A concordance framework for building trust evidences

Anirban Basu*†, Natasha Dwyer‡ and Stephen Naicken†
*Graduate School of Engineering, Tokai University, 2-3-23 Takanawa, Minato-ku, Tokyo 108-8619, Japan
abasu@cs.dm.u-tokai.ac.jp
†Department of Informatics, University of Sussex, Brighton BN1 9QJ, UK
{a.basu,stephenn}@sussex.ac.uk
‡Victoria University, Footscray Park Campus, Ballarat Road, Footscray, 3011, Australia
natasha.dwyer@vu.edu.au

***Abstract*—Online dating is one domain, which would benefit from the application of computational trust. One of the problems with the application of traditional computational trust models, as identified in our previous work, is authenticity of information provided by parties which helps other users ascertain whether they want to go on dates. In this position paper, we suggest a solution: a concordance based framework for a game to be built into a online dating system. The game provokes users to provide spontaneous and thus more genuine data about themselves. The key feature of the game is the respect for privacy that supports and encourages the user to provide authentic information. Future work will comprise of implementation of the game and its user testing.**

***Index Terms*—computational trust, emotive application, trust evidence, game**

I. Introduction

One of the key problems of any trust model, particularly in a highly emotive context, is with the lack of truthfulness on the part of the user in the "information gathering" stage [1]. In the domain of online dating, some respondents purposefully lie in their profiles in attempts to attract potential dates. However, trustors seek genuine information about others because this gives an indication of what a person is 'really' like, that is the data has not been filtered [2].

In this position paper, we propose a framework of a game for users to play which helps assess whether two parties are broadly in agreement, i.e., *concordant* about certain opinions or not. The aim is not for users to build trust but rather to assess whether they might trust other users with certain qualities. Fukuyama [3] argues that we have more trust in those who share our values. Rather than our trust-based decisions being motivated by pure self-interest, our decisions are shaped by the belief that people with similar values to our own will be interested in a positive outcome for the group with whom they identify [4]. At the core of the proposed framework is the posing of questions that provokes respondents to provide more truthful answers that others can use to build an authentic trust assessment. As the user needs to respond quickly to the questions, the user is likely to provide information spontaneously without the opportunity to contrive answers. The game can help an online dating system, amongst many other application scenarios, to build more authentic trust evidence displays for potential dating partners. While anonymised and non-persistent player identities constitute a privacy-respecting step, pseudonymous but persistent identities [5] can be used to detect liars while not compromising privacy. To encourage users to answer as authentically as possible, the game is in real time. Users do not have the time to contrive their answers. The spontaneous nature of the game is intended to capture an authentic measure of concordance.

II. A framework for concordance

A. Gameplay

The principles of the game are as follows: (I) At the start of the game, a player is asked to choose a partner from a list of active users (i.e., other players). If the choice is accepted, the game starts. (II) In each level, a player is asked to answer a set of questions on a numeric scale, e.g., from 1 to 10, within a time limit. The question itself is subtle and levels are used to group questions belonging to the same general topic. (III) In essence, questions can also be set by users themselves but before being posed to users, these ought to meet certain criteria: subtlety, respect for privacy and so on. (IV) Privacy is respected by not storing user data; by not allowing questions that can form the basis of inference-based attacks. This gives the participants the confidence to provide truthful answers, especially around sensitive topics. The players are also not required to answer any question that they do not wish to. (V) Concordant and discordant answers are calculated for each level between a pair of players. Players may choose to continue to the next level with the same partner, or select a different partner. (VI) At the end of the game, a player gets a good idea about how similar or dissimilar other players are in various contexts (i.e., levels). This helps two potential dates embark on a more direct form of meaningful interaction[1].

B. Measures of concordance

Given two players A and B, and the centrality measures for their answers as c_A and c_B respectively, the parties are said to be concordant on their opinions ($o_{k,A}$ and $o_{k,B}$ for

[1]Note that for safety reasons, offline communication may be preceded by third-party verification processes, which are beyond the scope of this paper.

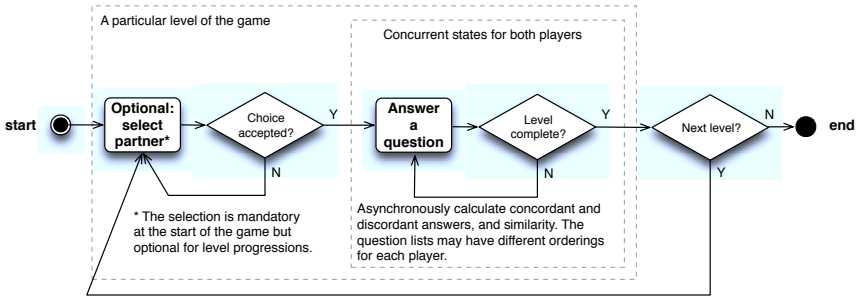

Fig. II.1. The proposed gameplay. At the end of the game, per level concordances (or discordances) can be used to suggest concordant (or discordant) partners.

