
Data Donors: Sharing Knowledge for Mobile Accessibility

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CHI'18 Extended Abstracts, April 21–26, 2018, Montreal, QC, Canada
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ACM ISBN 978-1-4503-5621-3/18/04.
<https://doi.org/10.1145/3170427.3188627>.

Abstract

Individuals regularly face challenges when interacting with their mobile devices particularly if they are not tech savvy users. When such difficulties occur, individuals often rely on more knowledgeable users to overcome difficulties. However, many do not have a support network of knowledgeable individuals available. Moreover, some challenges go beyond the need for guidance, as for example difficulties in performing swipes for motor impaired people. In this paper, we propose Data Donors, a conceptual framework proposing the enablement of users with the capacity to help others to do so by donating their mobile interaction data and knowledge. Inspired by charitable donations, we outline the Data Donors framework and discuss three applications that are being developed under the data donning paradigm. Through this work, we will explore the consequences and opportunities of sharing ones' data for the greater good and discuss the creation of global data donation programs.

Author Keywords

Mobile Computing; Crowdsourcing; Accessibility; Data Collection; Assistive Technology; Human Computation.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

Smartphone devices have empowered users with near limitless access to information, communication services, entertainment and more. These devices can be a strong propeller for independence and inclusion. Unfortunately, there are still barriers to their usage. From learning a new app, to adapting to an app update, all users face challenges from time to time. For individuals with additional digital technology access needs (e.g. people with visual or motor impairments) the issues can be vexing. When faced with barriers, people tend to rely on more knowledgeable users for help. Traditionally, we rely on people close to us for assistance; nowadays, through technology, there is the opportunity to widen our support networks [2]. Many knowledgeable users already contribute explicitly by sharing their experiences with everyone through videos, tutorials, blogs and podcasts. There is a clear value added by knowledgeable users when novice users are starting out, or when they come across a problem they can't solve [9].

If we look at web search, user navigation is implicitly collected and used to refine results for future users. In web applications, interactions are usually logged to understand user workflow behaviors and optimize the experience. This data is often mined by the companies and organizations in an effort to improve system performance and user retention [4], or to predict user preferences [1] and information needs [3]. In software development there are several works that look into how navigation data can be recorded and presented to facilitate the understanding of its procedures by different users [6, 10]. From enriching tutorials with user demonstrations [6] to collecting and mining local interactions histories with software repositories [10].

An alternative approach to acquire and enrich interaction knowledge is to leverage the power of the crowd to generate information to assist or improve user performance [5]. Kim et al. [5] used the crowd to add additional information to how-to videos on the web.

User interactions implicitly collected, and knowledge explicitly provided can be fostered to design solutions that leverage the wisdom of few, to benefit the many in need. However, currently interaction data collection methods are fragmented and are gathered by each app individually, with the purpose of self-improvement with limited control and awareness by the user.

We envision a paradigm shift where interactions and contributions by knowledgeable users can assist others beyond what app and operating systems (OS) provide. Thus, establishing a support network where there was none, enabling the creation of services and tools that tackle accessibility challenges informed by usage data. To illustrate a possible scenario, Alice is motor impaired and has trouble swiping. Alice really wants to play Fruit Ninja that all her friends are raving about, but since it requires swipes she is unable to. However, she finds a service that she can utilize other users donated gestural interactions to augment her own. Alice adds a new hotkey on the left side of the screen and maps the tap interaction to short swipes right; then repeats this process on the other side of the screen to swipe left. With no changes to the underlying gesture recognizers of the game and thus without any dependency on developers Alice is now able to play.

In this paper we introduce Data Donors, a conceptual framework inspired by the procedures, awareness and

globalization of charitable donations (e.g. food banks, clothes for homeless people and blood donation).

Data Donors Framework

Charitable donations are a common practice and, thanks to national-level programs, in many countries; food, clothes and blood are a few among many that can be readily available for individuals who, for a variety of reasons, may need it (e.g. financial difficulties, homelessness, surgery). The preventive nature of donations by individuals who wish to contribute guarantees its availability to others.

