# Yi-Ching (Janet) Huang • Research Statement

As a computer science researcher with a mixed background in human-computer interaction (HCI) and Artificial Intelligence (AI), I design and build **interactive systems** that supports people to **gain knowledge, develop skills,** and **accomplish complex tasks**. I strive to leverage **hybrid intelligence** (i.e., a mixture of human and machine intelligence) to support open-ended, ill-defined problem solving and learning. Also, I have had many experiences collaborating with designers and digital artists to create **interdisciplinary work**.

Specifically, my research has focused on **exploring structure** to support people, especially for novices, to **perform creative tasks**, such as writing, design, and drawing. Novices, who lack knowledge and abilities, are usually struggling with performing creative tasks because of its open-ended, ill-structured characteristics. To support creative task, I propose **"Never-Ending Creative Learning"** to facilitate collaborations among reviewers, authors, and learners for supporting learning and work performance (see Figure 1). The key concepts of this approach is incorporating review, practice, and reflection for supporting people to not only perform creative tasks and but also learn creative knowledge. My research demonstrates that **appropriately structuring human computation and machine intelligence** into the systems can enhance the process of **feedback generation and utilization**, facilitate **reflection and practice**, and ultimately improve learning experience and work performance. My Ph.D. research "Designing for Complex Creative Task Solving" won Ph.D. Thesis Honorable Mention Award at the 2018 International Conference on Technologies and Applications of Artificial Intelligence (TAAI 2018).

In the future, I would like to explore **"Human-AI Co-Learning"** for facilitating human-AI team to achieve superior outcomes on complex creative problem domains.

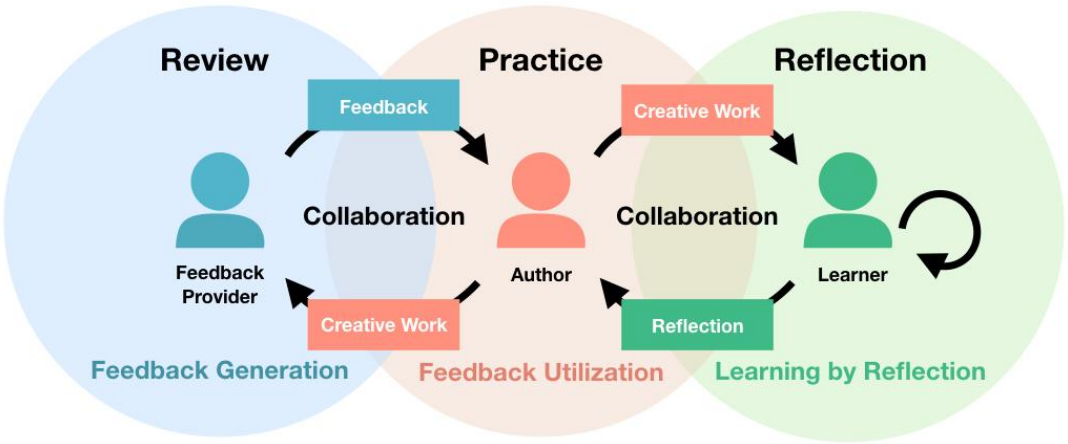



Figure 1: Never-Ending Creative Learning is a framework for supporting people to solve open-ended, ill-defined creative problems. It allows three types roles of actors to collaborate with each other in an interactive, iterative feedback loop. Actors as reviewers generate feedback to users; actors as authors utilize and integrate feedback in practice with a goal of improving the work quality; actors as learners gain new knowledge through a self-reflect learning loop.

## Crowd-Machine Feedback For Improve Writing Quality

Feedback helps improve creative work. However, obtaining high-quality feedback is challenging. Expert feedback is high-cost and limited availability; machine feedback is needed to be trained based on large amounts of data with experts' annotations, and only supports limited topics. To facilitate feedback generation, I created a thread of research exploring explores how to generate effective feedback for helping people improve their create work.

My research has explored ways of combining crowdsourcing and machine computation to generate effective feedback for ESL writing. I build StructFeed, a crowd-powered system that generates structural feedback for helping ESL writers recognize high-level writing issues and produce a unified article. A crowdsourcing workflow is used for allowing native-speakers to identify topic sentences and relevant keywords in an article. Next, the system will predict the location of topic sentences and irrelevant sentences by aggregating crowd annotations and then generate writing suggestions. The goal is to guide people to revise the paragraph to achieve the paragraph unity based on writing criteria.

