Sunjae Lee

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RESEARCH INTERESTS

Mobile and AI-driven systems for next-generation computing.

- **Mobile Systems**
  Distributed Computing, Mobile Operating systems design, User interface management, Edge computing
- **AI-driven systems**
  LLM-based task automation, Agentic AI systems, RAG systems, Human-AI-Computer interactions

EDUCATION

Korea Advanced Institute of Science and Technology (KAIST) **September 2021 – Feb 2025 (Expected)**
PH.D. In Computer Science *Daejeon, Rep.Korea*

- Advisor: Prof. Insik Shin
- Thesis: Towards Ubiquitous and Intelligent Mobile Computing: From UI Distribution to Mobile AI agents

Korea Advanced Institute of Science and Technology (KAIST) **March 2019 – Feb 2021**
M.S. In Computer Science *Daejeon, Rep.Korea*

- Advisor: Prof. Insik Shin
- Thesis: UI based Cross-device Screen distribution

Korea Advanced Institute of Science and Technology (KAIST) **September 2012 – Feb 2019**
B.S. In Computer Science *Daejeon, Rep.Korea*

PUBLICATIONS

1. **MobileGPT: Augmenting LLM wih Human-like Memory for Mobile Task Automation**
   Sunjae Lee, Junyoung Choi, Jungjae Lee, Munim Hasan Wasi, Hojun Choi, Steven Y. Ko, Sangeun Oh, Insik Shin
   *In Proceedings of the 30th ACM Int. Conf. on Mobile Computing and Networking (**MobiCom '24**)*

2. **FLUID-IoT: Flexible and Fine-Grained Access Control in Shared IoT Environments**
   Sunjae Lee*, Minwoo Jeong*, Daye Song, Junyoung Choi, Seoyun Son, Jean Y Song, Insik Shin
   *In Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems (**CHI '24**)*

3. **Supporting Flexible and Transparent User Interface Distribution across Mobile Devices**
   Sangeun Oh, Ahyeon Kim, **Sunjae Lee**, Kilho Lee, Dae R. Jeong, Steven Y. Ko, and Insik Shin
   IEEE Transactions on Mobile Computing

4. **MixMax: Leveraging Heterogeneous Batteries to Alleviate Low Battery Experience**
   Jaeheon Kwak, **Sunjae Lee**, Dae R Jeong, Arjun Kumar, Dongjae Shin, Ilju Kim,Donghawa Shing, Kilho Lee, Junkyu Lee, Insik Shin
   *In Proceedings of the 21st ACM int. Conf. on Mobile Systems, Applications, and Services (**MobiSys '23**)*

5. **It is Okay to be Distracted: How Real-time Transcriptions Facilitate Online Meeting with Distraction**
   Seoyun Son, Junyoung Choi, **Sunjae Lee**, Jean Y Song,Insik Shin
   *In Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (**CHI '23**)*

6. **A-Mash: Providing Single-App Illusion for Multi-App Use through User-centric UI Mashup**
   Sunjae Lee, Hoyoung Kim, Sijung Kim, Sangwook Lee, Hyosu Kim, Jean Young Song, Steve. Ko, and Insik Shin
   *In Proceedings of the 28th ACM Int. Conf. on Mobile Computing and Networking (**MobiCom '22**)*

7. **FLUID-XP: Flexible User Interface Distribution for Cross-Platform Experience**
Sunjae Lee, Hayeon Lee, Hoyoung Kim, Sangmin Lee, Jeong Woon Choi, Yuseung Lee, Seono Lee, Ahyeon Kim, Jean Young Song, Sangeun Oh, Steven Y. Ko, and Insik Shin
*In Proceedings of the 27th ACM Int. Conf. on Mobile Computing and Networking (**MobiCom '21**)*

8. **FLUID: Flexible User Interface Distribution for Ubiquitous Multi-device Interaction**
Sangeun Oh, Ahyeon Kim, **Sunjae Lee**, Kilho Lee, Dae R. Jeong, Steven Y. Ko, and Insik Shin
*In Proceedings of the 25th ACM Int. Conf. on Mobile Computing and Networking (**MobiCom '19, Best Paper** 🏆)*

