

### Statement of Purpose

My academic and career objectives are focused on making significant contribution in the area of Intelligent Systems, which can create effective relationship between technology and human life by leveraging techniques from Human-Computer Interaction (HCI) and Artificial Intelligence (AI). I believe that the Department of Computer Science of University of Illinois at Urbana Champaign (UIUC) is one of the best places for me to fulfill my objectives. My goal there will be to flourish intellectually and to make a significant contribution to research through my PhD dissertation.

I possess an intense interest of research which has been nourished during my undergraduate studies and teaching period at Bangladesh University of Engineering and Technology (BUET), the top engineering school in Bangladesh. To enhance my research, I have formed here the **Human-Technology Interaction Research Group** (<http://htibd.org>) with a number of undergraduate students. The challenges that I faced while devising effective technologies for people, have inspired me to pursue a PhD in Computer Science. I have recently got the **International Fulbright Science and Technology Award** which has boosted up my confidence.

In my PhD, I am particularly interested to continue my current works in the general area of HCI and AI. Recently, I have been working on devising effective systems for the autistic children to help their socialization. While working on this, I felt the lack of a system that could learn their emotions from their speech, expressions, gestures and behavior properly. Hence, as a PhD student of UIUC, I would like to focus on building intelligent systems that are perceptive to user's emotion and able to respond appropriately. I am particularly interested in working with **Profs. Karrie G. Karahalios, Brian P. Bailey, and Jiawei Han**, as I believe that my background and expertise will allow me to contribute the most to their projects.

I first got the opportunity to work on autism as I volunteered to work with one of the graduate students of the **Affective Computing Group** of **MIT Media Lab** in Dhaka in January of 2010. This project was supported by **IEEE Gold Humanitarian Award, MIT Public Services Grant, and One Laptop Per Child (OLPC)**. The goal of the project was to help people diagnosed with autism with their speaking problems by designing a set of speech enabled computer games. As a part of the team, I helped to customize a number of "Racing Games", where the participants had to speak louder in order to control an object (e.g. car, boats, ships etc.) in a game. **Autism Welfare Foundation (AWF)**, Dhaka, one of the premier institutions for autism, provided us resources to conduct this pilot study. Initial qualitative results, including teachers' and parents' feedback, as well as quantitative measures, seemed very encouraging. Our pilot study was featured in the premier national daily of Bangladesh, "The Daily Star", on the "World Autism Awareness Day", April 2, 2010.

The success of the pilot inspired me to advance toward a *Computer Game-based Speech Therapy* for the autistic children. First I conducted a survey on the frequent speech disorders found among the autistic children of the special schools of Dhaka. Then, with my group, I started developing interactive computer games addressing those disorders. Using the speech-to-text conversion techniques, we developed a game which could help the autistic children to utter a word "intelligibly". In this game the players had to pronounce the names of some objects clearly to get the virtual rewards. This game soon became popular among the children of AWF and we found rapid improvement in the speech of the participants. However, the poor performance of the speech recognition process compromised its scope. Later, we solved that problem by introducing a human judge in the game. Our papers on these have been accepted for publication in the *IEEE Workshop on Multimedia Technologies for E-Learning (MTEL '10)* and *ACM Symposium on Applied Computing (SAC '11)*. We are currently extending our works by developing a game that helps children to make a complete sentence in a similar process.

For helping children in taking trivial turns while taking part in a verbal conversation, I am trying to develop a system that can automatically detect questions, exclamations and end-of-speech in a running conversation from the patterns of wave-shapes of one's speech. So far, my program can successfully detect the deliberate longer pauses. While processing the stream of speeches, I am facing challenges to handle different intonations, unintelligible sounds, partially uttered words, and external noise. I would investigate the practical solutions of these problems in my graduate research. Again, interrupts, overlaps and backchannels are also very common in a spontaneous conversation. This makes it challenging to establish whether a speaker is really prepared to relinquish the floor when he or she produces a silent pause. Hence, I am interested in analyzing large corpora for studying the frequency and distribution of temporal phenomena in conversational dialogues.

Personalization of the learning environment is very important for autistic children. In our pilot, the games were initially designed using *Scratch*, an open-source game making tool, developed by MIT Media Lab. This allowed rapid customization of the games to incorporate preferences of each participant. The ease of adding different *Sprites* (characters) in *Scratch* inspired us to think of designing Virtual Reality (VR) for the autistic children with this. This would allow us to propose VR-based therapies for autistic children which could be easily customizable according to their preferences. For example, in a multi-modal conversation, turns are influenced by some signals, such as eye-gaze, physical gestures. Hence, if we can incorporate eye-tracking, head nods, facial expression, etc. in the customized virtual world of the autistic children, it will help their socialization.

Again, providing a personalized environment for everyone in a larger group, as in a classroom, is difficult for a teacher. Addressing this, we developed a software named “*A-Class*”, which worked on an already built database of users’ preferences. Now, I am trying to improve this software by adding a feature that learns users’ preferences from their behavior (type of responses, speed and sequence of keystrokes and mouse-moves, etc.). I am also in the process of extending my work to investigate synchronization between speech and other modalities, for example, eye-tracking, facial expression, and head nods. This would also allow me to detect the abnormal behavior and could be used for diagnosing autism. However, the real-time computation for mining behavioral pattern from a large chunk of activity log is a challenging task which I would like to explore in detail during my PhD.

Besides autism, I have also worked in developing location based services. I have launched the “*MapBangladesh*” project for making open maps for our country with the help of the *International OpenStreetMap Foundation*. In June 2010, I got the *OSI Travel Scholarship* to represent Bangladesh in their annual meeting, *State of the Map (SotM)* in Spain. I presented my works on maps there.

During my senior year at BUET, I worked in the area of Computational Geometry for my undergraduate thesis. In a group of two, I accepted the principal responsibility for devising techniques that optimize the cutting cost of a geometric shape out of another. I presented our work at the *Japan Conference on Computational Geometry and Graphs (JCCGG)* in 2009. Our paper was invited to the special issue of *Graphs and Combinatorics* of Springer.

As a PhD student of UIUC, I would like to extend my works on emotion and intelligent systems. I wish to work in the projects where recognizing users’ emotional responses will make the systems more personable and interactive. I am interested in projects like “*A3*”, “*Voice Space*”, “*Conversation Clusters*”, “*Creativity Support Tools*”, “*Mining Moving Objects, Trajectories, RFID, and Traffic Data*”. In fact, I find most of the projects of *Social Space* and *Orchid Labs* very interesting and suitable for me.

I feel that the works I have done so far have given me a sound foundation in HCI and AI, which will help my development as a PhD student at UIUC. I have always wondered whether there is a universal pattern in behavior across cultures and genders for emotion. Also, I always inquired whether there is a proper normalization schema for certain behavior to account for cultural and gender differences. I would like to address these issues in my PhD dissertation with an effort to making a significant contribution to Affective Computing, Behavioral Targeting, Reality Mining, and Social Intelligence. Therefore, I am submitting my application to be considered as a PhD student of UIUC.

Please feel free to visit my online portfolio at <http://kallol.echoz.com> to view my research, publications and other scholastic achievements.