A Dialogue with a Virtual Imaginary Interlocutor as a Form of a Psychological Support for Well-being

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Abstract

Computer, tablet and smartphone are tools that increasingly accompany us during everyday activities. Given the booming use of the virtual reality and the wide range of people who have access to it, people are increasingly presented with an online alternative to the support of professionals, therapeutic groups organized by healthcare institutions, or significant others (such as family, friends and colleagues). This can be used as a tool for personal development and to cope with stress. Our research program includes creating a virtual reality application to sustain well-being and improve quality of life. It assumes that avatars, representations of a person in the cyberspace, will provide support in the form of a virtual conversation. Dialogue with an imaginary person is as a supportive technique in a stressful situation as creating the list of solutions and on a long term period it can create a specific way to reach the desired change.

Author Keywords

inner dialogue; dialogical self; support tool; mental state; avatar; application; smartphone; chatbot

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. I.2.8. Artificial Intelligence: Problem Solving, Control Methods, and Search.

Introduction

When we look closely at the role played by different types of electronic devices in our lives, it is very easy to understand that this is really a big function. So lets look at this issue a little closer. It turns out that today's electronics devices based on electrical energy is everywhere around us: from the kitchen, through all the rooms in your home, at work and on the street. Thanks to the rapid technological advances, our quality of life is significantly increased. Without electronic devices, our lives would be much less convenient and interesting.

Smart devices such as mobiles and tablets are increasingly ubiquitous and important aspects of modern existence that are always with their owners. Because of this, these devices are excellent vehicles for behavior changes. Further, the fact that smart devices are inherently social makes them ideal vehicles for delivering and seeking support [5]. All this contributes to the potential for smart device technology to help shape interpretation and action in a variety of health-related contexts [6]

Application

The idea of application was born during the interdisciplinary summer school Human Computer Confluence, held in Milan in July 2012. Participants were divided into 3/5-person teams to perform a specific task. Project teams were made up of computer science professionals, psychologists /sociologists and people from other disciplines, and their task was to come up with, describe and present an idea that could provide new ways of feeling, perception, communication and experience, utilizing new technologies.

The following article discusses the application which uses the internal dialogue as a form of support in daily challenges and problems of life. This application is based on artificial intelligence software that learns our internal dialogue and delivers it to us in the form of a virtual conversation with the imaginary interlocutor.

Users share their inner thoughts and conversations with other avatars or other people in the address book. They get back an answer that encourages conduct an internal dialogue, aimed at improving their well-being, reducing tension and levels of anxiety or anger, and increasing self-esteem. The application checks for our mental health through an emotional readout tool that registers a depressed mood, tension and reduced self-esteem through a web camera and a set of questions about self-esteem and anxiety. Proposal responds to carry out an imaginary conversation with a virtual party.

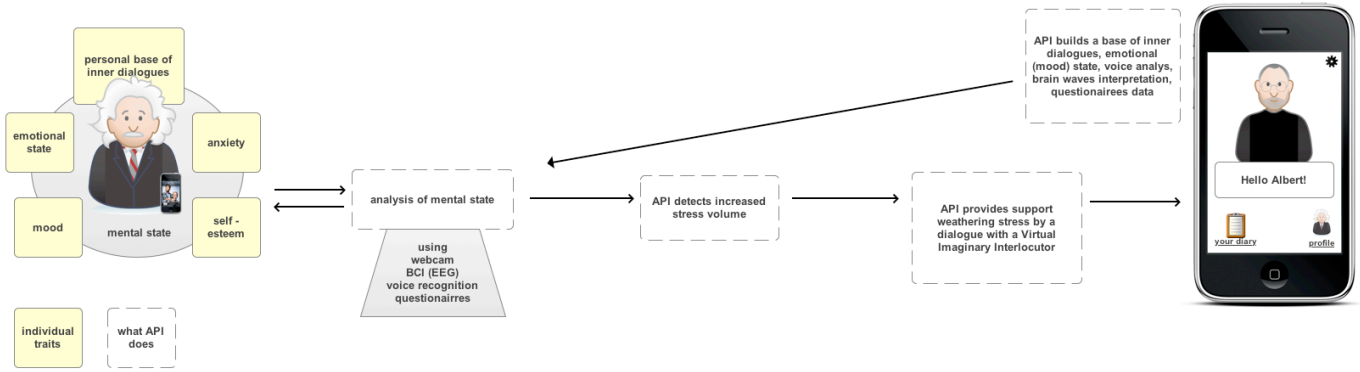

Figure 1. It shows the user flow of application for collecting data to the virtual agent control.

