Undergraduate Thesis Prospectus

Automated Diagnosis of Melanoma

(technical research project in Computer Science)

Automation in Medicine: The Limits of Medical AI

(sociotechnical research project)

by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.
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General research problem

How can technology best augment professional judgment in healthcare?

Professional judgment is necessary but fallible. Clinicians disagree about where the optimal balance between medical technology and professional medical judgment lies. Medical systems can save hospitals money, but they can also divert resources from important human caregiving responsibilities. In the 2020 coronavirus pandemic, health authorities have demonstrated the use of technology to augment professional judgment. In Germany, public health professionals used GeoHealth, a contact tracing application, to identify and inform individuals who had been exposed to sources of infection. To work, however, about two thirds of the population must activate the app (Klonowska & Bindt, 2020). In this case, technology alone is insufficient.

Automated Diagnosis of Melanoma

How can melanomas be more accurately and cost-effectively diagnosed?

As a student in the Computer Science department, I plan to address this problem by proposing a tool. My project will be independent, and my Capstone advisor is Professor Aaron Bloomfield.

Melanomas are one of the most dangerous types of skin cancer. Thus, it is vital for a potential patient to be diagnosed swiftly. Many lack the resources or time to get a professional opinion in time. Thus, I propose a self-diagnosis tool that uses machine learning to identify melanomas. Eventually, I hope that the tool could predict malignant melanomas with a 90% accuracy. The tool would be a web application hosted on a cloud platform. Because it is not a mobile application, there could be complications when accessing the app on a phone.

Thus far, there exists software that identifies skin cancer with artificial intelligence. One such software, called DERM, detected malignant melanomas with a 92.8% accuracy (Phillips et al., 2019). However, this software is currently not open to the public and not used for self-diagnosis. Additionally, there is no platform nor UI/UX design. There are also self-diagnosis applications that do not use machine learning. However, in these applications, the patient must communicate with a medical professional and the results are not immediate.

The self-diagnosis tool would be an application implemented with Django and deployed with Heroku. The TensorFlow API would then be used to implement deep learning algorithms. If a user of the application has a skin concern, he or she would upload a photo onto the application. To achieve a higher accuracy, the application will analyze previous photographs of melanomas before its release. Thousands of photos of true melanomas and similar skin lesions will be initially examined by the application. The application can then be able to identify melanomas based on previous images. If the application could not diagnose a melanoma based on the previous data, it will analyze an image based on asymmetry, border, color, and diameter of the skin lesion.

If this project succeeds, the software will be released to the public and then further maintained to reduce any false positive or false negative diagnoses.

Automation in Medicine: The Limits of Medical AI

How do physicians, hospitals, insurers, patient advocacies, and medical technology vendors compete to draw the line between legitimate and excessive reliance on medical AI in clinical care?

The proper place of artificial intelligence (AI) and predictive algorithms in medicine is controversial. Medical AI has been useful in the 2020 pandemic; with AI software, coronavirus can now be better diagnosed (Zhang et al., 2020). However, Obermeyer et al. (2019) caution that medical AI can introduce racial and class biases.

Researchers have examined the use of medical AI. Boeldt et al. (2015) found that consumers (40 percent) were more likely to prefer newer diagnostic systems than healthcare providers (14 percent). Obermeyer et al. (2019) found that racial biases encoded in predictive algorithms reduced the chances a Black patient will receive additional patient care from 46.5 to 17.7 percent. Zhang et al. (2020) developed an algorithm that diagnoses novel coronavirus pneumonia with 92 percent accuracy, indicating the value of automated systems in medical diagnostics.

In medicine, the doctor-patient relationship has been the subject of growing attention. Some physicians contend that medical technology has compromised the relationship (Verghese, 2011), to the detriment of healthcare. Others, however, propose that medical AI can restore the relationship (Chen, 2019). Some physicians warn that medical AI can encode and perpetuate discriminatory bias. Dr. Danton Char, assistant professor of anesthesiology, perioperative, and pain medicine at Stanford University Medical Center, contends that "AI and machine learning may worsen the economic and racial disparities already inherent in U.S. healthcare" (Char qtd. in Ward, 2019.) For hospitals, AI can yield cost-efficiency benefits (Blauwet & Bell, 2018). Medical technology companies promote their systems to hospitals. The companies typically claim that medical AI diminishes economic disparities and improves access to care (Nikolava, 2019). The American College of Physicians (ACP), a professional society representing internists, subspecialists, residents, and other medical professionals, is also engaged in the issue.

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