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PRIMARY RESEARCH OPEN ACCESS

Comparing the Interpretation of Emotion in the Context of Human Experts and Artificial Intelligence

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Abstract
This paper explores the ability of artificial intelligence (AI) to detect or interpret emotions from information provided in the form of text. The study utilizes surveys (profiles) of 10 participants receiving palliative care. The profiles are analyzed manually by human experts and separately by IntenCheck, an AI system, to identify emotions displayed by each profile. The findings of each entity is then compared. This research is preliminary in nature and is the groundwork for forthcoming use of this technology. In the future, this work will incorporate a predictive model once a reliable form of emotion-identifying AI is achieved. The predictive model will assess overall positive or negative emotion of text, and subsequently, compare the success of treatment and livelihood of patients. After comparing the overall emotion with sustainability of numerous people, the AI will expectantly be able to analyze and predict the success of treatment and the likelihood of achieving preferred outcomes for patients based on their personal profiles.

Keywords: artificial intelligence; emotions; attitudes; patient outcomes; palliative; analysis

Introduction

Palliative care is an approach to healthcare with the objective being to relieve suffering and increase quality of life [1]. Therefore, treatment for palliative patients focuses on maintaining comfort rather than extending life and curing disease. Palliative care encompasses various diseases with diverse outcomes for each patient; although two individuals may have the same diagnosis, they often do not have the same outcomes. Patient outcomes are largely influenced by lifestyle, environment, co-morbidities and personal attitudes; however, patient attitudes and emotions regarding palliative care and the treatment they receive during the end-stages of their illness is largely unexplored. Therefore, this paper examines human emotions and attitudes in the context of palliative care.

Similar work by a team of researchers at Harvard University studied the relationship between physical and psychological health. Specifically, they found a positive correlation between optimism and cardiovascular health [2]. Those who possessed a positive attitude were found to participate in healthy behaviours such as exercise, compliance to regimen, and healthy diet. The correlation between maintaining a positive attitude and healthy behaviours led to an increase in positive outcomes such as decreased levels of cardiovascular disease [2]. Based on the correlation found in that research, a similar finding may be present with respect to palliative patients and their health outcomes. Future research aims to explore the possibility of predicting the likelihood of successful treatment for terminal illnesses by analyzing perceived emotions from palliative patients' written stories. This can be accomplished through the analysis of the portrayed emotions and the use of the AI system findings which will be quantified to determine the probability for positive health outcomes.

In this project, AI is being used to streamline the process of analyzing emotions from text. AI is computer software that is able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages [3]. This research focuses on the first step of the streamlining process; therefore, the purpose of this research is to compare AI's interpretation of emotion with that of human experts.

The rest of the paper is organized as follows: a literature review from relevant articles, a description of methods utilized in this study, an explanation of our results and findings, a discussion of the significance of the results obtained, and a conclusion summarizing the findings of this study.

Literature Review

The implementation of advanced technology into the everyday life of older adults can promote independence and

increase quality of life [4]. Additionally, with the rapidly expanding elderly population, the application of intelligent technology can be a key factor in reducing healthcare costs. Specifically, authors report both healthcare providers and the elderly having a strong, positive outlook on the implementation of AI software; however, it may not be applicable for all cases, such as replacing interpersonal interactions in healthcare environments [4]. Authors also discuss the use of a "Smart Home" which is a home equipped with AI to control and monitor conditions of the house. Smart homes can be used to identify changing health statuses in clients to ensure prompt, effective interventions that facilitate positive health outcomes [5].

According to researchers, virtual and augmented realities have provided older adults with opportunities to increase their sense of presence by enhancing their embodied interactions with others [6]. Research has shown that interactions between older adults and AI has no significant difference when compared to the interactions of older adults with a human entity. Research on social robotics is at its initial stages; however, social robots are being considered as a potential solution to address the limitations older adults face with technology along with other issues such as social isolation.

Other research suggests that robots could potentially stand in for healthcare workers, caregivers, and even family members currently caring for and promoting these health outcomes in the aforementioned population [7]. Authors present a scenario where interaction and companionship can be facilitated between AI and a particular population within healthcare [7]. Ultimately, the use of similar AI mechanisms can improve the efficacy of healthcare provision in the older adult population.

