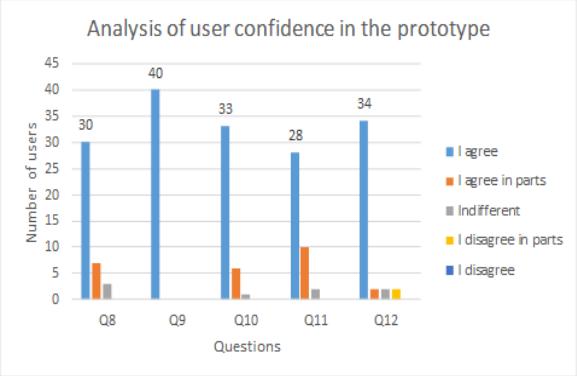

Figure 11: User reliability on using the prototype

Goal G2	
Question	Interpretation given the results
Q5	The PPMark prototype
Q6	is easy to use.
Q7	

Table 8: Results interpreation – G2

Goal G3	
Question	Interpreation given the results
Q8	The PPMark prototype can encourage and
Q9	facilitate the reading of privacy
Q10	policies.
Q11	The prototype is reliable in a decision making
Q12	scenario and useful on a daily basis.

Table 9: Results interpretation – G3

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