Personalization of Mobile Services

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Outline

• Introduction and Motivation
• State of the Art
• Research Goal and Questions
• Research Process and Methodology
• Research Contributions
• Results and Implications
• Conclusions and Further work
Introduction

Personalization of Mobile Services

User Modeling

User

Mobile Services

Personalization

Privacy
Introduction
Introduction

Classification of Mobile Services (Heinonen, K., Pura, M, 2006).

NTNU – Trondheim Norwegian University of Science and Technology
Introduction

• Providing the same contents or information to everyone at the same time may end up not serving anyone.
  – One size fits all approach - no more valid
  – Users are individuals

• Users are getting exposed to information and services without being able to control the flow of services and users’ information.

• Utilize the increasing capability of mobile devices and enabling technologies to fulfill real users’ needs.
Introduction

Classification of Mobile Services

What is Personalization?

A *multidimensional* concept:

- Varied focus and variety of definitions
- Customization, Adaptation, Individualization, One-to-One relationship, and Consumer Centric etc.
- marketing/e-commerce; computer science/cognitive science; architecture/ environmental psychology; information science; and social sciences, sociology, anthropology, and communication.
Key Elements for Personalization

- **User Needs and Goals**
  - The main purpose of personalization process is to fulfill user needs and achieve user’s goal as well as service provider’s goal.

- **Choice and Flexibility**
  - For adequate personalization, there must be choices for users. Choices must be flexible and easy to choose and adapt.

- **Control and Privacy**
  - User must have control over his/her personal information to achieve adequate privacy.
  - User’s trust can be increased by giving control over to his/her personal information.
Basic Personalization Process

1. Data collection
   - context
   - user log
   - explicit feedback

2. Update

3. Personalization

User model
Personalization and User Modeling

• **User Model** is a key for Personalization
  
  – User model is a representation of system’s belief about a user.
  – Personalized systems require a representation about the user in the form of a user model.

• **User modeling** is a process of creating, maintaining and consuming the user model.
  
  – The aim of user modeling is to capture user information such as preferences, beliefs, goals, and intentions to construct a user model.
Personalization and User Modeling

Seven purposes of a user model:

- Assist a user during learning of a given topic.
- Offer information adjusted to the user.
- Adapt the interface to the user.
- Help a user to find information.
- Give the user feedback about his knowledge.
- Support collaborative work.
- Give assistance in the use of the system.
Scrutable User Modeling

Scrutability refers to know:

- What is allowed into the user model?
- Which parts of the model are stored on which devices?
- Which parts of the model should be shared with particular application and people?
- How the user model is managed and maintained?
Personalization and Privacy « Paradox»

• Conflicting user needs for both personalization and privacy.

• The systems track a wide range of user behaviors, with little or no consent of users.
  – Beacon project, Instant Personalization, Unsolicited marketing

• It is increasingly important to understand how disclosed data is being used and reused and what can be done to control this further use and reuse.
Personalization and Privacy «Paradox»

- **Data Collection**
  - Tracking user’s location and collecting data *implicitly with or without the consent*.

- **User Model Creation**
  - new ways of analyzing data such as collaborative filtering and machine learning allow *unnecessary new predictions* to be inferred from the data.
  - *exchanging data* between the companies and send beyond the service it was collected in.

- **Adaptation Phase**
  - New personalization techniques are *distributing the personalized content* to the user’s social network: to friends, co-workers, and family or WWW.
Research Goals and Questions
Research Statement

Users with mobile devices can be viewed as *user data providers, user data consumers, and user data brokers* (which facilitate the user data sharing by providing mediation services e.g. semantic mediation and lookup) and the user can/should have *central role* in the marketplace of personalized mobile services.
Research Questions

1. What are the research issues in personalization of mobile services?

2. How to achieve privacy-enhanced personalization of mobile services?

3. How to put a user in control of her/his data and overall personalization process?

4. How to achieve scrutable user modeling for personalization process?

5. How to evaluate and measure the effectiveness of personalization of mobile services?
Research Process and Methodology

- Design Science Methodology

- Three Phases of research process

1. Conceptual Development
2. Design and Implementation
3. Evaluation
Research Process and Methodology

Phase 1
Conceptual Development
Understanding of domain knowledge, Literature review, Research issues and challenges

C1 P1, P2, P3

Phase 2
Design and Implementation
Design Approaches, Development of an approach, Development of Architecture, Proof of Concept

C2, C3 P4, P5

Phase 3
Evaluation

C4, C5 P6, P7

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Personalization of Mobile Services
Research Contributions

C1: Identifications of the research issues and challenges in personalization of mobile services.

C2: An approach for delivering personalized mobile services.

C3: Development of mobile client-side personalization architecture.

C4: Identification of the prospects of scrutable personalization of mobile services.

