AN EMBODIED CONVERSATIONAL AGENT FOR COUNSELLING ABORIGINES
Mr. Warnanggal

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Keywords: Agent based modelling, Virtual sociologist, Expert system, Natural language processing.

Abstract: Aboriginal people are the most neglected community in Australia. Although the trauma induced through oppression and genocide by the settlers is long gone, the deep scar still manifests through the consequences that are painfully apparent in their community. One of the consequences of past neglect and torture is the excessive consumption of alcohol and use of illegal substances. This has compounded the agony of aboriginal people to incomprehensible proportions and forced a sizable population into a grinding cycle of poverty and disease. Our paper proposes a novel approach to provide personalized counselling services to the aboriginal people by developing an interactive virtual sociologist as an embodied conversational agent. The system will simulate the role of a real sociologist in advising on strategies to overcome their addiction to alcohol and substance use and hence enjoy the fruits of prosperity with the rest of the Australian community.

1 INTRODUCTION

Australoids (Elkin, 1979) or Australian aborigines were food originally gatherers and hunters and are the original inhabitants of Australia who migrated to the mainland about 40,000 years ago (Elkin, 1979). Prior to colonization, the Aboriginals enjoyed an ideal lifestyle with roles of individual members set according to their position in the tribe; families would live in a communal environment with responsibilities being shared throughout the family (Walker, 1993). The men were usually hunters while women gathered nuts, berries and roots for the family (Sam, 1992)

Today, Aboriginals are the most socially and economically backward group in the Australian society and are vulnerable to substance (alcohol, tobacco, illicit drug and volatile substance) (AI HealtInfoNet) abuse. According to the Australian Bureau of Statistics (ABS), there are around 517,200 indigenous people in Australia (see ABS). Government report on drug abuse in Australia shows 52% of aborigines have consumed substance in one form or the other (Editor, 2007). The fact sheet from the office of aboriginal and Torres Strait islander affairs quotes the life expectancy of indigenous Australians is 20 years less than other Australians (Editor, 2003). One of the four primary factors attributed to this incongruity is alcohol and tobacco misuse; the other three being lower socio-economic status, location and environmental factors and historical factors (Healey, 2004).

Post colonization, aboriginal people were subjected to oppression and genocide that left the society in tatters. Racial discrimination over the years have caused great disadvantage in their employment, housing, health, education and training thus resulting in stress and anger within the family (Walker, 1993). According to Walker (Walker, 1993), the present addiction to alcohol and substance misuse which were apparently introduced in the Aboriginal society by the colonists, is a consequence of guilt and anger of past removal policies of the government of Aboriginal children from their parents.

This project models and develops a virtual sociologist, Mr Warnanggal to counsel aborigines and deter them from substance abuse for their social, economic, health and emotional wellbeing thus encouraging them to join the main stream Australian community. Warnanggal is a term in Wagiman aboriginal language, meaning doctor (Harvey &

Kavakli M., Rudra T. and Li M..
AN EMBODIED CONVERSATIONAL AGENT FOR COUNSELLING ABORIGINES - Mr. Warnanggal.
DOI: 10.5220/0003496103710376
In *Proceedings of the 6th International Conference on Software and Database Technologies* (ICSOFT-2011), pages 371-376
ISBN: 978-989-8425-77-5

Wilson, 1999). The system will be personalized to individual needs and will also guide the user on various educational and professional pathways to motivate them to lead a better quality of life.

The paper is organized as follows, in section 2 we explain the motivation for developing Mr. Warnanggal, in section 3 we describe the intricate implementation details of the proposed system and finally we present the conclusion.

2 SIGNIFICANCE

The primary motivation for developing the project is to endeavor to integrate the aboriginal community with the rest of the Australian society in enjoying the fruits of prosperity. Our research will also attempt to bridge the socio-economic gap created in the past by providing social support through counselling in resurrecting the Aboriginal community so that they can enjoy equal status in the modern Australian multi-cultural society. Aboriginal people have the concerns while accessing disability and social services from support services (DSA, 2006). Our research aims to address the above issues by providing counselling service through a virtual counsellor that can be installed and customized in a home or community computer; the services of which can then be used at the convenience of the user.

The popularity of computer games justifies that in highly immersive environments people tend to interact with virtual avatars as if with real human beings. Slater and colleagues redesigned a famous yet controversial 1960 experiment (Milgram, 1963) in a virtual environment. They found that although all participants knew that they were interacting with virtual characters and environment, the participants' intend to respond to the situation at the subjective, behavioural and physiological levels as if they were real (Slater, 2006). This is demonstratedvia concrete metrics such as increases in the participant's heart rate. This finding in literature justifies our strategy towards aborigines substance abuse using a virtual sociologist, Mr Warnanggal. Further, there are supporting studies suggesting that people feel more comfortable when interviewed by media-mediated electronic doctors and are more likely to release their flinched mind during the consultation process in contrast to human doctors (Yoshida et al., 2002).

