Research

Pioneering advancements in Human-Computer Interaction (HCI) offer the potential to revolutionize the dynamics of human-technology interactions. Ranging from refining user interfaces to developing inclusive accessibility solutions, HCI constitutes a critical component of today's technology-driven society. In the past three years, my role as a Research Software Engineer at Microsoft Research has immersed me in forefront research, tackling intricate challenges within HCI. The imperative of designing intuitive interfaces and harnessing cognitive models for elevated user experiences has fueled my aspiration for an in-depth comprehension of HCI. This professional trajectory has not only kindled my zeal for crafting seamless user interactions but has also solidified my determination to probe deeper into the intricacies of this domain. Driven by an unwavering dedication to make substantial contributions to ongoing research pursuits, I am unequivocally oriented towards pursuing a Ph.D. in Computer Science, with a specialized emphasis on Human-Computer Interaction.

Building upon this foundation, my pursuit of a **Master's degree in Computer Science at UW Madison** over the past two years has afforded me the opportunity to delve extensively into the intricacies of Human-Computer Interaction (HCI). The program's rigorous coursework, coupled with invaluable interactions with esteemed faculty, has provided me with invaluable perspectives and further fortified my dedication to this dynamic field. This immersive academic journey has not only heightened my technical proficiency but has also finely honed my research skills, equipping me to make meaningful contributions to the realm of HCI. Moreover, during my tenure at the UW Madison, I spearheaded the implementation of a high-performance distributed file transfer system, setting a new benchmark for network efficiency. Leveraging a sophisticated amalgamation of TCP/IP, UDP, and RDMA protocols, we achieved data transfer speeds that significantly surpassed existing systems, marking a substantial leap forward in data transmission capabilities. In a proactive stride towards network security, we designed a multi-layered defense mechanism, reinforcing safeguards against potential threats including DDoS attacks and IP spoofing. Notably, I introduced an innovative security measure termed Rootkit Sentinel, bolstering the network's resilience and serving as a formidable deterrent for potential intruders. In the event of an unauthorized access attempt, Rootkit Sentinel autonomously initiates a potent countermeasure, triggering a targeted wipe of critical data and discreetly embedding itself within the system's startup folder, rendering detection and removal a formidable task. This dual-pronged security approach not only underscores my proficiency in network protocols and security but also emphasizes my dedication to advancing cutting-edge cybersecurity solutions. This project stands as a seminal milestone in my journey towards making substantive contributions to the field of Human-Computer Interaction.

From the onset of my undergraduate studies, I exhibited a penchant for formulating inventive solutions to address substantial real-world challenges. This intrinsic drive led me to a pivotal internship at **Microsoft Research**. In this capacity, I made significant contributions to the development of Green Corridors tailored to critical emergency vehicles such as Ambulances and Fire Engines. The focal point revolved around architecting an IoT system characterized by both dependability and cost-effectiveness while upholding critical parameters including heat dissipation, power consumption, packet integrity, and transmission latency. Our collective endeavors culminated in a functional prototype, complemented by an intuitive online dashboard. Rigorous testing protocols and subsequent endorsement by the esteemed **Indian Institute of Science (IISc)** substantiated the efficacy of our solution. Notably, our work garnered commendation at the 10th International Conference on Ambient Systems, Networks, and Technologies, and further triumphed in distinguished hackathons including **MIT Grand Hack**. In 2016, our project

secured selection for presentation at the esteemed IoT World Congress in Fira de Barcelona. Subsequently, I had the privilege of presenting this endeavor to Mr. Norm Judah, Chief Technology Officer of Microsoft, who evinced keen interest in our work and commended our concerted efforts. This immersive project experience not only refined my research methodologies but also positioned me to mentor subsequent cohorts of interns in their own projects, a number of which culminated in notable publications.

This enriching trajectory culminated in a six-month research internship at Microsoft Research, where I made substantial contributions to the Massively Empowered Classroom (MEC) project—a flagship initiative within Microsoft Research. Beyond the automation of problem statement generation and solutions within the domain of Theory of Computation, I conceived and executed algorithms that not only produced but also assessed these questions based on automata state complexity. A noteworthy aspect of this algorithm lay in its ability to differentiate adept annotators from potential malicious users and spammers, a development that markedly amplified its effectiveness. This achievement prompted the project's integration onto Azure, broadening its accessibility. Subsequently, I undertook the task of transmuting this research into a cross-platform application compatible with both iOS and Android platforms. The successful implementation of this project in universities across India, coupled with its highly favorable reception, underscored its pragmatic value. This endeavor also afforded me the opportunity to collaborate closely with eminent researchers from Microsoft Research and IISc.

Impressed by my contributions during my internship, Microsoft Research extended my tenure as a Research Software Engineer. In this capacity, I embarked on research endeavors for the BlendNet project under the expert guidance of senior researchers. BlendNet, an end-to-end last-mile infrastructure project, entailed the deployment of a scalable, location-based content sharing network. This pioneering innovation empowered users to access content either from nearby kiosks or through other seeders via local Wi-Fi. Although initially met with a modest 8% adoption rate, a rigorous process of debugging, coupled with comprehensive analysis and innovative solutions, significantly amplified its performance and robustness. Through leading numerous pilot studies involving college students and farmers, complemented by meticulous ethnographic analysis, I succeeded in elevating the adoption rate to an impressive 98%. My contributions merited me the privilege of presenting Blendnet at the Technical Advisory Board (TAB), an esteemed event at Microsoft Research where noteworthy projects are showcased to dignitaries from Microsoft Research worldwide, as well as esteemed Professors from elite universities. The project further culminated in a successful collaboration with a prominent media house, resulting in its deployment in the market and reaching over 20 million active users. Witnessing the featured presentation of my research work on the Microsoft Research blog has been immensely gratifying.

I was extensively involved in a project of significant societal impact - "Augmented Reality for Visually Impaired Cooking (AR & Accessibility)." This innovative venture aimed to address the unique challenges faced by visually impaired individuals during culinary activities. Leveraging the advanced capabilities of the Meta Quest Pro platform, we developed an accessible Augmented Reality solution that provided real-time assistance in the kitchen. This endeavor not only showcased my proficiency in Human-Computer Interaction and computational modeling but also underscored my ability to collaborate across interdisciplinary teams, ensuring a user-centric design approach.

Another substantial initiative I led was the "Samaritan" project, which focused on imbuing humanoid robots with emotional recognition and object identification capabilities. This development enabled multilingual communication in English, Korean, Spanish, and Hindi, thereby revolutionizing human-robot interaction, particularly in critical domains like healthcare and education. Overseeing the integration of diverse technologies and coordinating the software implementation process, I played a pivotal role in the success of this project.

Additionally, I embarked on a substantial undertaking involving the design, development, and training of a large-scale generative language model tailored for intelligent customer service applications. This endeavor harnessed advanced Natural Language Processing (NLP) and Machine Learning (ML) techniques to enhance the model's capabilities. The resulting language model was adept at comprehensive language comprehension, facilitating tasks such as intention identification and emotion recognition. Furthermore, I implemented algorithms for the classification of videos based on content and associated hashtags, streamlining content organization.