Development of Heuristic Evaluation Checklist for AR Experiences

Category: Analysis of Software or Hardware

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Problem this Research Would Address

- There is currently a lack of standards/guidelines for the evaluation of AR solutions

- Heuristic Evaluation is a method that has been used in many software domains to identify usability issues

PROBLEM: Standard heuristics need to be developed and validated to allow a range of AR experiences to be evaluated

Problem this Research Would Address
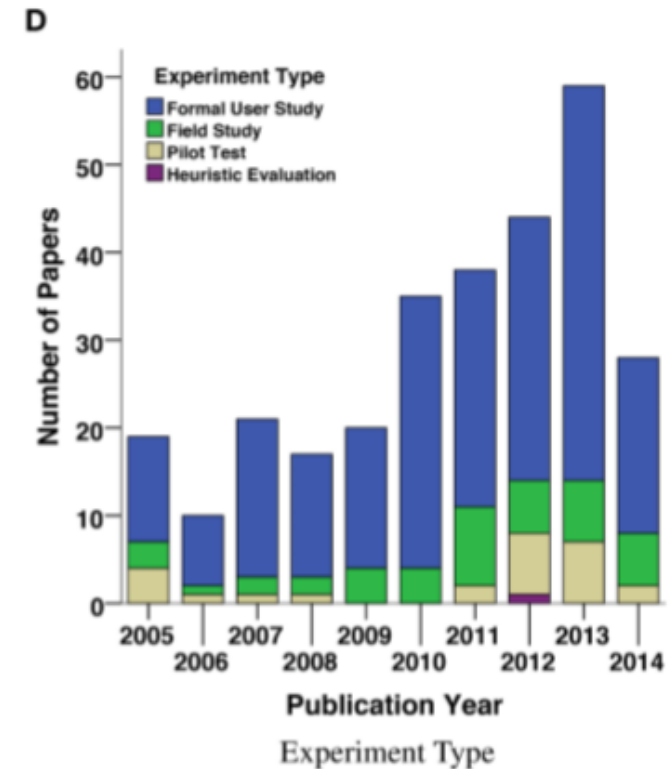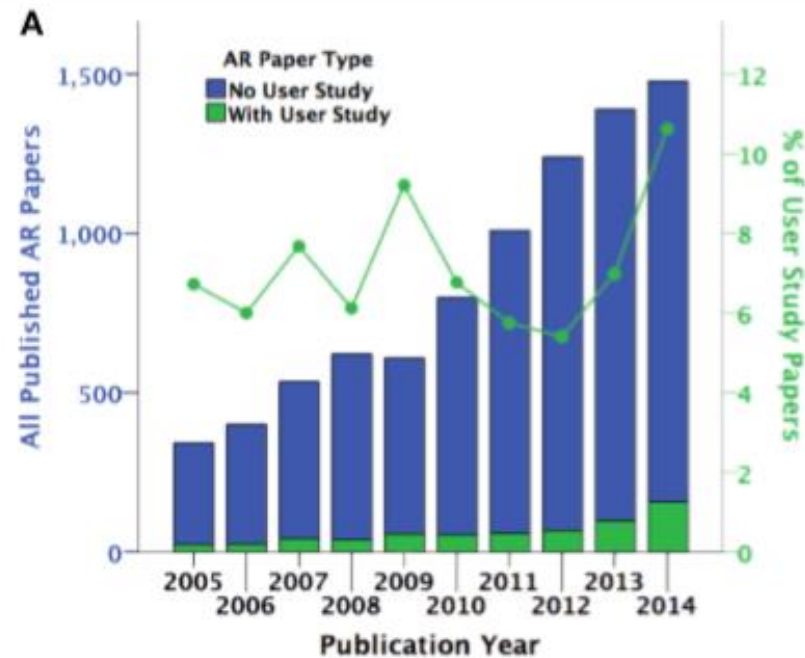
Dey, A., Billinghurst, M., Lindeman, R. W., & Swan, J. (2018). A Systematic Review of 10 Years of Augmented Reality Usability Studies: 2005 to 2014. *Frontiers in Robotics and AI*, *5*, 37.

