

Chapter 14

Deep Learning and Sustainable Telemedicine

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ABSTRACT

The need for healthcare is increasing on a global scale. The lack of medical professionals available to fill this need has increased interest in deep learning and sustainable telemedicine technologies. Telemedicine has been shown to be financially beneficial to both patients and healthcare facilities, provided that government regulations and insurance companies recognize them as a reimbursable expense. Advancements in cloud computing, deep learning, and telemedicine are creating a global standard for healthcare, and at the same time increasing the need for these services.

INTRODUCTION

The use of telemedicine in the healthcare industry has been around for over a century. Since the introduction of long-distance communication methods such as the radio and the telephone, telemedicine has been used by doctors to assist patients in regions where medical personnel are scarce. As communication technology improved, so did telemedicine. The introduction of the Internet has drastically improved a person's ability to receive medical treatment without visiting a healthcare facility. As of 2016, 47% of the world's population has access to the Internet, which is a 4% increase over the previous year (Taylor, 2016). The growth of Internet capable devices such as desktops, laptops, smartphones, and tablets has drastically increased a person's ability to use telemedicine.

Telemedicine is on the rise as telehealth services are becoming increasingly available to patients across the U.S. FAIR Health, a nonprofit organization, drew on its database of over 25 billion privately billed claim records to develop the FH Healthcare Indicators resource, which evaluates changes in demographics, utilization, diagnoses, procedures and costs. The report showed that from 2011 to 2016, telehealth service use increased substantially, especially in rural areas (960 percent). In comparison, telehealth use grew by 629 percent in urban areas, and by 643 percent nationally. However, more recently urban us-

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age has grown to match and even surpass rural usage. Between 2015 and 2016, urban areas saw a jump from just over 25 percent to over 45 percent, while rural growth increased from 35 percent in 2015 to just over 40 percent in 2016 (Fair Health, 2018).

Machine learning and artificial intelligence have many exciting applications in the medical field in general. IBM Watson Health program is able to analyze millions of pages of medical information within nanoseconds, and draw conclusions that can be used for diagnosis, comparison and recommendation. The enormous power of supercomputers to search through large volumes of data is combined with analytical and decision-making prowess in machine learning and artificial intelligence technologies (Hoyt, Snider, Thompson, & Mantravadi, 2016). Beyond just dealing with information, though, machine learning and artificial intelligence can also bring new capabilities to patient examination. For example, in radiology, machine learning algorithms can look at radiology scans and other resources to find evidence of outcomes and realities that can guide human decision-makers (Sennaar, 2019a).

There are also other formative examples of the power of machine learning and diagnosis in telemedicine. National Institute of Health provides automated analysis of retinal imaging, which can help detect certain types of sight loss linked to diabetes (Sim, Keane, Tufail, Egan, Aiello, & Silva, 2015). Google also teams up with National Health Service in UK to use Google DeepMind to help spot early signs of eye conditions that human eye care experts might miss at Moorfields Eye Hospital. Specifically, Moorfields is applying DeepMind's algorithms to 1 million anonymous OCT (Optical Coherence Tomography) scans. The aim is to determine whether the algorithms can learn to spot early signs of age-related macular degeneration and sight loss that occurs as a result of diabetes (Shead, 2017). NIH or NHS can save those diagnoses and OCT scan images in their repositories for future research and preventive treatment (Sim et al., 2015; Shead, 2017).

Recently, advancements in machine learning have brought about the creation of deep learning. The use of machine learning and deep learning with decision support tools have significantly improved a medical professional's ability to accurately diagnose and treat patients within a minimal amount of time. Combining deep learning with telemedicine will create opportunities for a vastly larger portion of the population to receive immediate healthcare without needing to enter a medical facility. Doctors will review it and sign on – instead of being only supported by videoconferencing, doctors will also be supported by key assistive technologies that are thinking and learning on their own (Sennaar, 2019b). As mentioned previously, a deep learning program is an decision support tool for physicians to provide effective healthcare services to telemedicine patients. The goal of deep learning technology is not to replace their jobs. According to a report published in the Physician Leadership Journal, physician leaders projected a 18.5% increase in telemedicine jobs in 2018, compared to 2012 (Anonymous, 2018).

The need for healthcare is increasing on a global scale. Telemedicine services have seen an increase in use to reach locations that would otherwise be unable to support the demand for healthcare professionals. Telemedicine has been shown to be financially beneficial to both patients and healthcare facilities, provided that government regulations and insurance companies recognize them as a reimbursable expense. Deep learning applications such as IBM's Watson and Google's DeepMind have paved the way for software programs to integrate with the healthcare industry. This chapter investigates the application of deep learning technology to sustainable telemedicine in the healthcare industry.

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