We compare our crowd-based method with three standard machine learning (ML) methods. The results suggest that our crowd-based method outperforms all ML methods. In addition, the new rule derived from crowd annotations outperformed all initial methods. Furthermore, we evaluated StructFeed with 18 online ESL writers in a between-subject experiment. The results showed that people who received writing suggestions (i.e., crowd-machine feedback) from StructFeed achieved the best performance than other people who received writing suggestions from one crowd worker or one expert. This research shows great potential of a hybrid intelligence systems that powered by crowd annotations and machine computation to generate effective feedback for supporting learners to improve work quality in the context of ESL writing domain. This project has been published at **AAAI HCOMP 2017**, a strong and competitive venue with mixtures of AI and HCI perspectives [1].

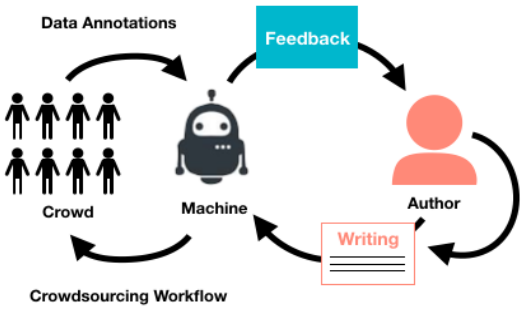



Figure 2: StructFeed generate effective feedback based on crowd annotation and expert rule/patterns.

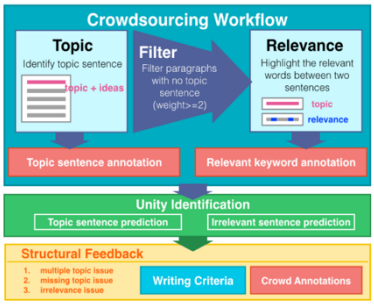



Figure 3: StructFeed combines a crowdsourcing workflow, expert rules, and automated mechanisms to generate structural feedback

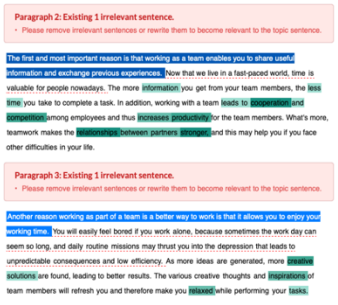



Figure 4: An interactive interface helps ESL writers identify writing issues and improve the writing quality.

## Machine-Structured Feedback for Facilitating Reflection and Revision

Writing, as a complex creative task, demands rich feedback in the writing revision process. While much effort has focused on improving diversity and quality of feedback, the difficulty in integrating feedback into revisions efficiently and effectively has been largely neglected. Many prior studies have shown that high-quality feedback does not always lead to better outcomes and our research also suggests that expert feedback with high perceived quality cannot help improve writing quality. Therefore, this work explores ways and focuses on designing technology for helping users **take full advantage of high-quality feedback** and facilitating them to **integrate feedback into revision** and improve their work.

We propose Feedback Orchestration, a framework that guides writers to reflect on high-level goals and facilitates an effective revision process (see Figure 5). This framework enables a flexible revision process by automatically classifying feedback into categories and presenting different levels of feedback in a sequence. we implemented ReviseO, a writing support system that guides novice writers to revise their writing based on structured feedback in a flexible revision workflow (see Figure 6) [3]. We evaluated our system with 12 self-motivated ESL writers. They were asked to write three 400-word essays before the experiment. The results showed that all participants felt helpfulness of using our system. Also, structured feedback helped filter information and identified their weaknesses in writing. More interestingly, some novices developed new strategies and plans for improving their revision behaviors and

writing abilities. This work has been published as a work-in-progress paper at **ACM CSCW 2018**, a top-tier HCI conference [3].