a specific question k) if: $o_{k,A} > c_A$ and $o_{k,B} > c_B$ or $o_{k,A} < c_A$ and $o_{k,B} < c_B$. They are discordant if $o_{k,A} < c_A$ and $o_{k,B} > c_B$ or $o_{k,A} > c_A$ and $o_{k,B} < c_B$. They are tied if $o_{k,A} = c_A$ and $o_{k,B} = c_B$. Concordance and discordance can only be calculated for questions which both parties have answered. A non-parametric statistic, e.g., the Sommers' d [6] is calculated for a comparable estimation of similarity between users for a particular game level; and is given as: $d = \frac{C-D}{N-T}$; where C is the count of concordant responses, D is the count of discordant responses, N is the total number of questions answered by both parties, and T is the number of ties in that particular level.

III. Generalisations

Although concordance is computed for a pair of players, the concept can be generalised into a multi-party scenario. The framework can be used in scenarios that involve humans making emotive decisions, e.g., the choice of flatmates who can live together peacefully. On the other hand, instead of measuring concordance between a pair of players, one can also measure the concordance of answers given by players in comparison with a pre-determined set of answers.

IV. Related work

Concordance measures have been in use to estimate degree of agreement in various problem domains. For example, a reproducibility index is developed based on a concordance correlation coefficient in [7]. Non-parametric measures of correlation (e.g., Spearman's rank correlation [8], Kendall's τ [9], Sommers' d [6]) fare better with data which either does not follow Normal distribution, or raises performance issues with a test for Normal distribution fit [10]. Lathia et al. have used concordance measures for privacy preserving collaborative filtering in [11]. With a completely different purpose (i.e., 'human computation'), von Ahn and Dabbish in [12] have described a game which encourages users to compete with each other to provide 'semantically correct' answers, e.g., image labels, and also develop mutually agreeing or disagreeing bonds during the gameplay. This approach follows the philosophy posited by Karahalios [13], which is to use interactive design to provide 'catalysts'; opportunities that allow participants to exchange evidence spontaneously in a digital environment. The catalyst approach has the potential for evidence to be less contrived as an exchange is created with limited opportunity for thought or planning.

V. Conclusions

A problem when users communicate via digitally mediated environments is that users can easily provide inaccurate data about themselves that others will use to form trust perceptions. For instance, in an on-line dating context, users can provide fake information in a profile. In this position paper, we propose a concordance game framework that can provoke more accurate trust evidences. As our on-going and future work, we plan to implement this game and run extensive user studies to assess its suitability in such emotive application scenarios.

References

[1] J. Stanier, S. Naicken, A. Basu, J. Li, and I. Wakeman, "Can We Use Trust in Online Dating?" *Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications*, vol. 1(4), pp. 50–61, 2010.

[2] M. Bacharach and D. Gambetta, "Trust in signs," *Trust in society*, vol. 2, pp. 148–184, 2001.

[3] F. Fukuyama, *Trust: The social virtues and the creation of prosperity*. Free Press, New York, USA, 1995.

[4] E. Uslaner, "Trust online, trust offline," *Communications of the ACM*, vol. 47, no. 4, pp. 28–29, 2004.

[5] I. Wakeman, D. Chalmers, and M. Fry, "Reconciling privacy and security in pervasive computing: the case for pseudonymous group membership," in *Proceedings of the 5th international workshop on Middleware for pervasive and ad-hoc computing: held at the ACM/IFIP/USENIX 8th International Middleware Conference*. ACM, 2007, pp. 7–12.

[6] R. Somers, "A new asymmetric measure of association for ordinal variables," *American Sociological Review*, pp. 799–811, 1962.

[7] L. Lin *et al.*, "A concordance correlation coefficient to evaluate reproducibility." *Biometrics*, vol. 45, no. 1, p. 255, 1989.

[8] C. Spearman, "The proof and measurement of association between two things," *The American journal of psychology*, vol. 15, no. 1, pp. 72–101, 1904.

[9] M. Kendall, "A new measure of rank correlation," *Biometrika*, vol. 30, no. 1/2, pp. 81–93, 1938.

[10] S. Shapiro and M. Wilk, "An analysis of variance test for normality (complete samples)," *Biometrika*, vol. 52, no. 3/4, pp. 591–611, 1965.

[11] N. Lathia, S. Hailes, and L. Capra, "Private distributed collaborative filtering using estimated concordance measures," in *Proceedings of the 2007 ACM conference on Recommender systems*. ACM, 2007, pp. 1–8.

[12] L. Von Ahn and L. Dabbish, "Labeling images with a computer game," in *Proceedings of the SIGCHI conference on Human factors in computing systems*. ACM, 2004, pp. 319–326.

[13] K. G. Karahalios, "Social catalysts: enhancing communication in mediated spaces," Ph.D. dissertation, Cambridge, MA, USA, 2004, AAI0807517.