In this study, in order for Mr Warnanggal to effectively conveya feeling of social presence for its user, we focus on two aspects, namely "behavioural realism" and "conversational realism". To enhance behavioural realism, scientists in the University of Southern California's Institute for Creative Technologies managed to create virtual humans that can exhibit non-verbal human behaviours such as emotions and gestures (Rickel et al., 2002). Advancements in "Chatbot" technology, which can simulate conversations of an intelligent human being, complements the above features of virtual human to make this idea of a high-realism virtual adviser possible. For example, a virtual advisor called "Franco", developed by Defence Science and Technology Organisation (DSTO) at Edinburgh, South Australia, would answer questions related to military aircraft, ships and geographic information (Broughton et al., 2002). Our research aims at incorporating both of these advancements into the design of Mr Warnanggal.

3 MR. WARNANGGAL

Figure 1 illustrates the interactions between the various components of Mr Warnanggal expert System. The interface between the user and the system is through an avatar of Mr. Warnanggal which is personified using an artificial embodied conversational agent. To overcome the impediments of automatic speech recognition, we will simplify the language of communication by limiting the grammar and vocabulary from English and focus on providing a high-quality counselling service with sophisticated animation.

The user module stores the personal data of the user for more personalized diagnosis and immersive experience during the counselling session. The emotion unit captures the emotion of the user for fine tuning the inference process of the expert system and giving a human touch to the avatar of Mr. Warnanggal by facilitating the generation of an appropriate non-verbal expression (both facial and gesture). The diagnosis history stores the diagnosis and interactions of the current and previous counselling (if any) sessions of the user with Mr. Warnanggal. It is updated by the experience unit of the learning module of the system. The information from the diagnosis history may serve as an aid to Mr. Warnanggal and begin the process of initial dialog with reference to earlier counselling sessions. The user profile stores the data about individual characteristics for better understanding of socio-economic and cultural background of the user to assist in diagnosis.

The intelligence and behavior of the avatar comes from the context and behavioral modules of the interactive drama engine. The context

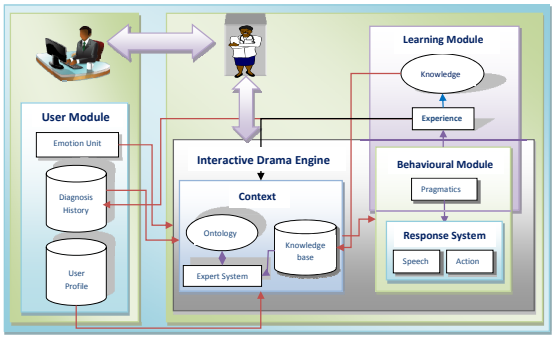

Figure 1: Model of Mr. Warnanggal.

module implements the advice for the coping process outlined in our research model and consists of an expert system for Mr Warnanggal. The decisions made by the expert system during the course of the conversation is drawn from the application of inference rules on the knowledgebase developed by consulting existing literature, clinical documents and experts in aboriginal counselling. The ontology provides a persona to the avatar of Mr. Warnanggal and guides in the reasoning process by cross checking the diagnosis history, experience from the current session and emotion state of the user. It governs the behavior of the avatar of Mr. Warnanggal during its conversation with the user.

The experience unit in the learning module stores vital conversation details between the user and Mr. Warnanggal for reference in current session and future consultations. Post diagnosis, data from the experience unit is documented in the diagnosis history database for future consultation with the same user. Pragmatics governs how the avatar of the virtual sociologist comprehends a situation and produce conversation with the user. Any new experience of the agent is stored as knowledge for updating the expert system knowledge base after consultation with a sociologist. The context module sends diagnosis related questions and decisions to the behavioral module which codes the speech and gesture (action) mark-up files for emoting the avatar of Mr. Warnanggal. The behavioral module is core to the realization of one of our research goals - believability of the user on the system.