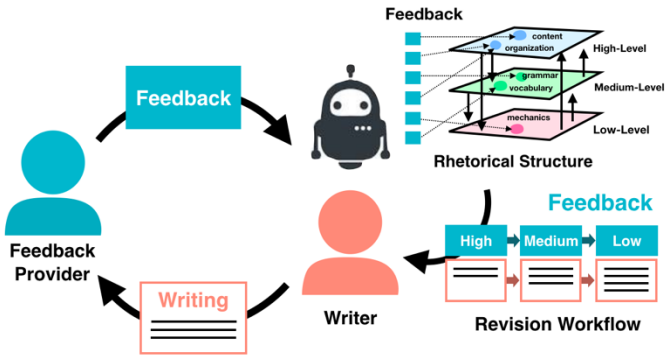



Figure 5: Feedback Orchestration enables novice writers to take full advantage of writing feedback from experts and integrate it into revision process

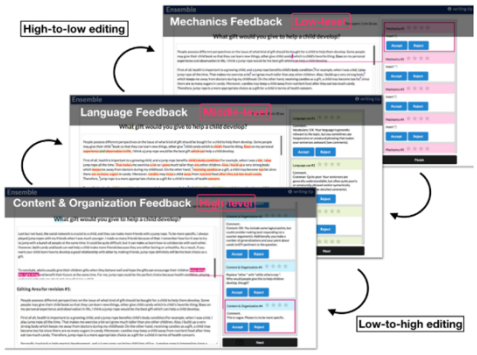



Figure 6: ReviseO provide a flexible revision workflow in which users can choose the preferable strategy to integrate feedback into their revision.

## Scaffolding Reflection and Practice to Enhance Video Learning

Creative tasks requires thinking and doing together. Rather than focusing on facilitating feedback-driven deliberate practice, people also need to continuously acquire new knowledge from a variety of materials. This work focuses on exploring appropriate scaffolding design for supporting learners to perform self-regulated learning in the context of video learning. Recently, many online learners usually use videos to acquire various knowledge (such as conceptual knowledge or practical tips) to perform complex tasks. However, novices usually face great challenges in applying knowledge to the task to achieve high-quality outcomes. This work introduce the **Reflection-Practice workflow** to support a reflective video learning process. Within the learning workflow, we introduce the **scaffolded prompting** to facilitate reflection on their learning and doing experience, promote effective revision to improve design performance and learning experience. We conducted two studies with 82 crowd workers to understand the effect of our reflective design on poster design tasks. Results show that participants reported an increase in self-efficacy and improved design quality after following our workflow; participants who got Scaffolded prompting reported a higher willingness to improve their design than without prompting. Our findings show that integrating reflection and practice into video learning can improve the learning experience and ultimately lead to better outcomes [5].

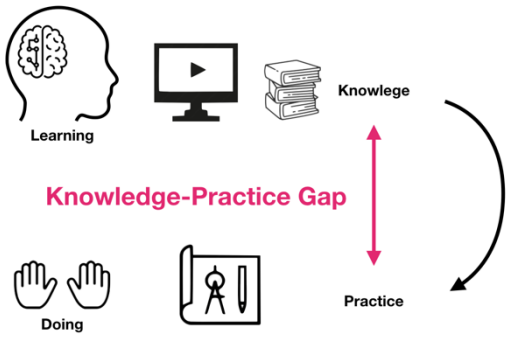



Figure 7: Novices face the difficulty of transferring new knowledge in practice.

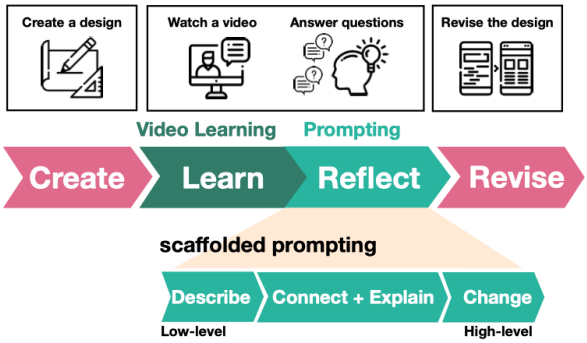
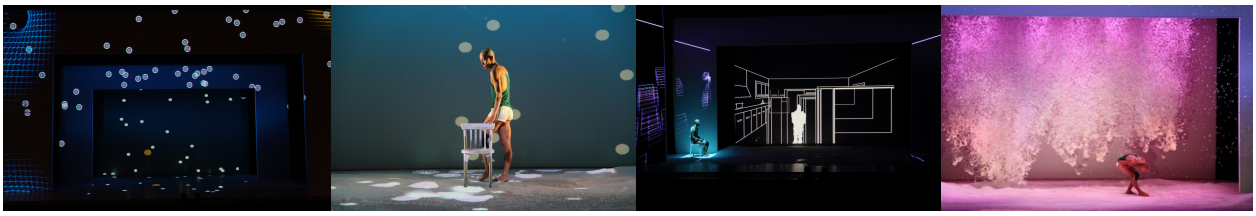



Figure 8: Reflection-Practice workflow integrates a scaffolding structure and reflection into video learning.