The project is a tool for supporting the formulation and articulation of ideas and solving internal our daily vicissitudes. The project does not replace the therapeutic relationship when a person is faced with mental health problems and never will be developed in this direction. The overriding goal is to create a solution that aims to improve the quality of life, self-discovery and development of better techniques for coping with everyday stressful situations.

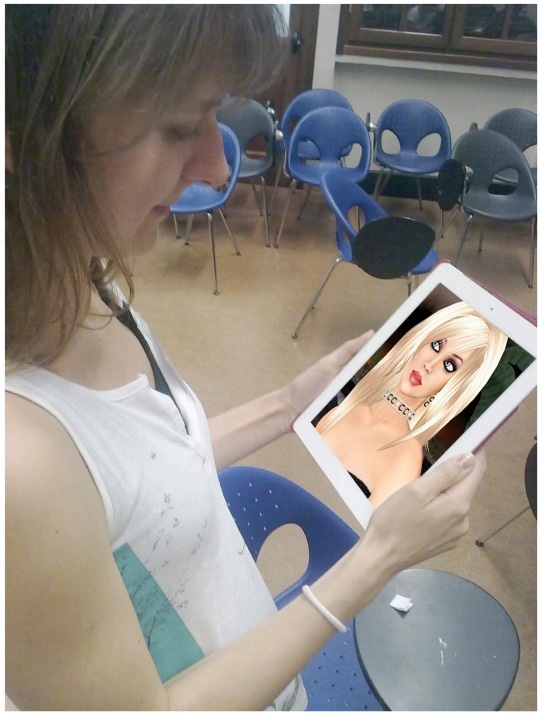

Figure 2. A user is talking to the imaginary interlocutor (picture was taken during HCC summer school 2012).

The tool uses a standard webcam which detects the user's face in order to recognise facial features and estimate the apparent emotion, a standard microphone which captures the user's voice in order to detect and analyse her/his speech and a BCI (brain computer interface) sensor to track the brain EEG waves.

Theoretical implications

The phenomenon of internal dialogues as a form of support can be seen under several theoretical implications.

Dialogism

Dialogism often refers to the concept used by the Russian philosopher Mikhail Bakhtin in his work of literary theory.

Dialogism is a name for a bundle, or combination, of theoretical and epistemological assumptions about human action, communication and cognition. Communication and cognition always involve interaction with others (other persons, other systems, other dimensions of one's self etc.). Such interactions involve interdependencies that cannot be reduced to outer cause-effect relations. The basic constituents of a discourse are interactions (exchanges, inter-acts), rather than speech acts or utterances by autonomous speakers (authors, communicators) [15].

The mind is voices speaking to each other; it is an ongoing process of dialogues instead of looking at one core self. What we name as personality and psychological being takes place in this inner conversation between voices. Voices are the speaking personality, the speaking consciousness. Personality is not a psychological structure inside us, but actions that happen in speaking, and in this way the human consciousness is generated. Stiles (2002) has tried to operationalize the idea of voices by noting that "Voices are traces and they are activated by new events that are similar or related to the original event". All our experiences leave a sign in our body, but only a minimal part of these ever become formulated into spoken narratives. In formulating these into words they become voices of our lives. Instead of speaking of

unconsciousness into which those experiences and emotions that we cannot deal with are repressed, it is more accurate to speak of non-conscious experiences. When the experiences are expressed in words, they are no longer unconscious and become supportive tools in our life [18].

Inner dialogue or self-talk is a continuous conversation going on in everyone's head. Inner conversations have a powerful impact on our emotional well-being and motivation. Constantly thinking about the same subject influences the subconscious mind, which consequently accepts these thoughts and acts on them. People who have enough faith in themselves and in their abilities are able to conduct positive inner dialogues. However, in many cases, inner dialogues are negative and strengthen any negative attitude and behavior.

Dialogical self theory

The dialogical self theory weaves two concepts, self and dialogue, together in such a way that a more profound understanding of the interconnection of self and society becomes possible. Usually, the concept of self refers to something "internal", something that happens within the mind of the individual person, while "dialogue" is typically associated with something "external" [8].

