Statement of Purpose

Introduction

I wish to pursue the direct PhD program in Design in the Mechanical Engineering Department at Purdue University. My research interest broadly lies in the field of Systems Engineering with special interest in **Product Design and Computational Design.**

Research Interest and Motivation

Product design and development has provided users with products and technology that can be seamlessly incorporated in our everyday lives. I am intrigued by the fact that the utilization of computational tools in design methodologies augments the cognitive and analytical abilities of designers, allowing them to propose and evaluate new ideas rapidly and effectively. These tools have not only improved the system efficiency and product quality but have also allowed new perspectives towards the design process itself thereby impacting the approach of a design team. This is most evident with the modern immersive interfaces which allow us to virtually visualize products that would have been difficult to visualize otherwise. These can then be made with rapid prototyping machines like 3D printers thereby easily allowing virtual objects to become a reality.

It would be challenging and rewarding for me to envisage processes beyond the obvious and investigate and explore the very fabric of the design methods used so that we can interweave designers, users and products into one successful system. In general, our social objective should be to create user friendly technological advancements that allow a seamless integration of user expectations with the design and final manufacture of products that people would want. I am fascinated by this field and challenges it possesses to innovate products by improving our understanding of design methodologies that could change the way we function.

Academic and Research Background

My own experience with research began when I applied to the interdisciplinary Smart and Sustainable Environment Laboratory (SSEL) in Korea Advanced Institute of Science and Technology (KAIST) South Korea for my post-sophomore year summer internship. Under the guidance of Professor Seongju Chang, a visiting scientist at MIT Media Labs, I was exposed to the idea of a reconfigurable space concept design to address the problem of space management. This first research experience allowed me to involve myself in the concepts of urban design planning and management. I was required to conceptualize the design of a house which could transform itself to create a ubiquitous and smart space. I learnt the art of visualization and was allowed to imaginatively explore the customization of several household objects like the kitchen table, shower booth and sink so that they can dynamically compose and decompose themselves. By extensive literature review, I learnt how the field of design, architecture and electronics can synergistically produce modern living spaces addressing the problem of space management. I also learnt the importance of systematic documentation as it helped me manage a multifaceted project with ease. The internship, most importantly, introduced me to the beautiful field of design and enabled me to generate ideas to develop interfaces that provide immersive experience to the user.

In my junior year, to thoroughly explore my research interests I participated in the **Annual Indo-German Winter Academy 2012,** supported by the prestigious **Erasmus Mundus scholarship,** for the course of Modelling and Algorithms for Fluid Dynamics and Heat Transfer. It was an intellectually enriching experience, meeting the top level faculties and undergraduates from India and Europe. During the course there were instances when the importance of the design of cricket balls, wind tunnels and even the design of various simulation softwares helped me appreciate the omnipresence of the field of design in every other research area. It was then that I realized that I had started perceiving research through the standpoint of design. I therefore, started exploring various other design disciplines like systems design, product design and interaction design. After reading extensively about various design disciplines I was left captivated by the field of **Systems Engineering and Design.**

The concept of visualizing complex systems through manifestations of design and applying fundamentals to model real life problems resonated with me.

Soon, I applied to the Collective Systems Laboratory (ColSys Lab) at Purdue University, Indiana, USA for a post-junior year summer internship. In the project, guided by Professor Jitesh Panchal, customization of products is seen as a system reanalysis. The idea was to develop an interface that would execute an efficient system reanalysis or in other words to understand if customization could help in product development. Essentially the work was focused on researching reanalysis methods to update the stiffness matrix inverse generated in the finite element method without its recalculation from scratch. My post-junior year internship experience tested and strengthened my mathematical knowledge exhaustively. I learnt various numerical methods and optimization techniques to recalculate matrix inverse. I chose to continue my post-junior year summer internship project as my final year Bachelors Thesis Project (BTP) as I would like to delve further into product development and design.

Long term goal

These research experiences have allowed me to explore and expand both my academic and non-academic boundaries. I have enjoyed researching in the domain of design and it brings me immense satisfaction to interact with and to be able to effectively describe my thought processes to others. As the students head in high school and also later in college as a senior mentor I gave various motivational lectures to students where I was able to impress upon them how formalized coursework can develop deeper insights. Thus, the prospect of being able to explain course fundamentals well to others and to be able to simultaneously do research in the domain of design, made me consider becoming an academician as a suitable career option.

Motivation to pursue graduate school at Purdue University

I strongly believe that an unconstrained environment is important for a student to pursue research with the broader aim of becoming an independent researcher. Experiencing the multicultural environment of Purdue University and its research culture made me consider applying back to this prestigious university. Consistent with my research experiences and my long term objectives, I believe that I would like to pursue a doctorate degree by doing design research in the field of systems engineering. I thoroughly believe that I am fortunate to share the same vision as that of the Collective Systems Laboratory in the Mechanical Engineering Department, Purdue University. With Prof.Panchal already as my advisor during my junior year internship and now for my BTP, I believe it would be an honour for me to pursue my doctorate degree under his supervision.

Conclusion

I believe I have the right attitude and aptitude to pursue research. I have always been sincere as a student and my current academic record reflects this well. I am currently ranked 4^{th} in class of 83 students with a GPA of 9.12 on a scale of 10. I have always aimed towards a holistic development by maintaining a balance between the creativity of a designer and the problem solving capability of an engineer. Therefore, I sincerely believe that I am ready to accept the challenges and responsibilities associated with graduate studies at Purdue University as I am wholly motivated to learn from every experience linked with both the campus and its people. I am looking forward to gaining admission to the direct PhD program in the Mechanical Engineering Department with full financial assistance and I reflect that this education might transform the way I think and feel about teaching, learning and most importantly, myself.

Thank you for considering my application.

Murtuza Shergadwala