Project Proposal: Developing a Dialogue Management System for a Companion Robot for Elderly People with Depression

As of 2016, approximately 15% of elderly people, aged 60 and over, suffer from mental illnesses, most common of which are dementia and depression [1]. Many conditions arising from ageing in America can contribute to new or worsening depression, such as limited mobility, a drop in socioeconomic status from retirement, a disability, and other physical and mental problems. These conditions can lead to loneliness, isolation, and other distresses, which are the main contributors to depression [1]. Many times, the symptoms of depression are ignored or untreated in elderly people because they occur simultaneously with other prevalent problems or because of the stigma attached to depression and its treatments, not to mention the prohibitive cost of some of these treatments. Some symptoms include fatigue, feelings of worthlessness or guilt, impaired concentration, insomnia or hypersomnia, diminished pleasure in activities, and thoughts of death or suicide [3]. In fact, elderly people had the second highest suicide rates in America, though trends in data project that suicide rates of the elderly may overtake the most at risk populations for suicide [4].

The true tragedy of this phenomenon is that mental illnesses, especially depression, are very treatable with high success rates of recovery once treatment has been sought out. Some of the best nonmedicinal treatments for depression are social and physical engagement and talk therapy, which can cost up to $200 per session [1,2]. The goal of this project is to create a dialogue management system for a robot or computer app that would be readily available to talk to elderly people at all times. This will help elderly people feel less lonely, help them to get the social interactions they need, as well as to decrease the stigma of talking to a psychiatrist and reduce the cost of sessions. The objective is not to treat or cure depression, nor should it be an excuse to not seek out help from professionals, rather, this project aims to develop a system that can help prevent and mitigate depression in elderly people specifically due to lack of social interactions.

Currently, there is a fair amount of research being done in socially assistive robots (SAR), to help provide healthcare for the elderly; Intuition Robotics is about to release a companion bot called Elli.Q, to begin a trial phase in February [5], DU's own eBear has recently undergone testing concerning the effects a SAR has on elderly people with depression [6], and DU's robot, Ryan, is currently helping elderly as well as children with autism spectrum disorder (ASD) [7]. With both these robots, much thought has gone into what the robot should do: ask the person it is talking to if he or she would like to exercise, watch a TED talk, or conduct an assessment for their current state of depression [5,6,7]. However, not much research has gone into the actual dialogue management system (DMS) of these robots. For instance, should the robot or computer app be sarcastic, optimistic, or reluctant? When asked for answers to tough questions, should the robot answer cynically, honestly, or try to avoid the question and instead direct the conversation towards lighter topics?

The answer to these questions is obviously quite multifaceted and greatly depends on an individuals' mood, preferences, and needs. However, creating a DMS that could handle all of these criteria would take much longer than just a meager ten weeks, so this project will focus on generalities and larger trends. Starting the second week of June, and going to August, this project has two phases: Research and Implementation. **Phase 1**, Research, shall be conducted by consulting psychiatrists concerning the tone of conversations the DMS will have and observing conversations happening in everyday life, books, and movies in order to gather a comprehensive

collection of topics the DMS can explore. We are also collaborating with Eaton Senior Communities, and I will be able to talk to the seniors and nurses there to create the best plan for the DMS. **Phase 2**, Implementation, will be to modify a working chatbot, ALICE from pandarabots, to be a proactive DMS that implements the research of Phase 1.

I am currently working on the precursor to Phase 2, **Phase 2a** as it were, in which I'm doing a general modification of ALICE to rid it of glaring discrepancies and unfortunate decisions in language. Already, I have found several troubling themes that I believe could potentially disturb an elderly person or any person for that matter. First and foremost, when asked the question "what is life?", the robot responded something akin to "one pointless event after another until it is over". That is certainly not something one wants to hear in daily conversation. Some other themes I've noticed, though not nearly as concerning, is a tendency to recommend medical marijuana for all sorts of ailments, which may not go over well depending on a person's stance on the matter. It also asks how much a person's possessions or desires cost, and whether or not they are getting paid enough to afford said possessions. As a college student, any discussion of money already stresses me out enough, and I'm sure a retired elderly person, with no reliable income, may also be worried enough about money as it is without a robot constantly bringing the topic up. Finally, I've also noticed some racist undertones to things the robot says. Something as overt as "Are you a white man? Can you jump?" when the topic of basketball is brought up, and more subtle undertones, such as suggesting Christianity as the only valid belief system.

Phase 2b will be to make the DMS more sophisticated and proactive. This DMS will differ from other DMSs, such as Siri and Alexa, in the ways it will be proactive; it will engage the user in several of the treatments recommended for depression, such as conducting mental health self-evaluations, engaging in physical activities, talking about themselves, and seeking out community activities [1]. The next level of sophistication for this DMS would be to give it the ability to search the web for questions it has no answers to; a function not currently available on pandorabots, the platform I have been using to create the DMS thus far. It is simple enough in practice: if the DMS doesn't have an answer, it will ask the user if he or she would like to do a web search. If so, the DMS will have a function that will input the user's original question into a web search, and return the first website or a list of websites. This function will allow this DMS to be competitive on the level of other commercial DMSs that almost all have this ability. To create this function, we will use a different platform for the DMS other than pandorabots. This platform is currently being developed by another student in the robotics lab.

It is my hope that this DMS can be implemented in many SARs in the future. Especially after seeing the success of eBear with a less sophisticated dialogue management system, I have great hope that this new dialogue management system will be much more helpful in reducing depression in elderly people. The universality of dialogue management system means that it can be used for many future projects to come at DU; the creators of eBear may even decide to adopt it for their project. If this project is successful, I would be particularly excited to adapt it to be compatible for Ryan, specifically for DU's research on the effect robotic therapies may have on children with ASD.

Sources

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