In the Dialogical Self Theory (DST) the self is considered as "extended", that is individuals and groups in the society at large are incorporated as positions in the mini-society of the self. As a result of this extension, the self does not only include internal positions (e.g., I as the son of my mother, I as a teacher, I as a lover of jazz), but also external positions (e.g., my father, my pupils, the groups to which I belong). The mind has the ability to imagine the different positions of the participants in an internal dialogue. The Self is populated by a multiplicity of "self-positions" that have the possibility to entertain dialogical relationships with each other. The Self has the ability to give voice to each position. These relationships between positions are inner dialogues [1].

Interactive minds

Interaction with others can be external as well as internal. Interaction with the mental representation of other persons' knowledge (internal or "virtual" dialogue) was as a powerful facilitator of wisdom-related performance as an actual social interaction with another person when the subsequent individual thinking time was provided [19].

The main inspiration for the subject to create an application that uses the internal dialogue as a form of support is Baltes and Staudinger (1996) research on the interactive mind (interactive minds) and its impact on the effectiveness of thinking based on the wisdom (wisdom-related performance). The concept of interactive mind assumes different states, based on a combination of internal and external dialogue. The researchers showed that internal dialogue can be effective in generating possible solutions to the problem situation which carry on the dialogue with the actual person familiar. Participants' study presents a problematic history and asked to generate solutions, but they just do it, or be preceded by a real or imaginary dialogue (on the subject) of any imaginary character. Both the dialogue actually carried out, as well as imaginary lead to a greater variety of possible solutions, if confronted with a different point of view - imagined or real - was enough to widen the horizons of thought [1].

Social support
In the last thirty years, numerous studies have shown that social support plays a vital role in everyday life and contributes to the mental as well as physical well-being of people. A lot of attention in this area has been devoted to how social support may benefit individuals who suffer from a mental or physical disorder.

Social support consists of a whole range of ways in which people can tacitly or explicitly help one another to improve the quality of their lives, and it is found to be beneficial for reducing stress, decreasing feelings of loneliness and isolation, getting hold of knowledge and information and learning strategies to cope with the situation people are facing [16].

Given the booming use of the virtual reality and the wide range of people who have access to it, people are increasingly presented with an online alternative to the support of professionals, therapeutic groups organized by healthcare institutions, or significant others (such as family, friends and colleagues). They can use virtual reality to seek help from people that face a similar situation [17] or talk to an imaginary person, who passed away, is unreal or not present at the moment. This imaginary condition we want to create as a virtual environment.

Social support can be measured in terms of structural support or functional support. Structural support (also called social integration) refers to the extent to which a recipient is connected within a social network, like the number of social ties or how integrated a person is within her or his social network. Family relationships, friends, and membership in clubs and organizations contribute to social integration. Functional support looks at the specific functions that members in this social network can provide, such as the emotional, instrumental, informational, and companionship support.

Some have suggested that "invisible support," a form of support where the person has supported without his or her awareness, may be the most beneficial [11].

Emotions as an internal language
Thoughts are inner emotional languages and dictate how you make an interpretation of behavior, your own and other's.

Emotions are our internal way of communicating to stimuli from the environment, are the result of reactions between the environment and the organism. These are the language of our mind, learned through exposure, expressed by behavior. The current language of emotional dialogue is an individual who performs with itself or with imaginary people, for it is the easiest and the most convenient language. The way people talk to themselves and the imagination strongly affect their emotional life. The unit has its own unique language with limited internal variability, defined by the ability of emotion regulation [12].

Emotions are the result of the interaction of certain processes that occur within the body of information coming from the environment and the information registered in the experience of the individual. In most of the emotions involved are at least two people joined a union. The validity of this relationship is the same as its ability to generate emotion. About the validity of choosing the meaning of everything that happens in relation to the welfare and objectives of one of the

parties. Emotions appear only in such systems, the reaction between the body and the environment, which are the source of the potential benefits or harm [4].

According to Daniel Goleman [7] emotional intelligence involves the ability to understand yourself and your emotions and to direct and control them, the ability of self-motivation, empathy and social skills on.

Currently, there are no studies and empirical data on the functions of internal dialogues as a form of emotional support - these areas of knowledge are not yet connected.