## Designing Systems for Digital Performance and Artwork

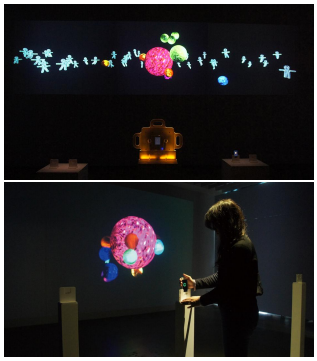
### Dinner of Luciérnaga, Digital Performance (2011)



Dinner of Luciérnaga is an interdisciplinary project produced by more than 10 talented members which include the director, dancer, choreographer, artist, interactive designer, sound designer, iPhone app engineer, image processing designer, stage designer and light designer. The goal of this project is to create new modes of interactive participation between the performers and audience through the use of an innovative iPhone application that links dancer to audience and audience to dancer. The application not only plays a key role in connecting the audience and dancer, but also uses an interesting sound generation application that enhances the spectators' experience. It creates and shares special interactive experiences. **I contribute to this projects in developing the whole infrastructure of all connected devices and an iphone application that creates unique experience between a dancer and audience.**

- This work was awarded with funding from the Council for Cultural Affairs' 2011.
- This work was published as an art paper in the 2012 ACM International Conference on Multimedia [10].
- Video: https://www.youtube.com/watch?v=EGUl00nS2Gs , https://www.youtube.com/watch?v=e93U18muUnI

### Chimeras sing a song (2013)



Chimeras sing a song is an art work regarding the moving, living, perceptive, and receptive conditions of the human race in the digital era. Through the message transfer link between a mobile handheld device and matrix, Chimeras Sing a Song invoked the song of a siren from Greek mythology as a metaphor for the contradictory sense existing between humankind and digital communication. This art practice explores a technologically-built system amidst visual representations and conversions of information, space, time, and imagery as it becomes digitally encoded and reconstructed into a state of existence and method for perceiving the world.

- This work has been exhibited in different countries, including Taiwan, China, Singapore, and Czech.
- This work has been acquired as one of holdings in Taoyuan Museum of Fine Arts in 2019.

### Scopophobic Kitties in Wonderland (2014)

This installation showcases an office desk, a wonderland where a group of diligent kitties live happily and work industriously to make artifacts react to users' eye gaze. Kitties are shy about being seen, but determined to keep everything in the wonderland moving after they hide behind. The desk environment consists of two paper objects augmented by video projections and two devices with digital displays as well as other office stationaries. One desktop eye tracker was carefully setup in order to track gaze in the 3D physical space. Users sit in front of the desk and work as a normal office worker while objects and devices behave in different ways upon the presence and absence of eye gaze of users. This work has been published and exhibited in CHI '14 Interactivity [11].

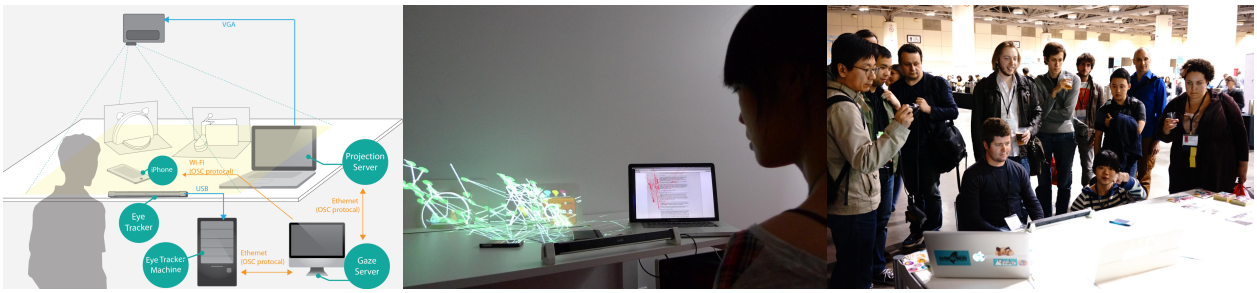



Figure 9: (a) (Left) the architecture of the whole system; (b) (Middle) the actual usage in real life; (c) (Right) participants engaged in playing this installation at CHI 2014.