The Data Donors framework explores how to enable individuals (Donors) to share both their mobile interaction data and knowledge to be used to aid other mobile individuals in need (Donees). We consider an interaction to be composed by a sequence of actions that can be characterized by multiple data sources (e.g. touch data, element selected, type of interaction, interface layout). The data is collected in-context, it can be recorded automatically and implicitly shared; and can be enriched explicitly when a donor takes an active role. Although not a life-threatening issue, we argue that the framework can be leveraged for mobile accessibility to address interaction needs when challenges arise, helping to tackle societal exclusion of these digital technologies.

Assessing Donor Suitability

In the mobile ecosystem, individuals have a variety of devices, OS and applications with the last two also having a variety of versions. Alike blood types, one must have a large variety and quantity of donations to ensure one can cover the requirements of each of the individual Donees. With data donors one must not

overburden the same donors constantly draining ones' resources (e.g. battery), only with a large number of donors can this be achieved. Another concern is the safety and reliability of the interaction data shared to guarantee no malicious intent is behind it; even if the donor is unaware. Screening mechanisms can be part of the solution certifying that the data comes from uncompromised devices.

Charitable Drives

Often events occur that trigger the need for charitable drives; from blood drives when a natural disaster occurs, to offering clothes for homeless people when poor weather conditions are approaching. With Data Donors similar events can be considered to preventively prepare for user's needs. An example is how people often struggle after an OS update. An interaction donation drive might be required to validate and update existing knowledge. Additionally, Donees themselves might commission from donors (e.g. gestures for Fruit Ninja), similar to how organizations request donations when they cannot keep up with demand.

Privacy & Trust

Phlebotomy (i.e. the drawing of blood) services are offered by a variety of facilities (e.g. hospitals, clinics) and performed by both medical and non-medical personal [11]. To guarantee the safety of both patient and healthcare workers, guidelines are in place and many countries require formal standardized training. It is fundamental for stakeholders to trust the institutions they are relying on. As with blood donations privacy and anonymity is a prerequisite. In Data Donors, there must be clear guidelines accessible to donors on how and which of their data is being donated to ensure trust. For example, when considering collecting

interaction data, one should always alert donors when they are being recorded; allow them to configure which data and in which applications they want to share interaction data and under which terms they are willing to donate. Additionally, one must implement a confidential unit of exclusion traditionally used to allow donors to recant their donations for being unsafe; giving donors control over their data.

Access

Donations are often associated with a national program that allows for multiple sources to request access. Although a Data Donation service can be useful in isolation, its reusability is an opportunity to develop integrated services that rely on a shared donation platform that would be otherwise impossible due to inability to collect enough relevant data. We argue that through Data Donors we can build a sharing economy that relies on the platform to be the broker that facilitates trust and access of Donees and services to donations through profiles and reputation mechanisms.

Continued Donor Engagement

In some cases, it is possible to determine when a donation has an effect on others' lives. In some blood donation programs in Europe donors are notified whenever their blood is used and by which hospital. In Data Donors to promote donors' intrinsic motivation to help one can create backtracking mechanisms notifying and quantifying how and when their data is being used and for what purpose thus establishing a donor profile.

Exercising the Framework

We present three applications that illustrate how Data Donors can be applied to existing ones (Assistive Macros [8]) and how it enables researchers to take

advantage of knowledgeable users' interactions (Assistive Updates, Assistive Play).

Assistive Macros

The Assistive Macros (AMa) application records the interactions performed on a device allowing users to create macros that perform a sequence of interactions across multiple applications with only a selection [8]. Using the Data Donor framework, AMa is being adapted so users can donate their interactions implicitly (i.e. interactions are periodically collected and donated) or explicitly by donating an interaction sequence annotated (i.e. macro). Now, as an app with access to donations, caregivers are no longer limited to recording macros locally and can share them across a larger population with considerably less effort.