PATENTS

1. **User interface distribution method for multi-device interaction** ***Rep.Korea***
Application Number: 10-2022-00091130 *Granted*
Insik Shin, Sangeun oh, Ahyeon Kim, **Sunjae Lee** *2022.02.28*

2. **Secure user interface distribution method for heterogeneous multi-device interaction** ***Rep.Korea***
Application Number: 10-2019-0180075 *Published*
Insik Shin, Sangeun oh, Ahyeon Kim, **Sunjae Lee** *2019.12.31*

3. **Method of transmitting UI display information based on smart contract** ***Rep.Korea***
Application Number: 10-2022-0026429 *Published*
Insik Shin, Daehee Lee, **Sunjae Lee**, Sangwook Lee *2022.02.28*

4. **Method of transceiving UI displays between user devices** ***Rep.Korea***
Application Number: 10-2022-0026430 *Published*
Insik Shin, Daehee Lee, **Sunjae Lee** *2022.02.28*

5. **Method of transmitting UI display information to peripheral clients by a local server** ***Rep.Korea***
Application Number: 10-2022-0026426 *Published*
Insik Shin, Daehee Lee, **Sunjae Lee** *2022.02.28*

6. **Secure user interface distribution method for heterogeneous multi-device interaction** ***U.S***
Application Number: US17/852,146 *Published*
Insik Shin, Sangeun oh, Ahyeon Kim, **Sunjae Lee** *2022.11.17*

WORK EXPERIENCE

Chief Technology Officer (CTO), Fluiz Corp. *Rep. Korea*
University spin-off founded by Prof. Insik Shin July 2022 - Feb. 2024

AWARDS

CES 2023 Innovation Award 🏆 Jan. 2023
Received as CTO of Fluiz Corp.

Minister's Award, Ministry of Science and ICT, South Korea 🏆 Dec. 2022
Awarded during the 22nd Mobile Technology Festival hosted by Korea Economic Daily

MobiCom '19 Best Paper Award 🏆 Oct. 2019
*Awarded to Sangeun Oh, Ahyeon Kim, **Sunjae Lee**, Kilho Lee, Dae R. Jeong, Steven Y. Ko, Insik Shin*

ACADEMIC SERVICE

External Reviewer
CHI 2025, IUI 2025

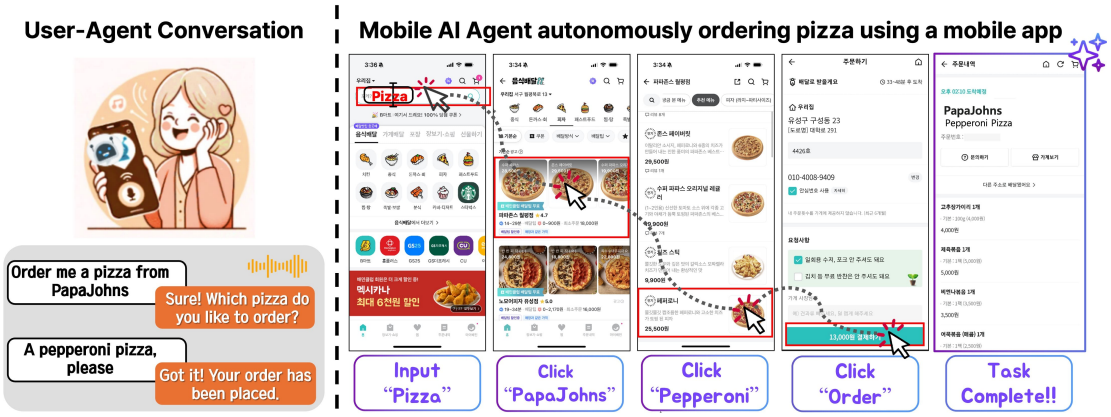
TECHNICAL SKILLS

Programming Languages: Python, Java, C, C++, JavaScript, Prompt Engineering
Environments/Platforms: Linux, Android Framework, Android Kernel
Languages: Korean (Native), English (Near-native)