As discussed, there are many strong examples of numerous opportunities for an interaction between AI and humans [9]. However, the question still lies in whether or not such software is capable of interpreting and understanding the complex nature of human emotion [9]. According to the authors, true AI needs to be able to interpret complex situations and determine appropriate emotional reactions [9]. By being able to decipher and explain emotion, AI, in the context of conversational technology, becomes substantially more intelligent [9]. Perhaps it is emotion itself that defines the intelligence of the AI [9]. If this sort of emotional understanding and display is possible, it can be translated for the prediction of feasible healthcare treatment outcomes.

Methods

The study utilized a non-experimental quantitative design. The study was conducted in two parts: computer science analysis and human expert interpretation. Participants' surveys were prefilled by older adult patients in palliative care and focus on the patient's life and health conditions. The participants' profiles were selected randomly and student experts were consulted to identify underlying emotions in the text of each booklet. The findings of the students were then compared against the interpretations of the AI system to answer the research question of this study.

Participants in this study were adults receiving palliative care. Ten of the participants' profiles were selected randomly and manually analyzed by human experts after receiving participant consent.

Materials used in this study include profiles consisting of questions and respective answers collected from the randomly selected participants. The human experts used their knowledge in health and medical sciences to interpret the participants' stories and identify the underlying tone of the text. The AI system used is IntenCheck (https://www.intencheck.com/), a digital text analyzer that searched for emotional keywords in the text such as hope, love, thankful and careful. Calculations included numeric ratios from contrasting emotions such as happiness and sadness, and calm and anger. Ratios were calculated to address the human expert and AI system findings; these findings were subsequently compared to evaluate compatibility between human experts and AI.

Procedure

The students received two versions of the profiles: version 1 consisted of anonymous profiles containing only the participants' stories and backgrounds, whereas version 2 consisted of the participants' full profiles which included additional information such as their demographics, background, contact information, family members involved in care provision, stories, strengths, talents, and their desired quality of life. The human experts analyzed each profile independently. Emotions from each profile were quantified on a scale from 1-10, with 1 being a lack of the identified emotion and 10 being the strongest perceived level of emotion; this was then converted to a 1-100 scale for accurate comparison with the AI results. The human experts then compared answers and averaged the levels of emotion found in each booklet, demonstrated in Table 1. However, the AI system received only version 2 of the booklets. The findings between students and the AI system were then compared adjacently to showcase the similarities and differences.

Results

Table 1 displays the calculated level of emotion present in each profile. To compare results between experts' opinions and the findings of AI, ratios were calculated for happiness to sadness, calm to anger, and happiness to fear. The ratios were calculated by addressing the level of emotion from each entity. For example, in Figure 1, a happiness to sadness ratio was calculated for the experts' findings as well as for the AI's findings. Each ratio was then classified as less than 1 or greater than 1. Successful interpretation of emotion by AI was obtained when ratios from the expert and AI findings were both less than 1 or both greater than 1. For the purpose of visual presentation, ratios that were less than 1 are

Table 1: Values of emotions determined by AI and human (manual) interpretation

	1H	1AI	2H	2 AI	3H	3AI	4H	4AI	5H	5AI	6H	6AI	7H	7AI	8H	8AI	9H	9AI	10H	10AI
Happiness	60	50	70	50	70	85	40	50	50	4	70	30	50	50	100	50	50	21	70	32
Surprise	1	44	1	50	1	60	30	13	40	17	1	14	1	50	1	5	30	11	1	8
Calm	80	68	50	93	40	100	40	50	30	97	60	88	50	72	70	97	1	98	70	95
Fear	70	9	30	16	60	1	100	7	1	79	30	53	1	41	1	2	30	21	60	16
Sadness & Disappointment	40	10	50	17	50	2	50	74	60	35	40	30	50	50	30	3	100	47	70	50
Anger	1	32	1	7	20	1	1	50	1	3	1	12	1	28	1	3	1	2	50	5
Disgust	1	27	1	42	1	1	1	6	1	30	1	25	1	39	1	2	1	5	50	15

represented by the number 0 and ratios calculated to be greater than 1 are represented by 1. Comparisons will be named as follows: comparison 1- happiness to sadness; comparison 2- calm to anger; comparison 3 - happiness to fear.