C5: Development of mobile services Personalization Evaluation Model.
Developed a taxonomy of personalization of mobile services

- Different dimensions of personalization.
- Different levels of personalization.
- Key elements of personalization.

“Personalization is a controlled process of adaptation of a service to achieve a particular goal by utilizing the user model and the context of use”. (Asif & Krogstie, 2011)
Research Contributions - 1

Research Issues:
• Creating and maintaining an accurate user model is a critical issue.

Few other important issues:
  – Life-long user model
  – Scrutability of a user model
  – Dynamic privacy control
  – Ubiquitous user model

• Measuring the effectiveness of mobile services personalization is also a challenge.
Research Contributions - 1

Role of Personalization

TAM Model
Research Contributions - 1

Role of Personalization

TAM Model and Personalization
Research Contributions - 2

Scrtuable mobile client-side personalization
Research Contributions - 2

- Combined *client-side personalization* and *scrubability*

- The use model is stored and managed on the user’s device.
  - A dedicated user modeling component.

- Provide users the *capability to scrutinize* their user model.

- A partial relevant user model is made available to the different domains of mobile services.

- Mobile services of same domain can share user generated data.
Research Contributions -3

Mobile Client-side Personalization Architecture
Research Contributions -3
Research Contributions -3

Architecture support the end users to:

– Check, what information is in the user model

– Modify the information in the user model

– Scrutinize, when other services access or attempt to modify their user model and,

– Understand how their shared user model affects the service personalization and their experience.

– **Personalized mobile news application** developed and tested
Scrutability of user model on mobile devices
Research Contributions -4

• User has the *right to know* which information is being shared with service providers.

• The *conceptualization* of user control is typically limited.

• The user model is considered as purely internal system information, and it is partially or completely *hidden from the user*.

• *Transparency* and *user control* can help to increase the user’s trust.

• *Externalization of user model* can increase the user understanding and awareness.
Research Contributions -4

• An *interactive* user model.

• A study to know
  
  – *if users really feel that it is useful to inspect, modify and control their user models.*
  
  – *if it is appropriate to present a user model in a comprehensive and user friendly way on mobile devices.*

• Used common GUI elements to represent user model.
Research Contributions -5

Mobile Services Personalization Evaluation Model (PEM)
Research Contributions -5 (PEM)

- Personalization is a *continuous and iterative* process.
- Need to examine the *impact* of personalization.
- Measuring personalization- *a challenge* due to its multidimensional nature.
- The *negative consequences* of personalization have rarely been investigated.
- Proposed an evaluation framework.
Research Contributions -5 (PEM)

Personalization Evaluation Model
Results and Implications
## Results and Implications

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Results and Implications

RQ1: *What are the research issues in personalization of mobile services?*

- **Research issues and challenges**
  - Privacy and Trust
  - User control and scrutability
  - Invisible, incorrect and inconsistency of user model.
  - Lifelong and ubiquitous user model

- Explored how personalization is overlooked and treated in different adoption studies.
Results and Implications

RQ2: *How to achieve privacy-enhanced personalization of mobile services?*

- Lack of trust and privacy concerns.
- Scrutable mobile client-side personalization.
- Put the user in control of their personal data.
- Its implementation and control is currently very challenging.
  - User’s lack of understanding of these notions.
  - Lack of effective and efficient user interfaces to support.
  - Usability issues.
Results and Implications

RQ3: *How to put a user in control of her/his data and overall personalization process?*

- Users share parts of the user model depending on the user’s situation and service providers.
- Pervasive user model.
- Possible to adapt a highly developed user’s information or knowledge to a new domain rather than building it from scratch.
- Requires more prototypes and evaluations.
Results and Implications

RQ4: *How to achieve scrutable user modeling for personalization process?*

- If users really feel that it is useful to inspect, modify and control their user models.
- If it is appropriate to present a user model in a comprehensive and user friendly way on mobile devices.

- Users like the idea to inspect, modify and control their user model
- Users were concerned about the usability issues
Results and Implications

RQ 5: How to evaluate and measure the effectiveness of personalization of mobile services?

• Developed PEM to measure the effectiveness of personalization.

• Empirical investigations shows promising results for PEM and its suitability to measure the personalization.

• An early stage of PEM
  - Require more evaluation in different domains of mobile services and others.
Conclusions and Future Work
Conclusions

• Personalization process is a challenging task
• Privacy and Personalization requires careful tradeoff.

• This research work focuses on
  – To understand and improve the personalization process.
  – To develop an architecture for scrutable mobile client-side personalization.
  – To develop an evaluation framework to measure the effectiveness of mobile services personalization.
Further work

• More evaluation and applications is required in different domains of mobile services.

• The concept of lifelong privacy-aware personalization requires long term evaluations.

• Srutable personalization approach needs to be addressed at OS level independent of applications.

• Mobile Services Personalization Evaluation model require more validations from different domains of mobile services.
Thanks!

Questions