Primary Care Interventions for Dementia Using Data Mining

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Abstract

Dementia and cognitive impairment associated with aging are a major medical and social concern. Elderly people constitute a significant percentage of the population all over the world. Patient Central Bureau of General Mobilization and Statistics (2013) reported that elderly represent 6.9% of the Egyptian population, it is estimated that the number of elderly people will be replicated in 2030. Eight percent (8%) of elders aged between 65 & 74, also about 50% aged over 80 suffer from the cognitive disease or dementia. The core of this study is to use intelligent techniques to fulfill specific needs of cognitive deficits patients and assess interaction changes based on patient's behavior in various disease stages. The aim is to provide a usable and effective help for elderly. The proposed idea will be divided into three main phases, evaluation phase, data mining phase and assistance phase. Patient proceeds in the three stages by behavior analysis and feedback to provide interactive evaluation and assistance for him/her.Data Mining phase consists of discovering a certain pattern in huge datasets.Here,the mined information not only help understand the physiological and pathological nature of dementia, but also assist physicians in prognostic risk assessments and developing the best treatment method.

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Chapter 1

INTRODUCTION

Dementia is a broad category of brain diseases that cause a long-term and often gradual decrease in the ability to think and remember that is severe enough to affect a person's daily functioning.

1.1 General

Dementia is a degenerative brain disease that affects cognitive abilities of patients in general and the elderly, in specific . This disease has many forms such as Alzheimer diseases (AD), Vascular dementia, Dementia with Lewy bodies (DLB), Mixed dementia, Frontal temporal lobar degeneration (FTLD). That affects cognitive abilities of patients such as memory, language,communication skills and all daily life activates .

Human-Computer interaction can be defined as a powerful tool used to make technologies more usable, simple and adaptive for everybody and especially with disabilities. Human-Computer Interaction (HCI) points out the design and implementation of computer based systems that different types of people interact with, including embedded systems in all kinds of devices, and desktop systems, as well . HCI is heedful with the following:

1. The user interface between computer and user for designing of the menus and screens,
2. The dialectics for building the functionality into the system.
3. The sequent of using the system over time and its impacts on the society, group, and individual.

1.2 OBJECTIVE OF THE WORK

The work focussed on assistive technologies that based on HCI models are facilitators that can be utilized to improve the quality of life for patients, disabled, and elderly. It can assist human in a more natural way to interact with his environment.

1.3 OUTLINE OF REPORT

First Chapter contains introduction to Primary Care Interventions for Dementia Using Data Mining. Second chapter contains case study of Dementia. Third chapter is Human-Computer Interaction. Fourth chapter is about Data mining and the fifth chapter contains an introduction to natural language processing.The sixth chapter contains conclusion.

Chapter 2

CASE STUDY - DEMENTIA

There is no known cure for dementia. The symptoms of dementia vary across types and stages of the diagnosis.The most common affected areas include memory, visual-spatial, language, attention and problem solving.

2.1 SIGNS AND SYMPTOMS

Most types of dementia are slow and progressive. By the time the person shows signs of the disorder, the process in the brain has been happening for a long time. It is possible for a patient to have two types of dementia at the same time. About 10% of people with dementia have what is known as mixed dementia, which is usually a combination of Alzheimer's disease and another type of dementia such as frontotemporal dementia or vascular dementia [1].Neuropsychiatric symptoms that may be present are termed Behavioural and psychological symptoms of dementia (BPSD) and these can include:

- Balance problems
- Tremor
- Speech and language difficulty
- Trouble eating or swallowing
- Memory distortions (believing that a memory has already happened when it has not, thinking an old memory is a new one, combining two memories, or confusing the people in a memory)

- Wandering or restlessness
- Perception and visual problems
- Behavioral and psychological symptoms of dementia almost always occur in all types of dementia and may manifest as:[2][3]
- Agitation
- Depression
- Anxiety
- Abnormal motor behavior
- Elated mood

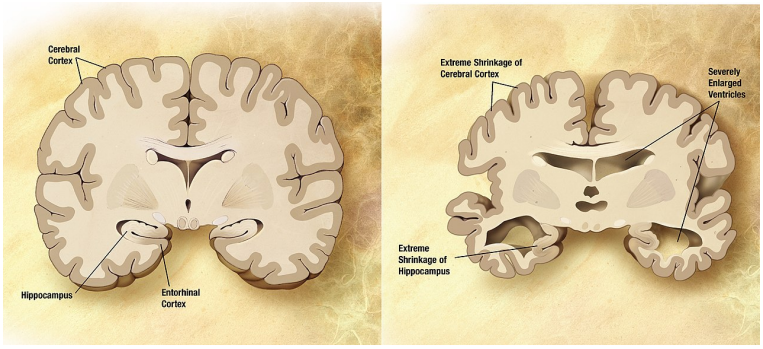

Figure 2.1: Comparison of a normal aged brain (left) and the brain of a person with Alzheimer's disease (right)

When people with dementia are put in circumstances beyond their abilities, there may be a sudden change to crying or anger (a "catastrophic reaction").Psychosis (often delusions of persecution) and agitation/aggression also often accompany dementia.

2.2 STAGES OF DEMENTIA

It starts with little symptoms and gradually increases.When people with dementia are put in circumstances beyond their abilities, there may be a sudden change to crying or anger (a "catastrophic reaction"). These are the main stages of dementia diseases like Alzheimer.

Dementia diseases don't appear all at once, but they start with little symptoms and gradually increase. The speed of symptoms increasing inversely proportional to brain actives like memory training, short and long activities for attention and concentration which help in increasing cognitive abilities. We aim in this research to stand against and delay degenerative brain and memory loss with cognitive brain activities. Cognitive deficits such as Alzheimer and dementia are the most common diseases that affect cognitive abilities for elders. As these diseases advances, more symptoms appear which negatively affect memory, language, and communication skill. It also causes depression and sleep disorders. Until now there is no cure for cognitive deficits that lead to functions loss and ultimately death. Current solutions only help in living with symptoms and decrease the speed of function loss .