Self-esteem

It can be said that self-esteem is a human reaction to affective self [8]. Self-assessment is a comprehensive self-evaluation [20]. People are notorious to have an irrepressible tendency to positive judgments about themselves. Having high self-esteem means that the operator feels positive emotions.

Man's self-esteem can be considered due to the trait or condition. A general level of self-esteem characterizes the entity which, however, is a change depending on the situation [11]. This feature is constant over time and independent of the emerging circumstances. In the case of the state, the individual events can increase or decrease the assessment of the perceived size [14]. Individual levels of self-esteem, as a trait, are relatively independent of objective events, while the state of self-assessment varies according to the successes and failures experienced by the individual. However, every positive or negative experience does not always affect the state self-esteem equally. The unit itself is made relevant to the selection of fields on which to base self-esteem [21].

The author proposes that the concept will be tested according to the mediator dialogism and social support.

Chatbots

The first virtual party, the chatterbot named ELIZA, was created in 1966 by Joseph Weizenbaum at MIT (Massachusetts Institute of Technology). The program served as a psychotherapist, but did not have any knowledge of mental health. ELIZA had only some sets of answers. Her job was to ask questions that help the patient to understand their problems. The program in the construction was very simple - based on capturing keywords and matching the patterns. For example, the sentence of "I feel sick" corresponded to "You come to me because you feel bad?"

The origins of the virtual speakers in Poland date back to the seventies of the twentieth century. The first Polish chatterbot named Mary was developed in 1973 at the Warsaw University Institute of Mathematical Machines. Another caller called virtual Teresa was established in 1977 at the Academy of Mining and Metallurgy in Krakow. He was the response of Polish specialists on Eliza and the same as the original simulated psychiatrist.

The concept of a virtual speaker on the role of psychotherapist has not accepted and will not be developed. Contact with a live person in the face of life's problems is irreplaceable.

Today's virtual callers are exploited to provide information, a simple chat or play the role of moderator

of the discussion. We are three generations of virtual speakers. The first generation includes simple chatterbots that do not use speech synthesizers, and their visual creations in the form of 2D or lack thereof were mainly used for various types of discussion forums, chatrooms or communication channels, which play the role of moderator. The second generation is complex computer programs that use artificial intelligence algorithms which perform semantic analysis of text entered by the user. They have a realistic portrayal - often confusingly similar to a human face. The visual character can perform basic movements and is enriched with gestures and facial expressions. Most chatbots of this generation use speech synthesis but do not recognize the user's speech. Virtual callers of this generation can be exploited in almost any purpose including partners in the discussion of free themes, teachers in e-learning courses and characters in the games. The third generation of virtual advisors, differently from the second generation, used artificial intelligence algorithms with a dialogue based on a two-way voice transmission. Visualization of these programs is carried out in a three-dimensional graphic, which allows the characters to become more and more realistic. It is increasingly difficult to identify users that are talking with the program and not a real person [17].

Research project

Realization of the application project will be to get to know the function of internal dialogue, including on whether a meeting with the provider of support is necessary, or just an idea of the person or talking on mediated communication tools by the computer (CMC - Computer Mediated Communication), such as chat, email and audio-visual communication (e.g. Skype).

The importance of the project

Research topic has been taken so that the earlier studies have defined that the support is a function of internal dialogue [16]. At the same time, social support plays an important role in coping with stress. However, an open question remains, that is whether in a difficult situation when the individual has to cope with a stressful event, internal dialogue can replace real social support. This issue is part of a broader issue: whether imaginary dialogues can have a positive impact on quality of life, well-being and/or self-esteem of the individual. The project investigates the application of imagination impact on the psyche and well-being of the individual.

Social context

The application will help people to sustain well-being and on a long term period can create a specific way to reach the desired change. Positive inner-dialogue is a self-empowerment at its peak. It can be defined simply as the empowering messages tat a person sends to her/himself.

When personal goals are formulated, inner-dialogues can activate the resources required to achieve them. Inner dialogues are personal affirmations of power which person can present either audibly or silently as though messages. Those silent messages become even more powerful when supplemented by the sound of your own voice.

A positive inner-dialogue is essential to self-empowerment because it provides instant and direct access to the unlimited powers of the subconscious. It includes all the positive messages we send to ourselves through a variety of channels that include not only our

verbal expressions but also our beliefs, orientations, aspirations, values, expectations, perceptions, and attitudes. A major advantage of inner dialogue is that it can use almost any time or place.