As shown in Figure 1, the results from the AI and manual interpretations aligned 8 out of 10 times. Comparison 1 suggests an 80% success rate of AI identifying happiness and sadness from text. In comparison 2, the results from the AI and manual interpretations aligned 10 out of 10 times. As shown in Figure 2, it suggests a 100% success rate of AI identifying calmness and anger. In comparison 3, the results from the AI and manual interpretations aligned 5/10 times. Comparison 3 suggests a 50% success rate of AI identifying happiness and fear which has been demonstrated in Figure 3.

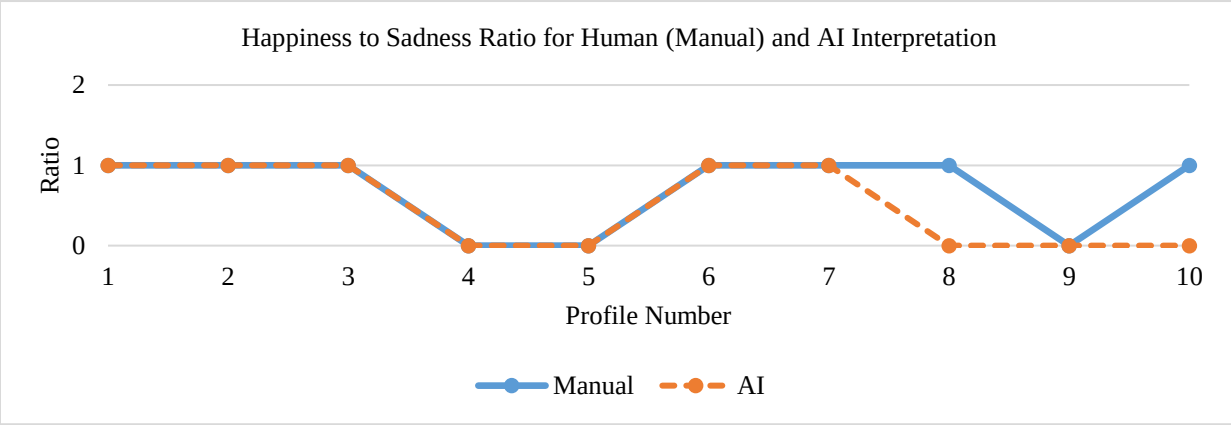

Figure 1: Compares the ratio of happiness and sadness from AI interpretation and manual interpretation. 8 out of 10 AI ratios were true to the human expert opinion.

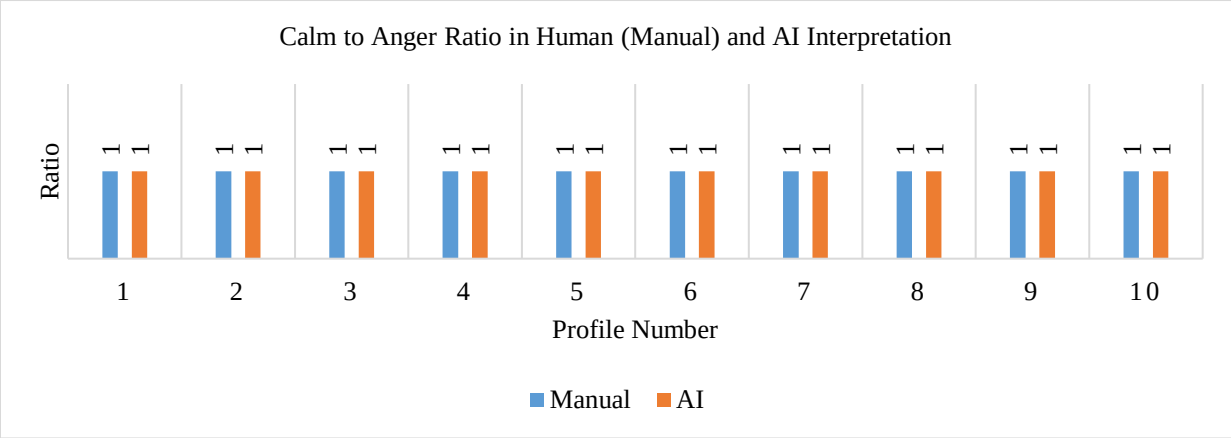

Figure 2: Compares the ratio of calm and anger from AI interpretation and manual interpretation. 10 out of 10 AI ratios were true to the human expert opinion.