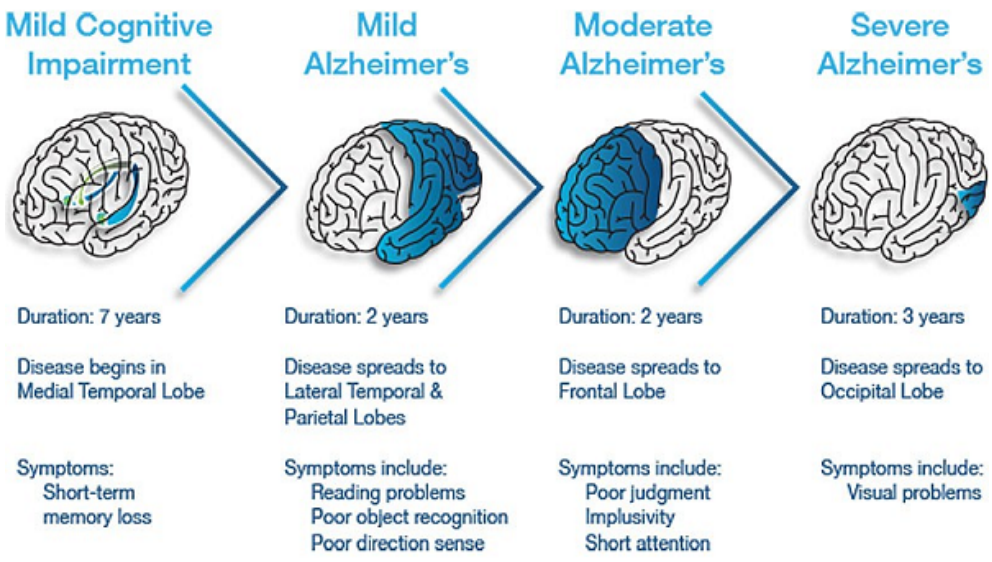

Figure 2.2: Distinct stages of Dementia

In the first stages of dementia, the signs and symptoms of the disorder may be subtle. Often, the early signs of dementia only become apparent when looking back in time. The earliest stage of dementia is called mild cognitive impairment (MCI). 70% of those diagnosed with MCI progress to dementia at some point.

As dementia progresses, the symptoms first experienced in the early stages of the dementia generally worsen. The rate of decline is different for each person. A person with moderate dementia scores between 6–17 on the MMSE.

People with late-stage dementia typically turn increasingly inward and need assistance with most or all of their personal care. Persons with dementia in the late stages usually need 24-hour supervision to ensure personal safety, as well as to ensure that basic needs are being met. If left unsupervised, a person with late-stage dementia may wander or fall, may not recognize common dangers around them such as a hot stove, may not realize that they need to use the bathroom or become unable to control their bladder or bowels (incontinent)[4]

Changes in eating frequently occur. Caregivers of people with late-stage dementia often provide pureed diets, thickened liquids, and assistance in eating, to prolong their lives, to cause them to gain weight, to reduce the risk of choking, and to make feeding the person easier.The person's appetite may decline to the point that the person does not want to eat at all. They may not want to get out of bed, or may need complete assistance doing so. Commonly, the person no longer recognizes familiar people. They may have significant changes in sleeping habits or have trouble sleeping at all.

Stage	Duration	Symptoms	Requirements
Mild-cognitive	7 years	Diseases begins in medial temporal lobe	- Short-term memory loss
Early-stage	2 years	Diseases spread to lateral temporal & parietal	- Previous stage problems - Reading problems - Poor object recognition - Poor direction sense
Moderate-stage	2 years	Disease spread to frontal lobe	- Previous stage problems - Poor judgment - Impulsivity - Short attention
Serve-stage	3 years	Disease spread to occipital lobe	- Previous stage problems - Visual problems

Table 2.1: Stages of Dementia

2.3 DIAGNOSIS

Diagnosis may be aided by brain scanning techniques. In many cases, the diagnosis cannot be absolutely sure except with a brain biopsy, but this is very rarely recommended (though it can be performed at autopsy). In those who are getting older, general screening for cognitive impairment using cognitive testing or early diagnosis of dementia has not been shown to improve outcomes.

Normally, symptoms must be present for at least six months to support a diagnosis. Cognitive dysfunction of shorter duration is called delirium. Delirium can be easily confused with dementia due to similar symptoms. Delirium is characterized by a sudden onset, fluctuating course, a short duration (often lasting from hours to weeks), and is primarily related to a somatic (or medical) disturbance. In comparison, dementia has typically a long, slow onset (except in the cases of a stroke or trauma), slow decline of mental functioning, as well as a longer duration (from months to years).Changes in thinking, hearing and vision are associated with normal ageing and can cause problems when diagnosing dementia due to the similarities.

A CT scan or magnetic resonance imaging (MRI scan) is commonly performed, although these tests do not pick up diffuse metabolic changes associated with dementia in a person that shows no gross neurological problems (such as paralysis or weakness) on neurological exam.[citation needed] CT or MRI may suggest normal pressure hydrocephalus, a potentially reversible cause of dementia, and can yield information relevant to other types of dementia, such as infarction (stroke) that would point at a vascular type of dementia.The functional neuroimaging modalities of SPECT and PET are more useful in assessing long-standing cognitive dysfunction, since they have shown similar ability to diagnose dementia as a clinical exam and cognitive testing.The ability of SPECT to differentiate the vascular cause (i.e., multi-infarct dementia) from Alzheimer's disease dementias, appears superior to differentiation by clinical exam.

2.4 MANAGEMENT

There is some evidence that educating and providing support for the person with dementia, as well as caregivers and family members, improves outcomes. There is low quality

evidence that regular (at least five sessions of) music therapy may help residents in institutions. It may reduce depressive symptoms and improve overall behaviour. There may also be a beneficial effect on emotional well-being and quality of life, as well as anxiety reduction. Exercise programs are beneficial with respect to activities of daily living and potentially improve dementia and these can include:

- Psychological therapies
- Medications
- Diet
- Alternative medicine
- Palliative care

All the above mentioned are not excatly sure about removig dementia perfectly.It may help to get some sort of relief.Although persistent pain in the person with dementia is difficult to communicate, diagnose, and treat, failure to address persistent pain has profound functional, psychosocial, and quality of life implications for this vulnerable population. Health professionals often lack the skills and usually lack the time needed to recognize, accurately assess, and adequately monitor pain in people with dementia. Family members and friends can make a valuable contribution to the care of a person with dementia by learning to recognize and assess their pain. Educational resources (such as the Understand Pain and Dementia tutorial) and observational assessment tools are available. Among otherwise healthy older people, computerized cognitive training may improve memory.

However it is not known if it prevents dementia.Educational resources (such as the Understand Pain and Dementia tutorial) and observational assessment tools are available.

Dementia impacts not only the individuals with dementia, but also their carers and the wider society. Among people aged 60 years and over, dementia is ranked the 9th most burdensome condition according to the 2010 Global Burden of Disease (GBD) estimates.The global costs of dementia is around US $818 billion in 2015, a 35.4% increase from US $604 billion in 2010.

There are some brief tests (5–15 minutes) that have reasonable reliability to screen for

dementia. While many tests have been studied,presently the mini mental state examination (MMSE) is the best studied and most commonly used. The MMSE is a useful tool for helping to diagnose dementia if the results are interpreted along with an assessment of a person's personality, their ability to perform activities of daily living, and their behaviour.Other cognitive tests include the abbreviated mental test score (AMTS), the, Modified Mini-Mental State Examination (3MS).Another approach to screening for dementia is to ask an informant (relative or other supporter) to fill out a questionnaire about the person's everyday cognitive functioning. Informant questionnaires provide complementary information to brief cognitive tests. Probably the best known questionnaire of this sort is the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE).

Chapter 3

HUMAN COMPUTER INTERACTION

As accurate and portable brain imaging technologies become more mainstream, the nature of how we interact with computers will change completely and forever. .