3.1 Language and Grammar of the System

There were approximately 200 aboriginal languages (AL) in Australia, out of which nearly 20 are in use (Nathan, 2002). The characteristics of Aboriginal languages are defined by Horton (1994). English Grammar has primarily four types of sentences they are simple, compound, complex and compound complex; falling into the categories of declarative, interrogative, imperative and exclaimative (Williams, 1999). In our proposed system, dialogue between the user and Mr. Warnanggal will be through the use of simple sentences adhering to the categories of declarative, interrogative and imperative. There are distinctive features in aboriginal English in grammar, words and meanings as well as language usage that shows continuities with the traditional aboriginal languages (Eades, 2011). To overcome the impediments of speech recognition systems, incorporate the first five characteristics of aboriginal languages, address the complexity of English grammar and enhance the perpetuity in conversation with our system, we have developed a Computer Pidgin Language (CPL) [20] with a limited set of grammatical rules. The rules for interacting with Mr Warnanggal consists of 10 grammatical constraints adapted from Rudra (2008).

3.2 Database of the System

One of our design objectives is to isolate the knowledgebase from the code in the inference module and the conversation processor. The knowledgebase of the expert system is derived from this database along with user characteristics and vocabulary (for speech recognition during conversation). To realize our goal, we have identified 32 tables to implement the expert system knowledgebase. The tables along with their attributes are grouped under two broad categories: User Module and AI Module. We adopted the relational model from (Silberschatz, 2010) for the database.

3.3 Expert System for the Project

The system involves complex level of interactions with the user to advice on techniques to assist in their rehabilitation process. Our expert system implements a clinical decision support system (CDSS) (Berner, 2007) that incorporates the characteristics associated with CDSS as suggested by (Kawamato et al., 2005).

To implement Mr. Warnanggal, we have designed an expert system (Weiss and Kulikowski, 1984) that will simulate the reasoning and diagnosis strategy of a human sociologist. The knowledgebase of the system is derived from the database described in section 3.2. The input to the system is affective speech and the output is an emoted embodied conversational agent of Mr. Warnanggal. The model for our decision support system is shown in Fig. 2.

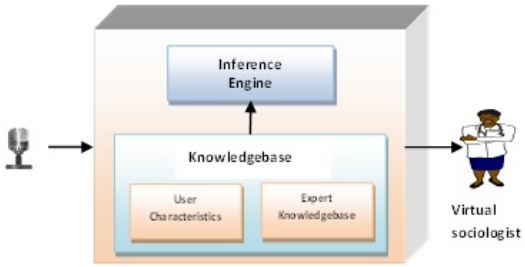

Figure 2: Expert system model for Mr. Warnanggal.

The expert system consists of inference engine that applies the rules of diagnosis on the knowledgebase based on the spoken input from the user to produce a verbal output that animates Mr. Warnanggal. The knowledgebase has two parts; the first stores the characteristics of the user and the second stores the knowledge of an expert sociologist. The user knowledgebase helps in creating a mind map (Buzan, 2010) of the user which supports the expert system knowledgebase in diagnosing affective symptoms. We develop our inference engine based on chained rules, adapted from causal network model by Lauritzen, 1988).

The steps from symptoms to advice are recursive and are repeated until the counselling session is complete. The issues (identified as either mental or physical) being spoken by the user determines his/her symptoms of stress and are based on the questions being asked by the system. If the issue under investigation is physical, the system generates and empathetic advice for relaxation, exercise, food etc. If the issue is social, the system generates empathetic advice on social activities, education and work. If the issue pertains to mental stress, the system attempts to diagnose the problem by applying probabilistic rules. The probabilities for diagnosis of different mental stress symptoms are developed by consulting expert aboriginal psychologists. Based on the certainty factor (CF) of diagnosis of the stress symptoms, an appropriate statement of advice and empathy (if any) is generated. The CF is calculated using the formulae by Castillo & Alvarez (1991).

The reliability of our expert system is totally based on the effective implementation of the inference engine. Although research suggests that transcribing medical knowledge with inference engines underpinned by probabilities may be affected with variations in clinical judgment of experts (Bar-hillel, 1980); we will ensure that this uncertainty does not influence the final outcome of the diagnosis. We intend to customize the system to individual user requirement by segregating the inference mechanism on user's demographic attributes by consulting expert psychologists specializing in counselling respective communities. We will also consider personality attributes of users for personalization of the system to cater for individual user category and needs.

