CS5542: Project Proposal

Cognitive Visual Recognition Tracker

By Matthew Velazquez

Motivation

Alzheimer’s is defined as being a progressive mental deterioration that occurs due to generalized degeneration of the brain. This debilitating disorder is the most common cause of dementia among elderly people and there are currently few ways of tracking its impact on a day-to-day basis at home. Mental status exams do exist but are typically only administered by medical staff and are often performed ad-hoc, rather than on a consistent timetable.

With Cognitive Visual Recognition Tracker (or CVRT), this application will allow patients with Alzheimer’s disease to ask questions on given visual stimuli to measure their image recognition capabilities. By leveraging different variables, such as the amount of overall questions or the total repeated questions, metrics can be formed that provide a much clearer overview on the progression of the patient’s disease.

Significance/Uniqueness

While there are many demos available in regards to the topic of Visual Question Answering, very few exist that have applicable results for the medical field. With this in mind, CVRT was designed to build on the existing Visual Question Answering space, but to produce practical, medically relevant data as a result. This application is significant because it provides a unique way to track the progression of Alzheimer’s disease based on image recognition in a more data-driven way than was previously possible.

Objectives

One of the main objectives of CVRT is for physicians to be able to determine trends from patient data that could either be applicable to the individual patient, or to many patients if an aggregate is formed from many individual datasets. On an individual level, these metrics would provide a way for the physician to monitor daily cognitive capability, whereas on a grander scale, these joint datasets could be used to provide better overall treatment for the disease with the future inclusion of predictive analytics. As for short-term advantages, since this monitoring would be implemented daily, delirium can be more quickly identified as it could be the logical result of a sharp drop in image recognition capability.

System Features

* Random pictures are displayed in the application with a question-answer focused interface
* Users can ask questions about those images in order to discover their identities/characteristics. (i.e. What is happening in this picture? Where is this? What item is on the table? etc.)
* Ability to track metrics for the individual patient’s image recognition ability over time.
* Short-term monitoring that can detect delirium and advise for emergent medical treatment.
* Possible ability to import custom images (i.e. A familiar location or relative’s home)
* Possible inclusion to aggregate multiple patients’ data to allow for better predictive analytics

Related Work

In regards to the Visual Question Answering space, similar work has been done related to the questions being asked of an image with answers generated in response. These demos exist online and serve as a form of introduction to the domain itself, however they do not apply to the medical field. There is also research that has been done regarding impaired visual recognition as a way of predicting the onset of Alzheimer’s, but this research has not been leveraged in a deep-learning application.

Backup Project: Home Risk Identifier for Elderly Living

This would assist elderly patients in home placement by scanning images of the future home and identifying items that could be obstacles in their daily living (i.e. stairs, railings etc.)

Bibliography

http://visualqa.csail.mit.edu/

https://www.ncbi.nlm.nih.gov/pubmed/18568983

https://www.ncbi.nlm.nih.gov/pubmed/23572062