3.1 INTERACTION DESIGN

HCI in assistive technology for special diseases (disabled, elderly) aims to understand and facilitate the needs of patients and their communities (caregivers, doctors, patients). Complete HCI system for Alzheimer's patient (AD) developed by D. Mandiliotis et al. which make an integrated system that fulfill patient's needs in adaptive way, system provide facilities to caregivers and doctors to monitor patient and deal with his needs (symbio music, symbio games, symbio organizer... etc.).

Authors of [5] provide prototype for smart environment for Alzheimer's patient this project aims to depend on monitor patient and immediately help when error has been happened by sending text message to caregivers, this home prototype proposed built-in sensors for oven, refrigerator, sink to reduce risks and allow caregivers to monitor and follow patient actions, authors. This paper demonstrates, in theory, how HCI can be achieved in a smart environment for Alzheimer patients. Others provide multimedia story include (images, videos, music) which allow patient to interact with multimedia, this interaction adaptive dynamically according to the state of the diseases, it will help in the mid stage of cognitive deficits.

Some studies try to interact with patients according to sensors, [6] try to extract emotions in three levels arousal valence and dominance dimensions VAD levels developed HCI system to understand and classify human emotions through VAD levels, physiological features used from DEAP dataset to analysis and extract features for emotional patterns. Extreme machine learning (ELM) used to predict emotions. Others (as shown in Fig. 2.) depend on speech and gesture as input for developing HCI System, gesture input is provided through a computer mouse (instead of a pen), speech recognition made using the open source software Pocket Sphinx. Screen recording and camera recording used as inputs datasets another type of interaction by hand gesture .

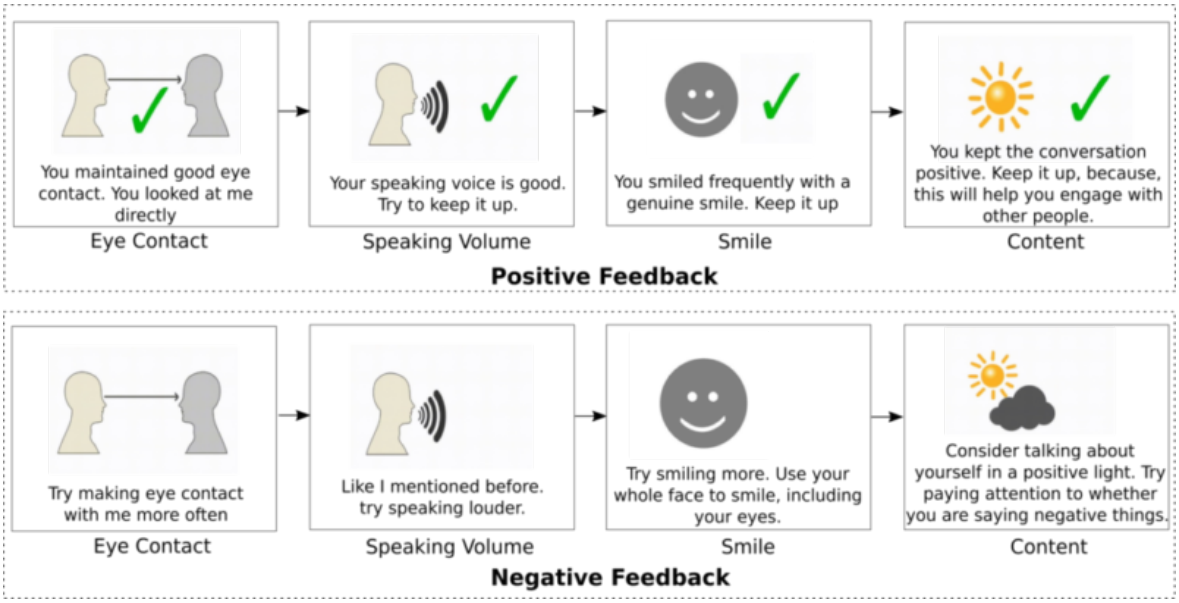

Figure 3.1: HCI -Example

Healthcare industry nowadays produces big dataset about patients, disease recognition and diagnosis etc. The massive amount of data is the core of analyzing and extracting knowledge that helps in efficient decision making and cost saving. Healthcare application depends on data mining in diagnosis, treatment and enhancing healthcare resource management etc. Using data mining and machine learning in health care would save various manual process that leads to improving patient care, data mining provides several types of processes that extract valuable information that help doctors and caregivers in taking the right decision in patient diagnosis and treatment. Machine learning in healthcare recently made huge improvements, Google developed machine learning algorithm

that made diagnosis cancerous tumors based on mammograms.
It also reported high results in skin cancer using deep neural network . Diabetic retinopathy in retinal images also diagnosed using deep machine learning algorithm . Ilayaraja et al [15] proposed data mining technique to predict the patient under risk based on some chosen features and the level of risk. This method was applied over 1000 record of heart disease patient who suffer from several heart diseases it depends on, discarding the unnecessary item set which does not satisfy the support value, this method increases efficiency and save execution time.

3.2 PHASES

HCI points out the design and implementation of computer-based systems that different types of people interact with. Various kinds of data are needed to simulate human- computer interactions for elderly. These data could be structured or unstructured.One of the main contributions of our research is to enhance prediction of emotion and needs of the patient based on data mining. Assistive technologies that based on HCI models are facilitators that can be utilized to improve the quality of life for patients, disabled, and elderly. It can assist human in a more natural way to interact with his environment. Proposed framework will be divided into three main phases :

- Evaluation phases and Acronyms
- Data mining phase
- Assistance phase

First phase is the user interface between computer and user for designing of the menus and screens and the second phase is The dialectics for building the functionality into the system. And in the third phase contains the sequence of using the system over time and its impacts on the society, group, and individual.System provide facilities to caregivers and doctors to monitor patient and deal with his needs symbio music,symbio games.