PROJECTS

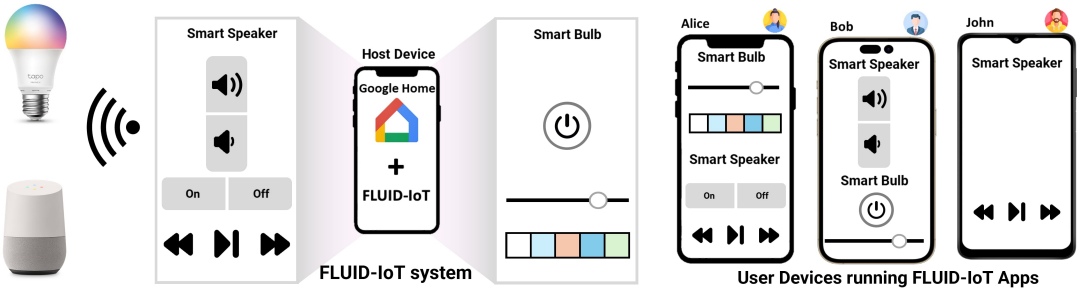
MobileGPT: Augmenting LLM with Human-like Memory for Mobile Task Automation **2024**

- To appear in MobiCom '24 (First Author)
- The advent of large language models (LLMs) has opened up new opportunities in the field of mobile task automation. Their superior language understanding and reasoning capabilities allow users to automate complex and repetitive tasks. However, due to the inherent unreliability and high operational cost of LLMs, their practical applicability is quite limited. To address these issues, this paper introduces MobileGPT, an innovative LLM-based mobile task automator equipped with a human-like app memory. MobileGPT emulates the cognitive process of humans interacting with a mobile app—explore, select, derive, and recall. This approach allows for a more precise and efficient learning of a task's procedure by breaking it down into smaller, modular sub-tasks that can be re-used, re-arranged, and adapted for various objectives. We implement MobileGPT using online LLMs services (GPT-3.5 and GPT-4) and evaluate its performance on a dataset of 185 tasks across 18 mobile apps. The results indicate that MobileGPT can automate and learn *new* tasks with 82.7% accuracy, and is able to adapt them to different contexts with near perfect (98.75%) accuracy while reducing both latency and cost by 62.5% and 68.8%, respectively, compared to the GPT-4 powered baseline.



FLUID-IoT: **2023**
Flexible and Fine-Grained Access Control in Shared IoT Environments via Multi-user UI Distribution

- Published in CHI '24 (Co-First author)
- The rapid growth of the Internet of Things (IoT) in shared spaces has led to an increasing demand for sharing IoT devices among multiple users. Yet, existing IoT platforms often fall short by offering an all-or-nothing approach to access control, not only posing security risks but also inhibiting the growth of the shared IoT ecosystem. This paper introduces FLUID-IoT, a framework that enables flexible and granular multi-user access control, even down to the User Interface (UI) component level. Leveraging a multi-user UI distribution technique, FLUID-IoT transforms existing IoT apps into centralized hubs that selectively distribute UI components to users based on their permission levels. Our performance evaluation, encompassing coverage, latency, and memory consumption, affirm that FLUID-IoT can be seamlessly integrated with existing IoT platforms and offers adequate performance for daily IoT scenarios. An in-lab user study further supports that the framework is intuitive and user-friendly, requiring minimal training for efficient utilization.



MixMax: **2023**

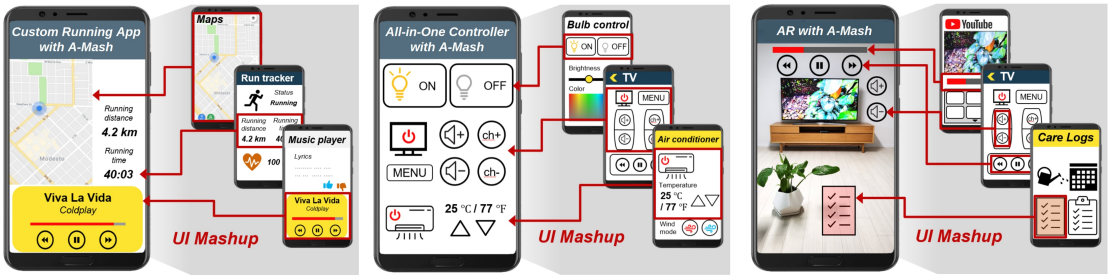
Leveraging Heterogeneous Batteries to Alleviate Low Battery Experience for Mobile Users