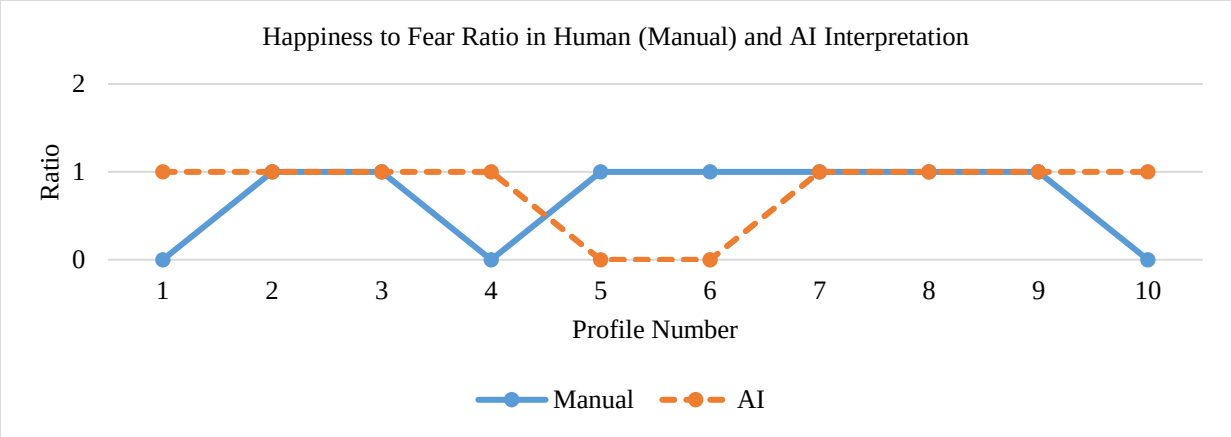

Figure 3: Compares the ratio of happiness and fear from AI interpretation and manual interpretation.5 out of 10 AI ratios were true to the human expert opinion.

Conclusions

This research explores the potential of AI's capacity to expedite the process of analyzing emotions from text. The ability of AI to analyze emotion was tested by comparing human experts' findings with AI's findings. The results displayed some discrepancies between the experts' manual interpretation and the AI's interpretation; however, it also displayed a great deal of similarity. The similarities between interpretations is promising and, in subsequent trials, overcoming challenges and limitations will likely increase the success of AI's ability to interpret emotion. Further research is needed to conclude the absolute ability of AI to interpret emotions from text.

This research has expanded the horizons of existing literature which primarily explores opportunities for interaction between AI and humans; however, there is minimal research exploring AI and human emotion. In sum, successful AI interpretation of emotion will eventually lead to a predictive model of the software where patient success is determined from emotions in the text. Once a reliable form of emotion-identifying AI is achieved, the overall positive or negative emotion of the text can be compared to the success of treatment and livelihood of patients. After comparing the overall emotion with sustainability of numerous people, the AI will be taught to predict the success for specific patients based on their personal profiles.

List of Abbreviations

AI: artificial intelligence

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Ethics Approval and/or Participant Consent

Approval from the University of Windsor Research Ethics Board was obtained.

Authors' Contributions

BB: made contributions to the analysis and interpretation of data, drafted the manuscript, and gave final approval of the version to be published.
DB: made contributions to the analysis and interpretation of data, drafted the manuscript, and gave final approval of the version to be published.
HB: made contributions to the analysis and interpretation of data, drafted the manuscript, and gave final approval of the version to be published.
MA: made contributions to the analysis and interpretation of data, drafted the manuscript, and gave final approval of the version to be published.
PMZ: Substantial contributions to the conception and design of the study, the acquisition, analysis and interpretation of data, revised the manuscript, and gave final approval of the version to be published.

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