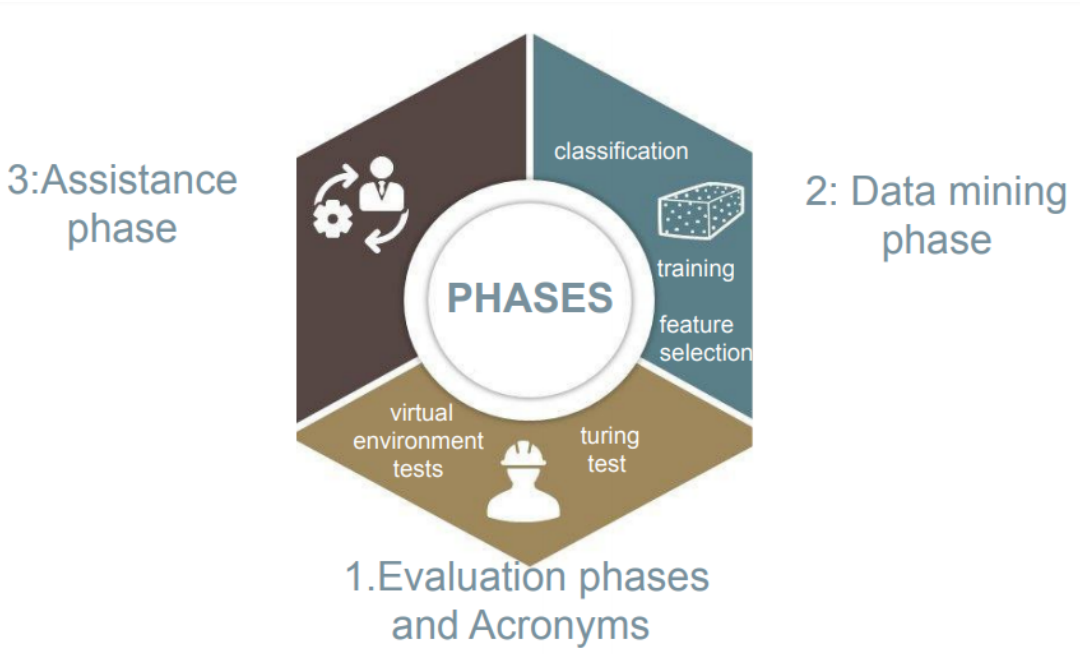

Figure 3.2: HCI - Phases

3.2.1 Phase 1: Evaluation phases and Acronyms

This phase will focus on the evaluation of cognitive abilities using games and tests that evaluate short-term memory, attention, and concentration, the proposed test will focus in the evaluation of memory functions which related to recent events and conversations. Proposed cognitive evaluation test based on turning test and virtual environment tests. This stage will be considered as an input to the third stage. System in the third stage will vary and dynamically change according to cognitive abilities.

3.2.2 Phase 2: Data mining phase

In this phase, the system will try to capture data from patient sensors and analyzeit in the real time with the clinical and the in a middle data mining layer. Physiological and vital data will be analyzed, and key features will be extracted using feature selection techniques, then training and on time classification. This stage has a great importance in understanding and developing of usable and accessible HCI interface that will assist in improving cognitive abilities of the patient.

3.2.3 Phase 3: Assistance phase

This phase is the most important phase of proposed system.The sequence of using the system over time and its impacts on the society, group, and individual contains here. It provides thefollowing possibilities:

- Use data mining from the previous step to predict patient needs.
- Provide mental activities to develop awareness and recognition.
- Make periodically assessment to the patient
- Provide feedback and automatically adapt system according to patient status.

Human–computer interaction (HCI) researches the design and use of computer technology, focused on the interfaces between people (users) and computers. Researchers in the field of HCI both observe the ways in which humans interact with computers and design technologies that let humans interact with computers in novel ways. As a field of research, human–computer interaction is situated at the intersection of computer science, behavioural sciences, design, media studies, and several other fields of study. Poorly designed human-machine interfaces can lead to many unexpected problems. A classic example is the Three Mile Island accident, a nuclear meltdown accident, where investigations concluded that the design of the human-machine interface was at least partly responsible for the disaster. Similarly, accidents in aviation have resulted from manufacturers' decisions to use non-standard flight instrument or throttle quadrant layouts: even though the new designs were proposed to be superior in basic human-machine interaction, pilots had already ingrained the "standard" layout and thus the conceptually good idea actually had undesirable results.

A number of diverse methodologies outlining techniques for human–computer interaction design have emerged since the rise of the field in the 1980s. Most design methodologies stem from a model for how users, designers, and technical systems interact. Early methodologies, for example, treated users' cognitive processes as predictable and quantifiable and encouraged design practitioners to look to cognitive science results in areas such as memory and attention when designing user interfaces. Modern models tend to focus on a constant feedback and conversation between users, designers, and engineers

and push for technical systems to be wrapped around the types of experiences users want to have, rather than wrapping user experience around a completed system.

Chapter 4

INTRODUCTION TO NATURAL LANGUAGE PROCESSING

Nowadays, it is used to power search engines, filter spam and to obtain analytics in a fast and scalable manner. Researchers are even able to boast of near human level perfection in many of these tasks, the most prominent being machine translation. With the surplus of tools and technologies dedicated to NLP, it's so easy to get started..

4.1 History

The history of natural language processing (NLP) generally started in the 1950s, although work can be found from earlier periods. In 1950, Alan Turing published an article titled "Computing Machinery and Intelligence" which proposed what is now called the Turing test as a criterion of intelligence.Some notably successful natural language processing systems developed in the 1960s were SHRDLU, a natural language system working in restricted "blocks worlds" with restricted vocabularies, and ELIZA, a simulation of a Rogerian psychotherapist, written by Joseph Weizenbaum between 1964 and 1966. Using almost no information about human thought or emotion, ELIZA sometimes provided a startlingly human-like interaction. When the "patient" exceeded the very small knowledge base, ELIZA might provide a generic response, for example, responding to "My head hurts" with "Why do you say your head hurts?".

In the 2010s, representation learning and deep neural network-style machine learning methods became widespread in natural language processing, due in part to a flurry of

results showing that such techniques can achieve state-of-the-art results in many natural language tasks, for example in language modeling, parsing,[7] and many others. Popular techniques include the use of word embeddings to capture semantic properties of words, and an increase in end-to-end learning of a higher-level task (e.g., question answering) instead of relying on a pipeline of separate intermediate tasks (e.g., part-of-speech tagging and dependency parsing). In some areas, this shift has entailed substantial changes in how NLP systems are designed, such that deep neural network-based approaches may be viewed as a new paradigm distinct from statistical natural language processing. For instance, the term neural machine translation (NMT) emphasizes the fact that deep learning-based approaches to machine translation directly learn sequence-to-sequence transformations, obviating the need for intermediate steps such as word alignment and language modeling that were used in statistical machine translation (SMT).
Nowadays, it is used to power search engines, filter spam and to obtain analytics in a fast and scalable manner. Researchers are even able to boast of near human level perfection in many of these tasks, the most prominent being machin translation. With the surplus of tools and technologies dedicated to NLP, it's so easy to get started.