Whose problem would be addressed?

- Providers of enterprise wearable AR platforms would be able to more quickly/reliably
  - Assess usability and user experience (UX)
  - Iterate design/development
  - Develop more satisfying, efficient, and effective solutions
- Enterprise safety managers would
  - Benefit from better designed solutions
- Regulatory agencies or groups would
  - Appreciate the standardization and overall improvement in quality

How would this research be conducted?

1. Literature review
   - Existing heuristics and guidelines
   - Experimental findings
2. Correlation of AR features to usability/UX attributes and heuristics
3. Checklist items developed for each heuristic
4. Validation
   - Experts
   - Users with AR experiences
5. Refinement

How would this research be conducted?

TABLE III. CHECKLIST: VERIFIABLE VARIABLE EFFICIENCY

Item	Heuristic
Is the loading time of virtual objects in the scene satisfactory?	Visibility of system status
Are the virtual objects merged correctly with the real world? (position, texture, scale)	Match between system and the real world
Is the virtual object animation coherent with the real world?	Match between system and the real world
Are actions/feedback standardized? (e.g., borders are added to the outside of the tracked object)	Consistency and standards
Is error prevention enabled? (i.e., if the user shows an unexpected marker, is an error message presented to the user?)	Error prevention
Is it easy to remember the application's functionalities? (i.e., is it easy to memorize the functionalities of each marker?)	Recognition rather than recall
What is the learning curve like for novice users?	Flexibility and efficiency of use
Can expert users utilize the application in an optimized manner? (e.g., can they skip introductory videos)	Flexibility and efficiency of use
Is it easy to stand the marker in an appropriate position and orientation to be detected by the camera/sensor?	Flexibility and efficiency of use
Is the user instructed about what to do during the interaction? (e.g., show the marker to the camera or is there a manual)	Help users recognize, diagnose, and recover from errors
Are there specific requirements? (camera, marker, mobile, GPS, user position, lighting, print, calibration)	Environment configuration
Is the tracker system stable?	Accuracy
If the tracker system detects more than one object in the scene, does the application continue to function correctly?	Accuracy

TABLE VI. VERIFYING THE EFFICIENCY VARIABLE FOR THE AUTOMOTIVE APPLICATION

Checklist	Severity degree	Expert comments
Is the loading time of virtual objects in the scene satisfactory?	0,0,1,0,1	About 5 seconds, which is considered high
What is the learning curve like for novice users?	1,2,1,0,1	The application is not very intuitive. It is available as a demo video and a tutorial (images).
Can expert users utilize the application in an optimized manner? (e.g., can they skip introductory videos)	3,2,3,3,2	The application is simple, so novice and expert users interact in the same way.
Is it easy to stand the marker in the position and orientation required for detection by the camera/sensor?	2,1,2,2,1	Users need to spend time placing the marker in the camera viewing field.
Is the user instructed about what to do during interactions? (e.g., showing the marker to the camera or is there a manual?)	0,1,0,1,0	A video and a manual are available to the users via the home page, which are good.
Are there specific requirements? (e.g., camera, marker, mobile, GPS, user position, lighting, print, calibration)	1,1,2,1,2	The user has to print the marker.

de Paiva Guimarães, M., & Martins, V. F. (2014, May). A checklist to evaluate Augmented Reality Applications. In *2014 XVI Symposium on Virtual and Augmented Reality* (pp. 45-52). IEEE.

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How would this research be conducted?

Areas to Consider:
- User interface design of AR components
  - Contrast/legibility on variety of backgrounds
  - Affordance
  - Consistency
  - Location of AR elements
- Comfort of device
- Alignment between physical and virtual environments
- Ease of interaction
- Etc...

How would this research be conducted?

Deliverables

- Literature review white paper
- Validation results & discussion white paper
- Final heuristic checklist(s)

Benefits to AREA Members

- AREA members will be able to more quickly assess the usability/UX of emerging AR experiences

- Long term impacts of this research:
  - Increased user focus in development
  - Improved usability/UX solutions
  - Increased user satisfaction and acceptance of AR technology