- Published in Mobisys '23
- Despite the physical advance of an existing single-cell battery system, mobile users are still suffering from low battery anxiety. With a careful analysis of users' battery usage behavior collected for 19,855 hours, we propose a heterogeneous battery system, MixMax, consisting of three complementary battery types tailored to minimizing the low battery time. While composing a heterogeneous battery system opens up a chance to simultaneously improve the capacity and the charging speed, one must face non-trivial challenges to determine the ratio of enclosed batteries and charge/discharge policies during the run-time. They are highly dependent on each other, which entails almost infinite candidates for the choice. MixMax gracefully unwinds the dependencies as it formulates the decision making problem into an optimization problem and decomposes it into multiple sub-problems instead. To evaluate MixMax, we fabricate coin-cell batteries and experiment with them to model an accurate battery emulator which sophisticatedly reproduces the dynamics of battery systems. Our experimental results demonstrate that MixMax can reduce the low battery time by up to 24.6% without compromising capacity, volume, weight, and more importantly, users' battery usage behavior. In addition, we prototype MixMax on a smartphone, presenting the practicality of MixMax on mobile systems.

A-Mash: **2022**

Providing Single-App Illusion for Multi-App Use through User-centric UI Mashup

- Published in MobiCom '22 (First Author)
- Principle investigator
- Mobile apps offer a variety of features that greatly enhance user experience. However, users still often find it difficult to use mobile apps in the way they want. For example, it is not easy to use multiple apps simultaneously on a small screen of a smartphone. In this paper, we present A-Mash, a mobile platform that aims to simplify the way of interacting with multiple apps concurrently to the level of using a single app only. A key feature of A-Mash is that users can *mash-up* the UIs of different existing mobile apps on a single screen according to their preference. To this end, A-Mash *1)* extracts UIs from unmodified existing apps (*dynamic UI extraction*) and *2)* embeds extracted UIs from different apps into a single wrapper app (*cross-process UI embedding*), while *3*) making all these processes hidden from the users (*transparent execution environment*). To the best of our knowledge, A-Mash is the first work to enable UIs of different unmodified legacy apps to seamlessly integrate and synchronize on a single screen, providing an illusion as if they were developed as a single app. A-Mash offers great potential for a number of useful usage scenarios. For instance, a user can mashup UIs of different IoT administration apps to create an *all-in-one* IoT device controller or one can mashup today's headlines from different news and magazine apps to craft one's own news headline collection. In addition, to further explore the effectiveness of A-Mash, we extended A-Mash's interaction space to an AR environment, in which users can map UI elements of different mobile apps to physical objects inside their AR scenes. Our evaluation of the A-Mash prototype implemented in Android OS demonstrates that A-Mash successfully supports the mashup of various existing mobile apps with little or no performance bottleneck. We also conducted an in-depth user study to assess the effectiveness of the A-Mash in real-world use cases.



It is Okay to be Distracted: **2022**

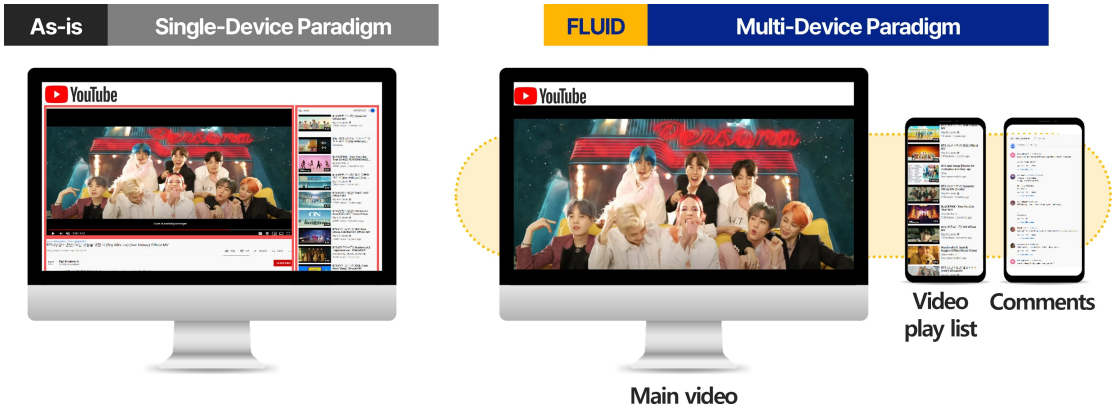
How Real-time Transcriptions Facilitate Online Meeting with Distraction