4.2 Components of NLP

Though natural language processing tasks are closely intertwined, they are frequently subdivided into categories for convenience.Main Component of Natural Language processing are:

- Morphological and Lexical Analysis
- Syntactic Analysis
- Semantic Analysis
- Discourse Integration
- Pragmatic Analysis

Natural Language Understanding is mapping the given input in the natural language into a useful representation.Convert chunks of text into more formal representations such

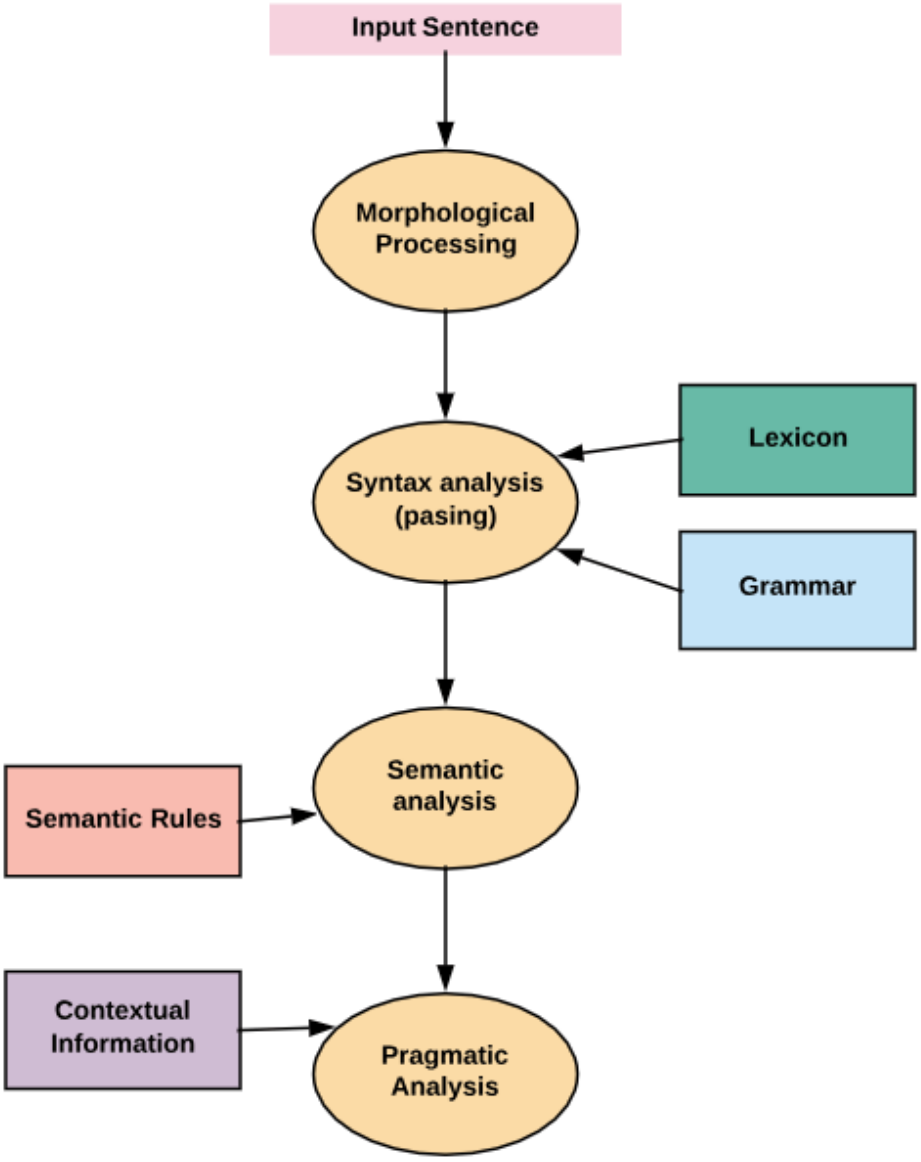

Figure 4.1: Component of Natural Language processing

as first-order logic structures that are easier for computer programs to manipulate. Natural language understanding involves the identification of the intended semantic from the multiple possible semantics which can be derived from a natural language expression which usually takes the form of organized notations of natural language concepts. Introduction and creation of language metamodel and ontology are efficient however empirical solutions. An explicit formalization of natural language semantics without confusions with implicit assumptions such as closed-world assumption (CWA) vs. open-world assumption, or subjective Yes/No vs. objective True/False is expected for the construction of a basis of semantics formalization.

4.2.1 Morphological and Lexical Analysis

Lexical analysis is a vocabulary that includes its words and expressions. It depicts analyzing, identifying and description of the structure of words. It includes dividing a text into paragraphs, words and the sentences Individual words are analyzed into their components, and nonword tokens such as punctuations are separated from the words.
Separate words into individual morphemes and identify the class of the morphemes. The difficulty of this task depends greatly on the complexity of the morphology (i.e. the structure of words) of the language being considered. English has fairly simple morphology, especially inflectional morphology, and thus it is often possible to ignore this task entirely and simply model all possible forms of a word (e.g. ”open, opens, opened, opening”) as separate words. In languages such as Turkish or Meitei, a highly agglutinated Indian language, however, such an approach is not possible, as each dictionary entry has thousands of possible word forms.

4.2.2 Semantic Analysis

Semantic Analysis is a structure created by the syntactic analyzer which assigns meanings. This component transfers linear sequences of words into structures. It shows how the words are associated with each other.One among them is Named entity recognition (NER). Given a stream of text, determine which items in the text map to proper names, such as people or places, and what the type of each such name is (e.g. person, location, organization). Although capitalization can aid in recognizing named entities in languages such as English, this information cannot aid in determining the type of named entity, and in any case is often inaccurate or insufficient. For example, the first letter of a sentence is also capitalized, and named entities often span several words, only some of which are capitalized. Furthermore, many other languages in non-Western scripts (e.g. Chinese or Arabic) do not have any capitalization at all, and even languages with capitalization may not consistently use it to distinguish names. For example, German capitalizes all nouns, regardless of whether they are names, and French and Spanish do not capitalize names that serve as adjectives.
Semantics focuses only on the literal meaning of words, phrases, and sentences. This

only abstracts the dictionary meaning or the real meaning from the given context. The structures assigned by the syntactic analyzer always have assigned meaning
E.g.. ”colorless green idea.” This would be rejected by the Symantec analysis as colorless Here; green doesn’t make any sense.

4.2.3 Pragmatic Analysis

Pragmatic Analysis deals with the overall communicative and social content and its effect on interpretation. It means abstracting or deriving the meaningful use of language in situations. In this analysis, the main focus always on what was said in reinterpreted on what is meant.
Pragmatic analysis helps users to discover this intended effect by applying a set of rules that characterize cooperative dialogues.E.g., ”close the window?” should be interpreted as a request instead of an order.

4.2.4 Syntax analysis

The words are commonly accepted as being the smallest units of syntax. The syntax refers to the principles and rules that govern the sentence structure of any individual languages.Syntax focus about the proper ordering of words which can affect its meaning. This involves analysis of the words in a sentence by following the grammatical structure of the sentence. The words are transformed into the structure to show hows the word are related to each other.
One among this is parsing.Determine the parse tree (grammatical analysis) of a given sentence. The grammar for natural languages is ambiguous and typical sentences have multiple possible analyses. In fact, perhaps surprisingly, for a typical sentence there may be thousands of potential parses (most of which will seem completely nonsensical to a human). There are two primary types of parsing, Dependency Parsing and Constituency Parsing. Dependency Parsing focuses on the relationships between words in a sentence (marking things like Primary Objects and predicates), whereas Constituency Parsing focuses on building out the Parse Tree using a Probabilistic Context-Free Grammar (PCFG). See also: Stochastic grammar.

4.2.5 Discourse Integration

It means a sense of the context. The meaning of any single sentence which depends upon that sentences. It also considers the meaning of the following sentence.