Among the most effective forms of inner-dialogues are the positive "I am" messages we send to ourselves. Examples are: "I am empowered to succeed", "I am destined for greatness", and "I am a person of worth", each of which can build powerful feelings of self-confidence and well-being. Even when not directly targeted to the subconscious mind, inner-dialogues will nonetheless be registered there.

Working on the application solutions for facial and voice emotion recognition will be developed. Moreover connections between emotions, mood, personality traits and mental states will be found which could provide ways to measure and relief stress and anxiety.

Gained data in dialogues could provide information about person inner identities - full of her/his motivations, goals, beliefs, desires, fears, values and approaches. These could give cues for brands for customer needs, motivations and demands.

Risks of the presented approach
As subject of virtualization, the inner dialogism brings a series of threats. One is to divert the world of applications may thereby reduce the wealth of social interaction and real conversations. Another may be the lack of ability to control the state of the person who is the internal dialogue and its negative impact on the emotional state. Moreover, the application can replace the existing positive techniques for dealing with stress on worse solution. The authors of the project do not intend to create a therapeutic application but aim to create a solution that is an endeavour in the challenges of daily life and serve as a tool in stressful situations.

Pilot study

The aim of this study is to determine whether the use of virtual and imaginary support can be as an effective way to deal with stressful situations, and what its impact on mental health is. The authors examine the impact of internal dialogues on the social support at the level of fear and self-esteem.

Method
The study is an experimental scheme where the independent variable (manipulation) is the solution to the problem - with the help of internal dialogue or a list of solutions, and the dependent variables and the quality of the resulting support (measured by answers to questions about the effectiveness of the support).

The mediator is based on the level of self-esteem (measured on the scale of self-esteem - SES, Rosenberg: a simple questionnaire consisting of 10 claims).

Dependency is moderated by gender (data specifications) and anxiety level (measured by means of a questionnaire anxiety: STAI - anxiety as a state).

Procedure
In order to investigate if the internal dialogue is a particularly effective way to benefit from support in a stressful situation, an experimental condition in which user imagined stressful situations and carried out imaginary dialogue with persons picked from previously created social support map was created. Through an

online questionnaire for imaginary dialogue conditions we obtained insights into the users' personality traits and the impact of the internal dialogue on a level of anxiety. Questionnaires concerned self-esteem and level of anxiety as a state. Control group helped to answer the main research question whether the inner dialogue is a successful form of weathering. In this experiment condition users were asked to make a list of a solution in facing imagined stressful situations.

The survey was created using LimeSurvey software and made available on the lab.swps.edu.pl website between November 2012 and January 2013.

Participants
In total we received 73 completed questionnaires. The questionnaire respondents came from social networks (Facebook), students from University of Social Sciences and Humanities and Polish-Japanese Institute of Information Technology.
The distribution of participants with regard to their sex was majority of female users (51 woman and 22 men).

Results
The analysis confirmed the hypothesis that inner virtual dialogue is a successful form of coping with stress. Analysis of Student's t-test for independent samples showed that support in the form of dialogue affect the assessment of the effectiveness of aid received [t (71) = 3.68, P <0.05]. Imaginary dialogue was judged to be more effective (M = 6.72, SD = 2.31) than the creation of a list of possible solutions (M = 5.58, SD = 3.06).

People with low self-esteem assessed support higher than those with high self-esteem. People with low self-esteem assessed quality of support higher than those with high self-esteem [F(1,71) = 6.559; p<0,05]

Measures showed that after the experiment the level of anxiety as a state increased (both dialogue and list) [F(1,72) = 4.120; p<0.05].

Discussion
The main goal of this study was to examine whether the use of virtual imaginary support can be as effective way to deal with stressful situations.

With regard to the relationship of self-esteem, anxiety level and internal dialogue study provided clear and mostly expected results that help to better understand the influence of online internal dialogue and extend and confirm existing knowledge on this topic in the context of virtual application.

The most surprising result however was that level of anxiety increased after the experiment. Future work should explicitly include different context and form of dialogue to clarify this issue.

Experiment details

This PhD research project shall put forward at least four types of dialogues with imaginary interlocutors conducted using virtual applications avatar. The various persons in the following experiments will deal with stressful situations: the past, the real unified for all tested and imagined which are to be the most difficult. In the control experiment, users will dialogue with an imaginary trip to Mars. To that end users will be able to perform one or a series of imaginary dialogues with interactive caller.

