Usage of Decision-Making Information in Adaptation for Intelligent Systems

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Background

User Modeling

- Many sorts of user data are used to model a user
- Such as using heart rate, blood pressure and temperature to model engagement

Intelligent Systems

- Using this model to recognize and adapt
- By predicting if someone is bored or overstimulated

Decision-Making

- Selecting the best choice out of two or more alternatives
- Also contains the identification of alternatives
- Influenced by a variety of factors

Research Question

How do intelligent systems acquire and use user data to model decision-making and reasoning, and how are these models applied for recognition and adaptation?

Methodology

Search Strategy

- User Modelling
- Human Decision-Making & Reasoning
- Intelligent Systems
  - Recognition
  - Adaptation

Core Concept	Search Terms
User Modelling	user modeling, user profil*, user model, cognitive model*, affective model*, student model*, persona model*, patient model*, player model*, employee model*
Human Decision-Making & Reasoning	decision making, decision-making, human decision, decision support
Intelligent Systems	intelligent system, adaptive system, support system, recommender system
Recognition	recogni*, detect*, sens*, perce*, observ*, identif*, classif*, monitor*, track*, analy*
Adaptation	adapt*, act, feedback, respon*, interact*, personali*, react*, updat*, modif*, adjust*, tailor*, customi*

Table 1: Core Concepts and corresponding Search Terms

Databases

Database	Scope
Scopus	Broad range of scientific papers
Web of Science	Large multi-disciplinary database
IEEE Xplore	Includes papers by the Institute of Electrical and Electronics Engineers
ACM Digital Library	Publications of the Association of Computing Machinery

Table 2: Databases and descriptions

Exclusion Criteria

- Exclude papers not written in English
- Exclude surveys and reviews
- Exclude papers that do not use user modeling
- Exclude papers that do not model decision-making
- Exclude papers that do not contain an intelligent system that recognizes and adapts

Feasibility Criteria

- Exclude papers published before 2021

Screening Papers

- Screen title and abstract
- Use exclusion criteria
- From 163 papers to 94

Data Extraction
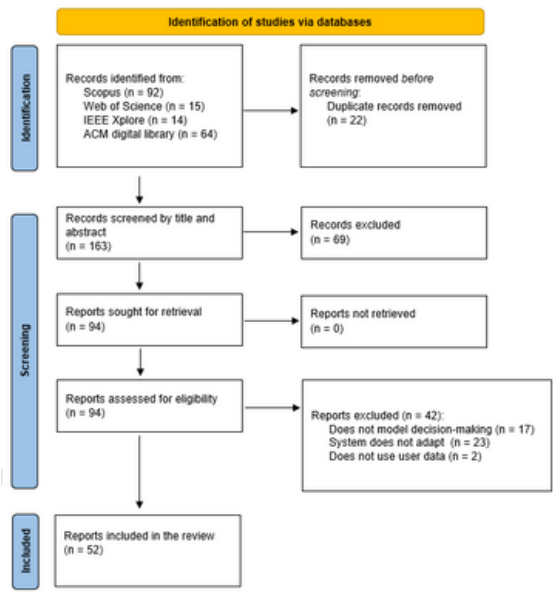
- Creating a table with questions
- From 94 papers to 52

Figure 1: PRISMA Flow Diagram

Results

Data and User Modelling

- User preferences the most prominent
- User Behaviour & Characteristics also used often
- Wide range of user models used

Models	Number of Papers
User Preferences	45
User Behaviour	18
User Characteristics	14
User Demographics	6
User Interests	6
User Relations & Social Influence	5
User Needs	5
User Emotions	3
User Skills	3
User Motivation	1
User Satisfaction	1
User Engagement	1
User Perception	1

Table 3: User Models and Number of Papers

Recognition & Adaptation of Intelligent Systems

- Recommender Systems predict user ratings to recommend items
- Decision Support Systems predict user ratings to advise
- Assistance Systems predicts behavioural decision-making and warns or assists

Intelligent Systems	Number of Papers
Recommender Systems	44
Decision Support Systems	5
Assistance Systems	2
Social Robots	1

Table 4: Intelligent Systems and Number of Papers

Domain of Intelligent Systems

- Recommender systems are active in all domains
- Important function in Health & Food
- Decision Support Systems are active in 3 domains including mobilility, transport & safety
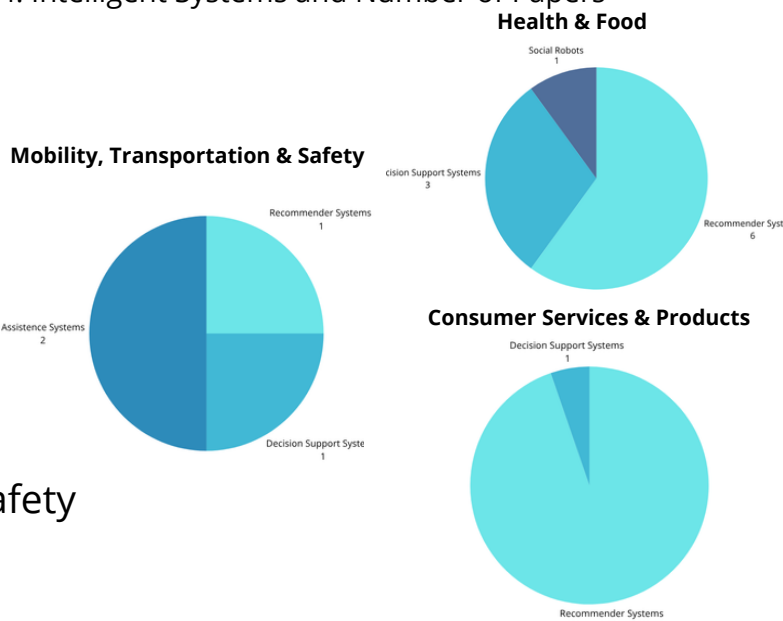

Figure 2: Domain and Number of Intelligent Systems

Challenges of Intelligent Systems

- Prediction Accuracy
- Biases, Fairness & Explainability
- Interface & Usability
- Privacy & Security
- Data Collection

Challenges	Number of Papers
Prediction Accuracy	36
Biases, Fairness & Explainability	8
Interface and Usability	5
Privacy & Security	3
Data Collection	2

Table 5: Challenges and Number of Papers

Conclusion

- Recommender systems being most prominent explains the prominence of user preferences
- User preferences are modeled using other models
- Making decision-making easier and enabling nudging
- Decision Support Systems serve important purposes
- Assistence Systems and Social Robots, smaller but serving very important objectives

Future Work

- Include research from before 2021
- Intelligent systems that are not recommender systems