One among this is Coreference resolution. Given a sentence or larger chunk of text, determine which words (”mentions”) refer to the same objects (”entities”). Anaphora resolution is a specific example of this task, and is specifically concerned with matching up pronouns with the nouns or names to which they refer. The more general task of coreference resolution also includes identifying so-called ”bridging relationships” involving referring expressions. For example, in a sentence such as ”He entered John’s house through the front door”, ”the front door” is a referring expression and the bridging relationship to be identified is the fact that the door being referred to is the front door of John’s house (rather than of some other structure that might also be referred to).For example, the word ”that” in the sentence ”He wanted that” depends upon the prior discourse context.

4.3 Architecture of the components of a Conversational Agent

Approaches to computational architectures of conversa-tional agents vary a great deal with respect to the underly-ing practical requirements, with no agreement betweenresearchers on the most productive approach. This architecture contains sixmodules, each of which corresponds to a certain cognitiveaspect underlying the human language processing system.The speech recognition and natural language understandingmodules extract meaning from the user’s input. The dialo-gue management module controls the dialogue flow. Itaccepts interpreted dialogue acts as input, interacts withexternal knowledge resources (e.g. a task managementcomponent), decides on which dialogue acts should be gen-erated, formulates their meaning, and so on. The naturallanguage generation and speech synthesis components mapfrom meaning to speech. This architecture is rather general,that is, not based on particular requirements. It encapsulatesthe common foundation of different conversational agents,and can be adapted to various conversational scenarios.

At the other end of the scale, there are a number ofmore elaborate architectures in terms of an increasednumber of modules that implement additional functionalrequirements (e.g. emotion recognition, multimodal inter-action, etc.). The requirements on such architectures arisefrom particular scenarios of use. The advantage of thesearchitectures is that they are based on (more or less) well-defined requirements. The disadvantage is that they arenot really applicable to other scenarios. The trade-offbetween the two ends of the spectrum is apparent, andresearchers tend – for obvious practical reasons – to focuson scenario-specific design.However, it is important to emphasize that speech rec-ognition modules are usually architecture-agnostic all overthis scale. In other words, the research question of speechrecognition is usually considered outside of an architecturalcontext. The researchers take into account dimensions ofvariation in speech recognition tasks such as vocabularysize, fluency of speech, variation in channel and noise, andspeaker-class characteristics.

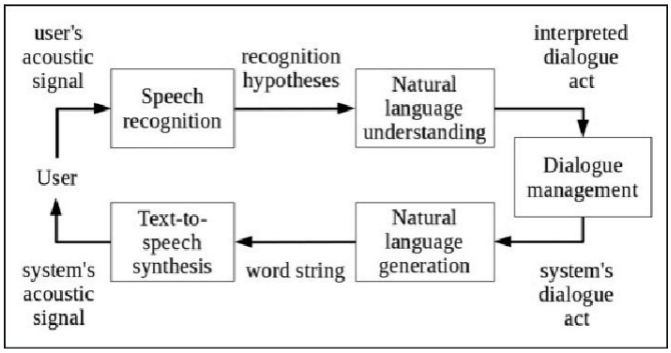

Figure 4.2: Architecture of the components of a Conversational Agent

Chapter 5

CONCLUSION

Elderly people constitute a significant percentage of the population all over the world. The aim of the study is to explore needs of patients with cognitive deficits and understand the need to help in patient's daily activities.This paper reports an ongoing research project of for elder people. The core of this research is to apply intelligent techniques to meet particular needs of cognitive deficits patients and assess interplay adjustments based totally on his or her behavior in diverse disease stages.The aim of the study is to explore needs of patients with cognitive deficits and understand the need to help in patient's daily activities.

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APPENDIX

- Reference Paper of the Seminar-A Proposed Effective Framework for Elderly with Dementia Using Data Mining
- PPT of the Seminar

A Proposed Effective Framework for Elderly with Dementia Using Data Mining

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***Abstract*—Elderly people constitute a significant percentage of the population all over the world. Patient Central Bureau of General Mobilization and Statistics (2013) reported that elderly represent 6.9% of the Egyptian population, it is estimated that the number of elderly people will be replicated in 2030. Eight percent (8%) of elders aged between 65 & 74, also about 50% aged over 80 suffer from the cognitive disease or dementia. The core of this research is to use intelligent techniques to fulfill specific needs of cognitive deficits patients and assess interaction changes based on patient's behavior in various disease stages. The aim of this paper is to provide a usable and effective framework for elderly. The proposed framework will be divided into three main phases, evaluation phase, data mining phase and assistance phase. Patient proceeds in the three stages by behavior analysis and feedback to provide interactive evaluation and assistance for him/her.**

Keywords—Dementia; Alzahimar; Elderly; Data-Mining; HCI

INTRODUCTION

Dementia is a degenerative brain disease that affects cognitive abilities of patients in general and the elderly, in specific [1] . This disease has many forms such as Alzheimer diseases (AD), Vascular dementia, Dementia with Lewy bodies (DLB), Mixed dementia, Frontal temporal lobar degeneration (FTLD). That affects cognitive abilities of patients such as memory, language, communication skills and all daily life activates [2]. Human-Computer interaction can be defined as a powerful tool used to make technologies more usable, simple and adaptive for everybody and especially with disabilities.

Human-Computer Interaction (HCI) points out the design and implementation of computer-based systems that different types of people interact with, including embedded systems in all kinds of devices, and desktop systems, as well [3]. HCI is heedful with the following:

1. The user interface between computer and user for designing of the menus and screens,
2. The dialectics for building the functionality into the system.
3. The sequent of using the system over time and its impacts on the society, group, and individual.

Assistive technologies that based on HCI models are facilitators that can be utilized to improve the quality of life for patients, disabled, and elderly. It can assist human in a more natural way to interact with his environment.

Alzheimer and other forms of dementia have many symptoms that affect cognitive abilities such as memory loss, communication, and intellectual skills, as time progress symptoms change and the disease deteriorate more brain cells through early, mid, and late stages, symptoms can vary for everyone in each stage. Until now, there is no cure for cognitive deficits, but some technologies were developed to overcome symptoms and decrease worse illness [4].

Although the research on elders' welfare is extensive, there is very little research on evaluating and dynamically adapting to user needs. Adapting to patients' behaviors, changes and communication skills is the core of our research. The system will depend on monitoring patient continuously and analyze its activities and behaviors by intelligent techniques, then offer assistance that suits his/her needs. In most systems inputs are usually provided by hardware devices such as a mouse, or a keyboard. In HCI systems inputs provided by smart devices like (GPS, Health devices, etc.) or captured from sensors in a way that permits capturing data without the user noticing (through gaming techniques) which makes interaction natural. Our main task is to make an evaluation and analysis of data in real-time and provide adaptive friendly and effective assistance for all daily activates.

In the literature, the majority of HCI systems for patients with dementia present an insufficiency [5] in analysis due to the complexity of processing different kinds of data and emotions. However, integrating elders' needs in one framework is a necessity.

The second section of this paper presents the related work. 3rd and 4th sections will present the aim of this research and the research question, respectively. The proposed framework is presented in section 5. Finally, the conclusions and future work are presented.