## Future Research Agenda

My research goal is to build technology or interactive systems that empowers users to learn difficult concepts, develop skills and expertise, and solve complex problems. As I have explored various scaffolding structures to allow people as different roles to collaborate with each towards a collective goal of accomplishing creative tasks and improving learning experience. Also, my research has shown potential benefits of **combining human and machine intelligence to achieve superior results** than a single machine and an expert alone [1, 3, 7, 8]. Human and AI as a team will be the next big thing. Therefore, my future research will continue to explore the possibilities of **how human and AI work can collaborate together and become a better team**. I focus on "**Human-AI Co-Learning**" in which people and AI interact and learn with/from partners, and grow over time (see Figure 10). I will keep designing and developing interactive systems to explore this open research question.

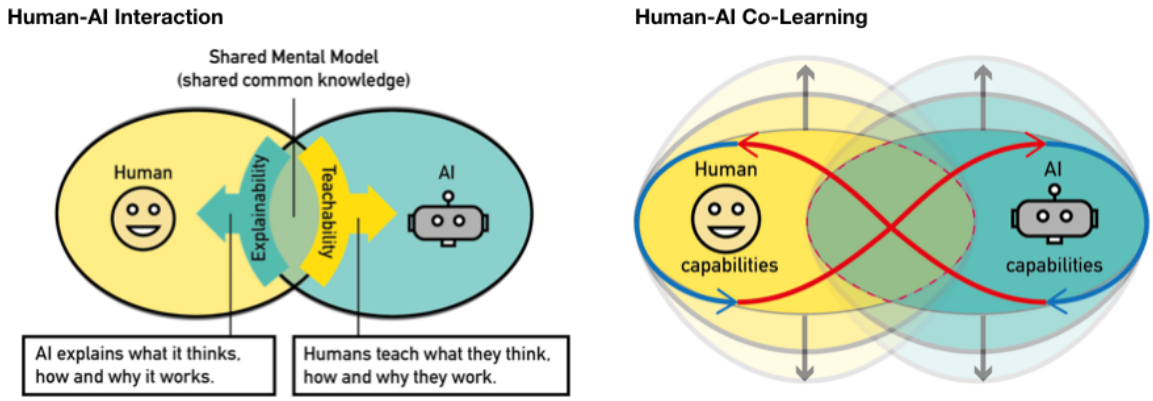



Figure 10: My future research will focus on exploring Human-AI Co-Learning to allow human and AI as a team to learn and grow together toward superior outcomes.

## Interaction Patterns for Human-AI Co-Learning

I plan to explore and extract possible interaction patterns for human-AI co-learning. Nowadays intelligent agents (e.g. Amazon Alexa, Apple Siri, etc.) are becoming part of our daily life. However, such relationships between users and intelligent agents can be limited in practice. I plan to study interaction patterns from currently available rich resources—Sci-fi movies. Sci-fi is not purely based on fantasy, but also is a social reflection on technology, which in turn can inspire design researchers to understand and speculate the complexity of future intelligent agents. I collaborate with Yu-Ting Cheng, a design student at TU/e. Recently, I have built a new system that allows people to annotate social roles of intelligent agents while watching a movie. This project focuses on understanding a specific type of agents—-Voice Conversation Agents (VCAs). Our preliminary study contributes a social role matrix containing 43 Sci-fi VCAs, and suggests possible design directions for designing the role of VCAs. The initial findings has been published as a late breaking work at CHI 2019 [9]. Next, I plan to design and develop a creative support tool that support design inspiration by getting inspiring sci-fi examples relating to their design context.

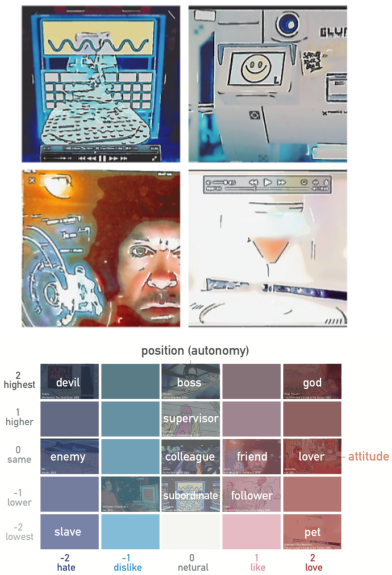



Figure 11: A social role matrix for voice conversation

## Innovative Human-AI Co-Learning Applications

Learners can collaborate with feedback providers or other learners asynchronously to accomplish creative tasks. However, learning and doing is a continuous process. How can we actively engage people in the collaborative process toward a never-ending learning loop in the long run? How can we facilitate diverse people to discover their best learning or doing pathways to achieve greater learning experience and task performance specific? I will explore various scaffolding structure for guiding human and AI to collaborate well for improving productivity, creativity, and learning in a variety of creative domains. There are two future directions I'd like to pursue:

**1. Co-Learning for Productivity:** *How can intelligent agents prompt immediate and personalized feedback based on dynamic changing abilities, knowledge, and preference of a learner?* I plan to explore how design an human-AI co-learning environment in which creative workers can deal with large amounts of information from a variety of resources and supporting their creative process, including data sense-making, ideations, idea synthesizing, and artifacts creations. Possible application domains contains (1) a AI playground that allows users to co-learn with AI to extract code snippets, exchange feedback and correct mistakes with a goal of understanding the machine training process; (2) a writing tool that allows writers and AI to co-create useful expressions or phrases to improve writing; (3) a design tool that allows designers and AI to co-extract design patterns, and AI provides inspirations or guidance for helping people improve poster of UI design [6, 7].

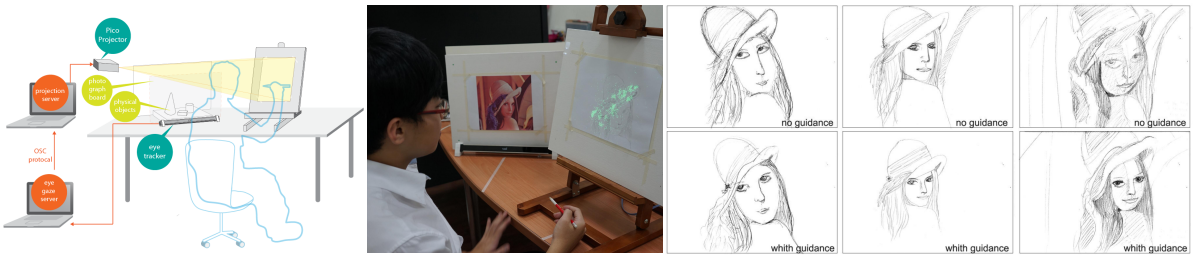



Figure 12: An example of a gaze-guided drawing support tool in the physical studio [12].

**2. Co-Learning for Creativity**: *How can we leverage distinct abilities from humans and AI to explore new possibilities of creativity?* Instead of enhancing productivity, I'd also like to explore new possibilities of human-AI creativity. Whether biased outputs generated from AI can be transferred into new ways of exploration? How can users create new value for AI's errors, unexpected bias in artwork exploration? Whether AI-generated questions or ideas serve as prompts for self-reflection or inspiration? I plan to explore these interesting research questions in our research. Possible application domains contains (1) a drawing support tool that support people to identify their weaknesses [4] by observing other learners' demonstration [4] or by increasing awareness using gaze points [12] (see Figure 12). (2) people and machine co-create an improved music performance [13] (see Figure 13);

Figure 13: (a) PureData program that generates music (left). (b) An example of transferring human perception into sounds (middle) at TEI '14 [13]. (c) A live performance in which people and machines to perform music together.

## Conclusion

In sum, I aim to expand the scaffolding structure design from **human-human collaboration** to **human-AI co-learning**. I will continue to design and build interactive systems that are used by real users in answering the proposed research questions, contribute effective interaction patterns for the human-AI team, and enable human-AI co-learning for the future of work.

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**Note: Top Computer Science Conferences** (ref: http://www.guide2research.com/topconf/)
1. AAAI : AAAI Conference on Artificial Intelligence (H-index: 95) **[AI]**
2. CHI : Computer Human Interaction (CHI) (H-index: 87) **[HCI]**
3. CSCW : ACM Conference on Computer-Supported Cooperative Work & Social Computing (H-index: 60) **[HCI]**
4. ACMMM : ACM International Conference on Multimedia (H-index: 58) **[Multimedia, Computer Vision]**
5. UIST : ACM Symposium on User Interface Software and Technology (Hindex: 46) **[HCI]**
6. DIS : Conference on Designing Interactive Systems (H-index: 33) **[HCI]**
7. IUI : International Conference on Intelligent User Interfaces (H-index: 27) **[HCI & AI]**
8. TEI : International Conference on Tangible, embedded, and embodied interaction (H-index: 25) **[HCI]**