ABSTRACT

EXPLAINABLE RETINAL SCREENING WITH SELF-MANAGEMENT SUPPORT TO IMPROVE EYE-HEALTH OF DIABETIC POPULATION VIA TELEMEDICINE

Jannatul Ferdause Tumpa, M.S.

Marquette University, 2021

Diabetic Retinopathy (DR) is one major complication of diabetes and is the leading cause of blindness worldwide. Progression of DR and complete vision loss can be prevented by keeping diabetes in control and by early diagnosis through annual eye screenings. However, cost, healthcare disparities, cultural limitations, lack of motivation, etc., are the main barriers against regular screening, especially for a few ethnically and racially minority communities. On the other hand, to well-manage and control diabetes, the diabetic population needs to be physically active and keep their weight healthy. From the perspective of Behavioral Science, some self-management techniques based on motivational interviewing can be utilized to motivate people to take preventive and mandatory measures to control diabetes. However, behavioral science is still deprived of technology’s progression and is not sufficiently available to healthcare providers who work with the diabetic population. Thus, collaborative teamwork of Computer Science and Behavioral Science is contemporary to improve eye health and the overall health of the diabetic population.

In this dissertation, we have proposed and designed a community telemedicine framework connecting our clinicians with community partners to organize retinal screenings in community settings rather than traditional clinical settings. Secondly, automating the initial retinal screenings utilizing Deep Learning models, particularly Convolutional Neural Network (CNN), can reduce ophthalmologists’ workload and cost of screening. However, such Machine Learning models lack transparency and cannot explain how these models make particular decisions. We have developed an explainable retinal screening model to facilitate the recommended annual screening to overcome this limitation. Finally, we have designed and developed a computer-aided Action Planning (CAP) tool to motivate the diabetic population to adopt healthier behaviors through Brief Action Planning, a self-management support technique. Through several feasibility studies, it is evident that the combined contributions of this dissertation can help prevent vision loss from diabetes to a great extent.