RELATED WORK

It's no doubt that cognitive deficits such as Alzheimer and forms of dementia are the most public health and social care challenges facing people currently and in the future and the most expensive diseases today in many countries. T.R. Reid [6] reported in a recent article in the AARP Bulletin that "the cost of caring Alzheimer and dementia patients in America exceeds the cost of treatment for heart and cancer patients. An estimated of 46 million people have Alzheimer and dementia worldwide, this number is excepted to increase 131.5 million by 2050. The symptoms of dementia disease vary from person to person. In contrast with most of diseases and disorders, dementia

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diseases don't appear all at once. It starts with little symptoms and gradually increases. Most cognitive deficits patients have in common symptoms and stages, learning about diseases help in setting the stage of the patient and maintain needs accordance with this stage. There are three main stages of dementia diseases like Alzheimer (mid-early stage, Moderate stage, serve early stage) Fig. 1 illustrate brain status in the three distinct stages".

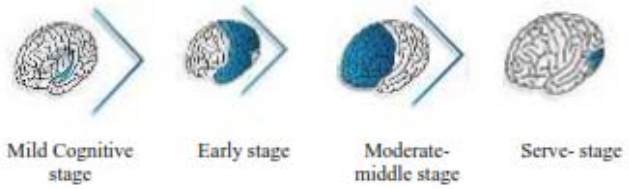

Fig. 1. Distinct Stages of Alzheimer

TABLE I. STAGE DURATION, SYMPTOMS, AND REQUIREMENTS

Stage	Duration	Symptoms	Requirements
Mild-cognitive	7 years	Diseases begins in medial temporal lobe	- Short-term memory loss
Early-stage	2 years	Diseases spread to lateral temporal & parietal	- Previous stage problems - Reading problems - Poor object recognition - Poor direction sense
Moderate-stage	2 years	Disease spread to frontal lobe	- Previous stage problems - Poor judgment - Impulsivity - Short attention
Serve-stage	3 years	Disease spread to occipital lobe	- Previous stage problems - Visual problems

As mentioned above in table 1 dementia diseases don't appear all at once, but they start with little symptoms and gradually increase. The speed of symptoms increasing inversely proportional to brain actives like memory training, short and long activities for attention and concentration which help in increasing cognitive abilities. We aim in this research to stand against and delay degenerative brain and memory loss with cognitive brain activities. Cognitive deficits such as Alzheimer and dementia are the most common diseases that affect cognitive abilities for elders. As these diseases advances, more symptoms appear which negatively affect memory, language, and communication skill. It also causes depression and sleep disorders. Until now there is no cure for cognitive deficits that lead to functions loss and ultimately death. Current solutions only help in living with symptoms and decrease the speed of function loss [7].

HCI in assistive technology for special diseases (disabled, elderly) aims to understand and facilitate the needs of patients and their communities (caregivers, doctors, patients). Complete HCI system for Alzheimer's patients (AD) developed by D. Mandiliotis et al. [7] which make an integrated system that fulfill patient's needs in adaptive way, system provide facilities to caregivers and doctors to monitor patient and deal with his needs (symbio music, symbio games, symbio organizer... etc.). Authors of [8] provide prototype for smart environment for Alzheimer's patient this project aims to depend on monitor patient and immediately help when error has been happened by sending text message to caregivers, this home prototype proposed built-in sensors for oven, refrigerator, sink to reduce risks and allow caregivers to monitor and follow patient actions, authors. This paper demonstrates, in theory, how HCI can be achieved in a smart environment for Alzheimer patients. Others [9] provide multimedia story include (images, videos, music) which allow patient to interact with multimedia, this interaction adaptive dynamically according to the state of the diseases, it will help in the mid stage of cognitive deficits.

Some studies try to interact with patients according to sensors, [4] try to extract emotions in three levels arousal valence and dominance dimensions VAD levels developed HCI system to understand and classify human emotions through VAD levels, physiological features used from DEAP dataset to analysis and extract features for emotional patterns. Extreme machine learning (ELM) used to predict emotions. Others [10] (as shown in Fig. 2.) depend on speech and gesture as input for developing HCI System, gesture input is provided through a computer mouse (instead of a pen), speech recognition made using the open source software Pocket Sphinx. Screen recording and camera recording used as inputs datasets another type of interaction by hand gesture [11].

Healthcare industry nowadays produces big dataset about patients, disease recognition and diagnosis etc. The massive amount of data is the core of analyzing and extracting knowledge that helps in efficient decision making and cost saving. Healthcare application depends on data mining in diagnosis, treatment and enhancing healthcare resource management etc. Using data mining and machine learning in health care would save various manual process that leads to improving patient care, data mining provides several types of processes that extract valuable information that help doctors and caregivers in taking the right decision in patient diagnosis and treatment. Machine learning in healthcare recently made huge improvements, Google developed machine learning algorithm that made diagnosis cancerous tumors based on mammograms[12]. It also reported high results in skin cancer using deep neural network [13]. Diabetic retinopathy in retinal images also diagnosed using deep machine learning algorithm [14]. Ilayaraja et al [15] proposed data mining technique to predict the patient under risk based on some chosen features and the level of risk. This method was applied over 1000 record of heart disease patient who suffer from several heart diseases it depends on, discarding the unnecessary item set which does not satisfy the support value, this method increases efficiency and save execution time.

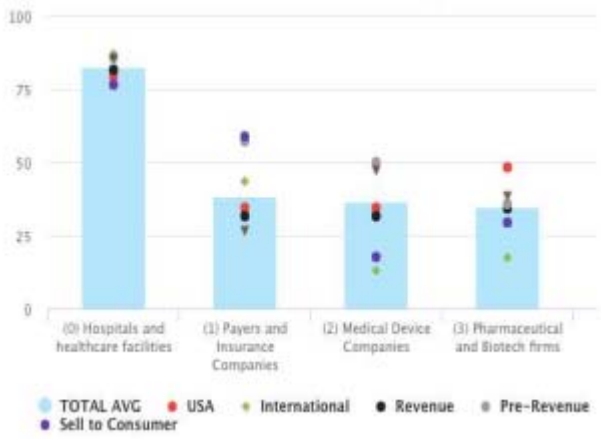

Fig. 2. How Data Mining Affect In Healthcare Side World Side and in USA [10]

MOTIVATIONS

It is clear that a limited number of devices and assistive software are developed for elders in technology industries. In spite of the fact that the number of elder people with cognitive deficits is significant, it's clear that Alzheimer Disease International (ADI) [16] has reported that there are 44 million people with AD around the world and 83 million people that suffer from cognitive deficits This number is expected that this number will triple by 2050.

Designing technology system for elders allows them to stay in their home longer and safer. For example shopping systems, emails, security system and games will increase the sense of dependable and well-being, as T.cohne [9] reported that speed of memory and functions loss will decrease with daily activities.Therefore the present study aims to understand and interact with AD patients, develop an application with simple and accessible interface could effectively adapt with patient requirements and, predict patient needs and increase cognitive abilities through daily life activities.

