

Study/ Research Objectives

The scarcity of easily accessible and dependable healthcare is a major problem in Pakistan. A 2013 study [1] of 93 public health facilities in Sindh province revealed that most healthcare facilities were severely underequipped to provide quality critical care. Furthermore, it was concluded that combined with a gap in physician knowledge, this hindered the delivery of effective care to patients. Therefore, there is an urgent need to develop sustainable systems that can assist doctors by providing actionable information for rapid diagnosis and decision-making of patients.

To help alleviate this situation, I aim to pursue a doctorate degree (PhD) in Electronic/Electrical and Computer Engineering focusing on the multidisciplinary field of Health Informatics, which encompasses the areas of signal processing and machine learning to solve emerging problems in healthcare. Specifically, I intend to use Intensive Care Unit critical care data and Electronic Health Records (EHRs) to probe bio-markers that aid healthcare personnel in rapid diagnosis and decision-making. The proposed work aims to take advantage of recent developments in the fields of machine/deep learning and cutting edge signal processing to target developing solutions for technology based healthcare. It is anticipated that in the long run, tangible improvements in diagnostic trends and earlier clinical interventions through such systems will help reduce national morbidity and mortality rates, and decrease the patient burden on the already floundering healthcare system.

It may be noted that critical care has also been receiving attention in developed countries, including the U.S., due to an increasing burden on healthcare facilities associated with an ageing population. During my doctoral studies, I intend to work with doctors in American hospitals involving the collection of critical care data while adhering to requisite ethical and medical protocols. This will involve continuous feedback from health professionals involved in intensive care of patients. From thereon in, I will develop, apply and experiment with signal processing and machine learning algorithms that can be used to identify relationships within the aforementioned critical care parameters to identify a generalized, standardized and validated set of bio-markers that can be used by doctors for health assessment. The idea is to learn/establish a framework that will enable me to eventually customize a model applicable to data collecting/processing in Pakistan.

My undergraduate major in Electronic Engineering provides me with the necessary background in signal interpretation and processing as well as hardware that is necessary in such health-related measurement tasks. Moreover, after returning from my postgraduate education in 2013, I have embarked upon combining signal processing and machine learning to work on developing algorithms that cater to a variety of problems. In this regard, my previous research work has included Driver Drowsiness Detection for Advanced Driver Assistance Systems, Activity Recognition from inertial sensors and developing embedded systems for health monitoring. Lately, I have carried out work on the detection & immediate classification of arrhythmias from electrocardiograms (ECGs), and am currently working on applications of machine learning for critical care signal determination to further prepare myself for the proposed course.

The doctoral degree would enable me to not only achieve my goals as an academic but acquire the experience and expertise needed to utilize these techniques to solve problems in related fields. Furthermore, in line with my aim to initiate telemedicine systems in our country, I will collaborate with doctors from Liaquat University of Medical and Health Sciences – a neighbor medical university/tertiary care hospital – to collect data from patients and cooperate with the United States Agency for International Development (USAID) and other bodies to set up telemedicine healthcare facilities based on the framework developed during my PhD studies.

As a keen advocate of taking technology out of the lab and into the home, I believe many of the problems our country faces can be solved via solutions devised through locally developed technology. Besides enabling me to develop technical skills, a PhD degree from the U.S. would provide me with exposure to the very strong academia-industry environment that has resulted in startups being launched by students in US universities. In this regard, I want to come back with a toolbox of cohesive skills and fine tune my mind such that thinking out of the box becomes the norm, and thereby serve my people from beyond delivering lectures in the classroom and out into the real world as I believe I have the preliminary ability to make this happen.

References:

[1] Razzak, J.A. et. al, 2013. Emergency and trauma care in Pakistan: a cross-sectional study of healthcare levels. *Emergency Medicine Journal*, emermed-2013.