- Published in CHI '23
- Online meetings are indispensable in collaborative remote work environments, but they are vulnerable to distractions due to their distributed and location-agnostic nature. While distraction often leads to a decrease in online meeting quality due to loss of engagement and context, natural multitasking has positive tradeoff effects, such as increased productivity within a given time unit. In this study, we investigate the impact of real-time transcriptions (i.e., full-transcripts, summaries, and keywords) as a solution to help facilitate online

meetings during distracting moments while still preserving multitasking behaviors. Through two rounds of controlled user studies, we qualitatively and quantitatively show that people can better catch up with the meeting flow and feel less interfered with when using real-time transcriptions. The benefits of real-time transcriptions were more pronounced after distracting activities. Furthermore, we reveal additional impacts of real-time transcriptions (e.g., supporting recalling contents) and suggest design implications for future online meeting platforms where these could be adaptively provided to users with different purposes.

FLUID-XP: flexible user interface distribution for cross-platform experience **2019 – 2021**

- Published in MobiCom'21 (First Author)
- Being able to use a single app across multiple devices can bring novel experiences to users in various domains including entertainment and productivity. For instance, a user of a video editing app would be able to use a smart pad as a canvas and a smartphone as a remote toolbox so that the toolbox does not occlude the canvas during editing. However, existing approaches do not properly support the single-app multi-device execution due to several limitations, including high development cost, device heterogeneity, and high-performance requirement. In this paper, we introduce FLUID-XP, a novel cross-platform multi-device system that enables UIs of a single app to be executed across heterogeneous platforms, while overcoming the limitations of previous approaches. FLUID-XP provides flexible, efficient, and seamless interactions by addressing three main challenges: i) how to transparently enable a single-display app to use multiple displays, ii) how to distribute UIs across heterogeneous devices with minimal network traffic, and iii) how to optimize the UI distribution process when multiple UIs have different distribution requirements. Our experiments with a working prototype of FLUID-XP on Android confirm that FLUID-XP successfully supports a variety of unmodified real-world apps across heterogeneous platforms (Android, iOS, and Linux). We also conduct a lab study with 25 participants to demonstrate the effectiveness of FLUID-XP with real users.



FLUID: Flexible User Interface Distribution for Ubiquitous Multi-device Interaction **2019**

- Published in MobiCom'19 (Best Paper Award🏆)
- The growing trend of multi-device ownership creates a need and an opportunity to use applications across multiple devices. However, in general, the current app development and usage still remain within the single-device paradigm, falling far short of user expectations. For example, it is currently not possible for a user to dynamically partition an existing live streaming app with chatting capabilities across different devices, such that she watches her favorite broadcast on her smart TV while real-time chatting on her smartphone. In this paper, we present FLUID, a new Android-based multi-device platform that enables innovative ways of using multiple devices. FLUID aims to i) allow users to migrate or replicate individual user interfaces (UIs) of a single app on multiple devices (high flexibility), ii) require no additional development effort to support unmodified, legacy applications (ease of development), and iii) support a wide range of apps that follow the trend of using custom-made UIs (wide applicability). Previous approaches, such as screen mirroring, app migration, and customized apps utilizing multiple devices, do not satisfy those goals altogether. FLUID, on the other hand, meets the goals by carefully analyzing which UI states are necessary to correctly render UI objects, deploying only those states on different devices, supporting cross-device function calls transparently, and synchronizing the UI states of replicated UI objects across multiple devices. Our evaluation with 20 unmodified, real-world Android apps shows that FLUID can transparently support a wide range of apps and is fast enough for interactive use.