3.4 Behavioral Modeling and Animation

We will rely on behavioral protocols in the development of the behavioral module. Behavioral protocols require the presentation and recognition of cues that express social relations between humans. Although behavioral protocols are defined in guidelines for human ethics applications, as well as social policies associated with emergency situations, these are not integrated with the physical simulation of human behavior; physical simulations (e.g., (Gavrila and Davis, 1996), (Kavakli, 2005); (Newby, 1994); (Roy et al., 1994); (Semwal, 1996)) (Gavrila and Davis, 1996) treat the problem in isolation from the social studies. We believe that any intelligent agent must be able to detect and process the social cues to be able to operate in a social context in a virtual environment. While presentation of physical and social cues is a topic of animation, their recognition is an active research area in cognitive science. In modeling Mr. Warnanggal, first, we investigate social cues and produce realistic representations of avatars simulating natural motions based on behavioral protocols, and then, develop personality and emotion models in order to use them in user-adviser interaction.

In this project we will use a hierarchical model of body actions based on fine-grained action primitives (Emering et al., 1997), Video analysis (Sandrine et al., 2004), motion capture, and qualitative and quantitative analysis. The capture of the participants' motion is normally limited to a small body part, as one hand (Kavakli, 2005), (Newby, 1994), or one arm Roy (Roy et al., 1994). (Gavrila and Davis, 1996) attempted to identify the full body posture by analyzing multiple view frames. (Semwal, 1996) used a motion capture approach based on magnetic sensors that allows the identification of full body movement. We take advantage of the motion capture technology to provide the joint value input required for our approach to behavioral modeling that integrates social and physiological characteristics of animations. We have explored ways, to interactively, realistically, and efficiently create and animate virtual humans (Kavakli & Kartiko, 2007). We have collected face and body motion capture data to

develop face and body models to make use of in the project. We have produced animations using a motion capture suit, face trackers, Motion Builder, Softimage, Vizard, etc., at the VR Lab (see Fig. 3).

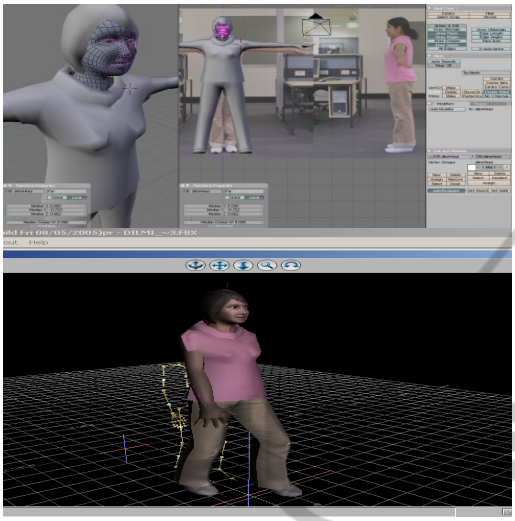

Figure 3: Inference engine of the system.

4 CONCLUSIONS

This study is a critical and first stage of an on-going long-term project carried out in a well-established Virtual Reality Centre by a group of interdisciplinary researchers and practitioners. We reviewed the aboriginal, social, psychological, and computer graphics literature underpinning the design of this intelligent virtual advisor and suggested an optimal system framework.

In the next stage of the project we will proceed to enhancing our initial prototype of Mr. Warnanggal and then move on to full-scale development of the system. We plan to use Greta (Mancini & Pelachaud, 2009, Pelachaud, 2010) a multi-lingual embodied conversational agent as a visual interface with the user to test our prototype. The narrative engine of the interactive drama engine (Szilas et al., 2007) developed by our team will be used to control the dialog between the user and the system. A critical part of our system development involves the creation of a comprehensive knowledgebase for the expert system through existing literature, clinical documents and interviewing aboriginal psychologists. Next, we will be able to develop and implement a speech based interactive narrative engine. Finally, we will develop an emotive talking head that will interface the patient and the expert system. However, it is also important to note that the knowledge base for the virtual sociologist needs to be verified by experts to ensure not to have any negative impacts on aborigines.

In this paper, we examine how to utilize the strengths of virtual interfaces to effectively mimic the knowledge, diagnosis and behavior of psychologists through an intelligent agent personified as an avatar – Mr. Warnanggal, to help aborigines to better cope with substance addiction. Besides, the self-learning expert system for counselling aborigines will have significant contribution in the area of social science and psychology. Further, the agent-based behavioral modeling of the avatar of Mr. Warnanggal will have implications in the field of machine learning for human computer interaction.

The current scope of the research is limited to aborigine psychology but it can be further extended to the application areas of stress diagnosis and management for people who are going through post-traumatic stress disorders,domestic violence, , breakups and depression. Our research model and design can be applied in the above application areas with modifications to the expert system database and behavioral modeling of the virtual avatar.

ACKNOWLEDGEMENTS

This project is sponsored by the Australian Research Council Discovery Grant (DP0988088) titled “A Gesture-Based Interface for Designing in Virtual Reality”.

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