In the experiment to determine the effectiveness of the coping techniques will be quality controlled achieved support. In addition, questionnaires will measure the level of self-esteem, anxiety as a state, emotional intelligence and gender. The proposed research tool described in this paper will measure the amount of the content of the dialogues carried out and the emotional state of the user.

Related work

Social support and comforting refers to communicative attempts, both verbal and nonverbal, to alleviate the emotional distress of another person [2].

Everybody is capable of comforting another person and themselves. Work in the field of affective computing demonstrated that virtual agents are able to reduce negative emotions in users by addressing them [9]. More recent developments show that empathic agents are increasingly capable of complex social and emotional dialogues. However, these dialogues are predominantly task-oriented, i.e. to help users in performing concrete tasks, such as finding information and learning, whereas giving social support is unrelated to this type of tasks.

Embodied Conversational Agent (ECA) provides social support to victims of cyber bullying. The ECA 'lives' on the computer screen of potential victims of cyber bullying. When a child feels uncomfortable because of a cyber-bullying incident, it turns to the ECA for emotional support and practical advice on how to deal with the situation, just as it would do with a human online counsellor [22].

Robin, an Empathic Virtual Buddy for Social Support is an Embodied Conversational Agent (ECA) that provides social support to cyber bullying victims aged 10 to 14. The results of the cluster analysis are consistent with the assumption that the users' subjective experiences of social support have been affected by underlying attitudes [23].

Avatar therapy represents a promising treatment for medication-resistant auditory hallucinations. The study was led by psychiatrist Julian Leff, who spoke to patients who had not responded to medication through their on-screen avatars in therapy sessions. The patients created a computer-generated face with a voice (avatar) that they thought was similar to the hallucinated voice. They were then encouraged to confront and challenge the avatar, which was "controlled" by a therapist. By the end of their treatment, patients reported that they heard the voices less often and that they were less distressed by them. Levels of depression and suicidal thoughts also decreased, a particularly relevant outcome-measure in a patient group where one in 10 will attempt suicide [23].

Technological methodology

In the field of human-computer interaction (HCI), automatic mood recognition performed by computers is still a challenging issue. Due to the recent advances in the mobile technologies, the increasing power of the smartphones enables users to be monitored during the everyday life. These technological advances have also led a significant improvement in the signal processing relating to the physical correlates of emotions which include verbal and non-verbal cues. Nowadays many applications for computer desktop or mobile devices

allow users to analyse their face or voice to detect their emotional internal state.

Our research program is thought to be a multi-modal application based on storing and tracking over the time both verbal and non-verbal cues but also on the explicit declarations of the users through the questionnaires and the chat activity with a chatbot. The general structure of the system is shown in Fig. 3.

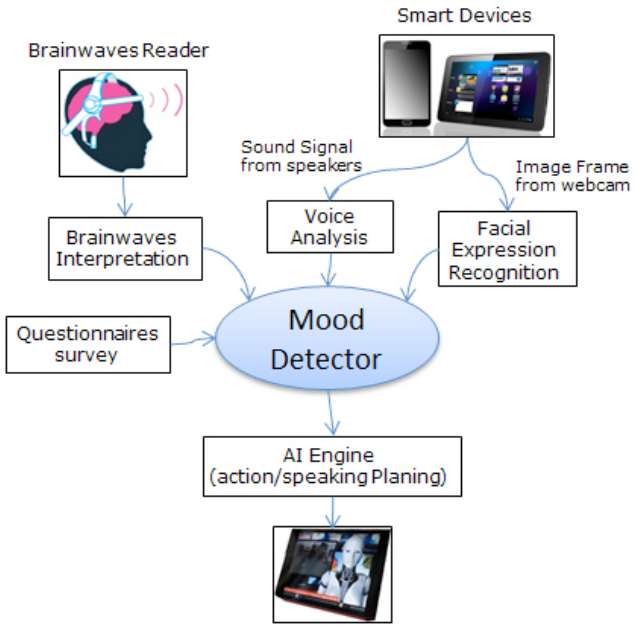

Figure 3. The modular structure of the proposed system

The system is composed of different modules which capture the incoming data flow of the user, extract various features and finally control an artificial social agent according to the user's mood. The system includes the following modules:

1. ***An emotion recognition module****:* it detects and analyses the user's face to obtain information about her/his expressions and physical details. Facial expressions as a non-verbal communicative cues are an important source of emotional messages. They properly reflect human thoughts and they are key features of human emotions. Facial expressions properly reveal the emotional mood of a person. In order to detect facial expressions, SHORE (Sophisticated High-speed Object Recognition Engine) will be integrated into the emotion recognition module [10, 3]. SHORE is a robust detection engine that detects multiple faces in a single frame and tracks them in the real-time. It receives 2D frames from the a webcam, detects the human faces and estimates various facial features of a person such as facial expressions (percentage of "Happy", "Surprised", "Angry" and "Sad"), gender (male/female), age (years), eyes and mouth state (open/close) (Fig. 4). It also detects the rotation of the face up to ± 60 degrees referred to the image plane.

2. ***A questionnaire module:*** it provides the system with explicit information to understand the internal state of the user. Questionnaires will measure the level of self-esteem, anxiety and emotional intelligence. The user's answers will be stored to better define her/his personality and behavior and to keep track of her/his mood over the time.

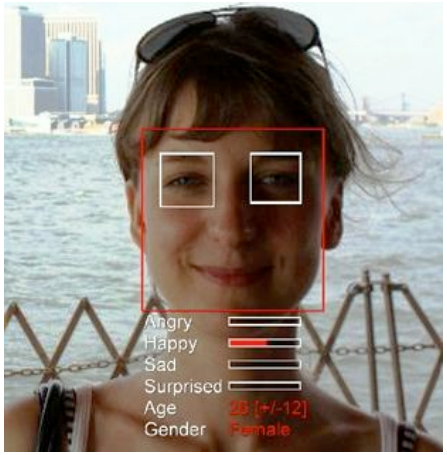

Figure 4. The emotion recognition module estimates the percentage of various apparent emotions such as ”Happy”, ”Surprised”, ”Angry” and ”Sad”. It detects also the age and the gender of a subject which is beneficial for a successful long term interaction.

3. ***A virtual assistant module:*** it is a part of the AI-Engine which uses a chatbot to engage the user in a natural small talk. A chatbot is a computer program designed to simulate intelligent conversations with humans using different heuristic pattern matching rules to the humans' responses. The chatbot is based on AIML (Artificial Intelligence Markup Language), an XML-compliant language used to create the knowledge base of the chatbot. The virtual assistant can also learn a limited set of user's personal preferences to become a personalized virtual assistant.

4. ***A voice analysis module***: it analyses the user's voice to obtain an in-depth view of her/his range of emotions inferring the stress and anxiety level. The voice can provide information about the internal mood state. Relevant emotional states such as stress, confusion, depression or anxiety produce abnormalities in the speech flow which are reflected in different properties of the voice. Mathematical and statistical algorithms can detect and classify these emotional cues of the user's speech by sampling the voice wave spectrums and classifying the acoustic parameters, for example the fundamental frequency, the pitch and the energy.

5. ***A brainwave detection module:*** as an effective component of the system, it is useful for detecting the emotional state of a person. The module will collect brainwaves EEG signals which are reconstructed by Neurosky headset during the interaction [13]. This module is included as an optional prototype module of the system.

A mood estimator engine will collect all the information coming from the different modules in order to estimate and track in real-time the user's mood and behavioral changes. It is connected with the AI-Engine which controls the behaviors of an artificial social agent (virtual person) according to the subject's mood. The AI-Engine has to be well-trained by the user in different situations. It learns the internal dialogues and controls the social artificial agent such that it shows the proper reactions in the way that has learned from the subject's inner dialogues.

Summary

Our research program concerns the development of an innovative e-service aims to increase knowledge of the

human phenomenon of internal dialogues and their functions. Its implementation will enable broader answer to the fundamental question of what is and what role dialogism in human life performs internal dialogues. The application will be used to support people at risk of stress and, indirectly, be used as a new technology for self-discovery and improve the quality of life.

Moreover, the application can replace the existing positive techniques for coping with stress for the worse solution. The authors of the project do not intend to create a therapeutic application but a solution that got us to support the challenges of everyday life and to serve as a tool in stressful situations.

The project aims to develop a compendium of the principles and methods of work with inner dialogues in a virtual environment, use of artificial intelligence in the form of virtual speakers to build the image of our inner polyphony self.

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