Assistive Updates

Updates to both OS and apps can be disruptive for users who have an established mental model of the navigation, especially for whom creating one can be a challenging task (i.e. blind and older adults). With an implicit donation service, AUp can create a model of all the possible interactions in each version assessing its differences. Consequently, when an update presents itself AUp can verify if the known workflows remain valid on the subsequent version or not; alerting for users how their workflows will be affected and how demanding it will be to adapt.

Assistive Play

Mobile games can require anything from simple taps to complex gestures with high precision both in time and location. Players are just as diverse and not all possess the dexterity needed to play some games (e.g. elderly, children, motor impaired). Assistive Play (APa) is a



Figure 1 - Assistive Play Donor Application Mock-Up; A- Screenshot of the screen at recording time with traces; B- Set Action Name; C- Timeline;

library that records interactions of users playing a game to assist less agile players. Occasionally, when a donor ends a gaming session APA asks the user to tag some of the interactions it collected during the gaming session. The donor is able to view screenshots of when the interaction took place and its trace (Figure 1-A); then it can use the timeline (Figure 1-C) to define the limits of an interaction; and finally tag it (Figure 1-B) (e.g. slice right, jump). With a large enough population of donors or enough play sessions, all the gestures needed to play the game will be identified. This data would allow APA to map end-user interactions to the interactions known to be required to play the game (e.g. tap to a slice right) making the Alice example presented previously possible. With APA users do not depend on the developers will to comply with accessibility norms. Moreover, by relying in gesture recording and tagging rather than traditional gesture mapping APA can support a high variety of gestures.

Discussion & Future Work

Nowadays, people rely on their smartphones to do everything, from performing a bank transfer to booking a flight. As the devices store more personal information, our concern for security can increase to a point that even sharing the device can be distressing. It is certain that we face major challenges in security, motivating donors and establishing a global program.

Security

A critical factor is understanding what can be shared safely within each context; and which data should never be recorded. As an example, let's consider one email application; all the texts that the donor writes and emails are sensitive; but how can we differentiate between inconsequential elements (e.g. "Inbox") from

sensitive information as third party donor services. Future work should seek to explore how we can rely on donor actions and/or automatic techniques to filter sensitive information from interaction data. One avenue is to explore filtering out all data that is solely found in a single donation and only be able to access data based on repeated measures from different donors.

Motivation to Donate

Our model is based on the premise that knowledgeable individuals are willing to share their interaction data. Some are intrinsically motivated to help. Others are already part of a support network for someone and would like to expand their reach. As with contributions to food banks, donors can recognize the social impact these initiatives have on others around them or even potentially in their life in the future.

Unlike approaches such as the popular crowdwork marketplace Mechanical Turk, Data Donors relies on a community intrinsically motivated to help and collaborate to help those in need. Moreover, donations can be triggered by the different stakeholders: donors can passively/actively contribute; Donees can request data; and apps/services can trigger donations drives. Data Donors aims to augment current support networks and allow multiple stakeholders to intervene in collaborative efforts to make smartphones accessible. Unfortunately, to unlock the full potential of data donning we need to understand what is shared, and there is no better way to do it then to ask the donor to play an active role. Moreover, the number of donors plays a critical part in the quality, reliability and availability of the interaction data. One possibility to foster donations, borrowing from blood programs, is to raise awareness of the benefits.

Establishing a Global Donor Program

Most accessibility applications developed are handicapped by the number of invested users. Although, there are challenges to the creation of a single protocol for sharing interaction data, there is also an opportunity to provide researchers and other developers with a tool to develop solutions reliant on user data. In this paper, we briefly present three applications that can benefit from a donation program as well as be part of a donation collection process. We will continue to develop and explore how a global donor program can be established in an effort to provoke new work in mobility accessibility.

We believe that the Data Donor framework can pave the way for a new kind of infrastructure that enable individuals to share their experiences to help others.

Acknowledgements

This work supported by FCT through funding of the scholarship, ref. SFRH/BD/103935/2014, LASIGE Research Unit, ref. UID/CEC/00408/2013; and DERC EP/M023001/1 (Digital Economy Research Centre)

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