RESEARCH QUESTION, OBJECTIVES

This study aims to understand the needs of patients with cognitive deficits; the main goal of this study is to answer some question,

- How can human-computer interaction help elderly in their daily activities in the efficient and friendly way?
- How can the research of this dissertation help in increasing the cognitive ability of elders?
- What kind of data mining techniques and dataset will help in diagnosis and assist elders?
- Will this kind of smart interface will encourage elders to change the way they convince about technology systems?

THE PROPOSED FRAMEWORK

The aim of the study is to explore needs of patients with cognitive deficits and understand the need to help in patient's daily activities. Our research focuses on help facility that assists patients with cognitive deficits using intelligent techniques. Proposed system aims to monitor patient activities, evaluate interactions and adjust the system to suit patient needs. Various kinds of data are needed to simulate human- computer interactions for elderly. These data could be structured or unstructured. Table 3 will list various types of human data that could be captured from different sensors according to literature.

One of the main contributions of our research is to enhance prediction of emotion and needs of the patient based on data mining. TABLE 2 AND TABLE 3 summarizes an overview of data mining techniques according to the literature review. Proposed framework will be divided into three main phases as shown in Fig. 3. Framework phases will be discussed in the following section.

TABLE II. TYPES OF HUMAN DATA

Data	Reference number(s)
Vital signs	[7], [17], [18]
EEG signals	[7], [19], [20], [17]
Eye gaze	[21], [22]
Speech	[10], [23]
Emotion	[4], [7]

TABLE III. DATA MINING TECHNIQUES

Classification techniques	Reference number(s)
Neural Networks	[12], [13]
Extreme Machine Learning (ELM)	[4]
Wavelet transform	[4]
Bayesian network	[24], [18]
Rule-based tree	[24], [25]

A. Phase 1: Evaluation phases and Acronyms

This phase will focus on the evaluation of cognitive abilities using games and tests that evaluate short-term memory, attention, and concentration, the proposed test will focus in the evaluation of memory functions which related to recent events and conversations. J.M. Montenegro ...et al [21] proposed cognitive evaluation test based on turning test and virtual environment tests. This stage will be considered as an input to the third stage. System in the third stage will vary and dynamically change according to cognitive abilities.

B. Phase 2: Data mining phase

In this phase, the system will try to capture data from patient sensors and analyze it in the real time with the clinical and the in a middle data mining layer. Physiological and vital data will be analyzed, and key features will be extracted using feature selection techniques, then training and on time classification. This stage has a great importance in understanding and developing of usable and accessible HCI interface that will assist in improving cognitive abilities of the patient.

C. Phase 3: Assistance phase

This phase is the most important phase of our proposed system. It provides the following possibilities:

- Use data mining from the previous step to predict patient needs.
- Provide mental activities to develop awareness and recognition.
- Make periodically assessment to the patient.
- Provide feedback and automatically adapt system according to patient status.

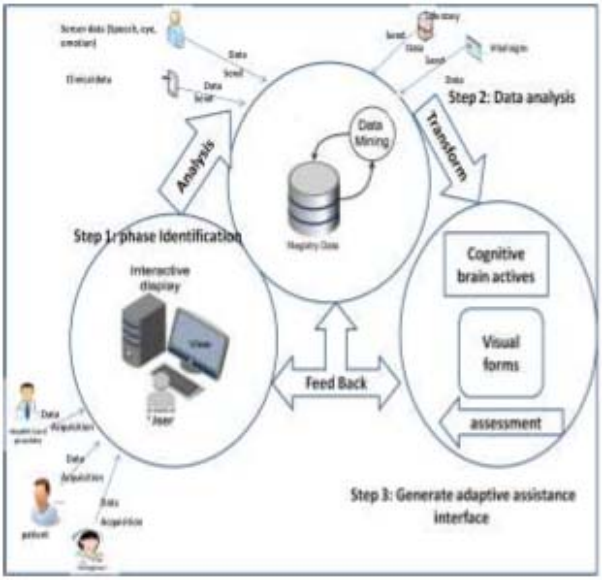

Fig. 3. The Proposed Framework

CONCLUSION AND FUTURE WORK

This paper reports an ongoing research project of for elder people. The core of this research is to apply intelligent techniques to meet particular needs of cognitive deficits patients and assess interplay adjustments based totally on his or her behavior in diverse disease stages. The aim of this paper is to provide an effective and usable framework for elderly; the proposed framework is divided into three main phases, evaluation phase, data mining phase and assistance phase. Patient proceeds in the three stages by behavior analysis and feedback to provide interactive evaluation and assistance for him/her.

After implementing this framework, authors will apply it for elderly and will try to improve it after recording the results.

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BETSIE

A Virtual Assistant for Dementia Affected Ones....

Overview

Not a specific disease, dementia is a group of conditions characterised by impairment of at least two brain functions, such as memory loss and judgement.

Globally, dementia affected about 46 million people in 2015. About 10% of people develop the disorder at some point in their lives. It becomes more common with age and There is no known cure for dementia. One in every 3 seconds a new person someone somewhere is affected by dementia. It’s not the disease of age, it’s a disease of the brain and patients may show Symptoms like loss of memory, difficulty in finding the right words or understanding what people are saying, difficulty in performing previously routine tasks and personality and mood changes

Betsie, the virtual assistant , will listen and detect what the user says and responds to user's requests in a friendly, effective manner via voice in a manner of a conversation. There are four main components of the system; the voice recognition module, the natural language processing module, conversational agent and the content extraction module. This is a much faster and interactive solution than regular assistive software for the patients affected with dementia.

A Proposed Effective Framework for Elderly with Dementia Using Data Mining

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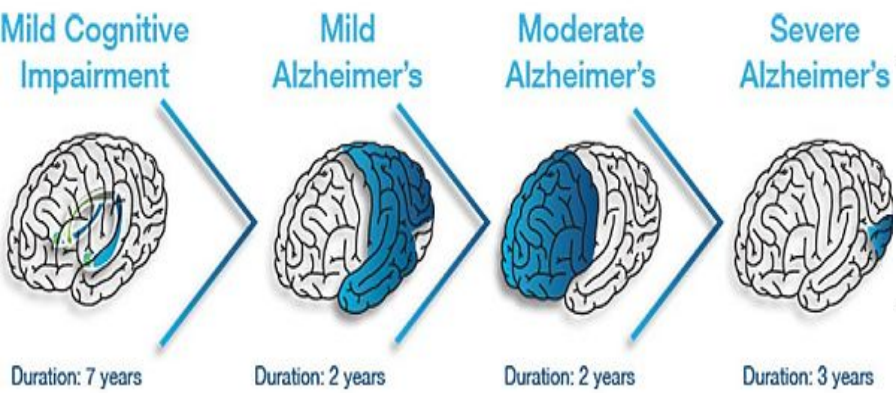
2018 International Seminar on Research of Information Technology and Intelligent Systems (ISRITI)

This paper reports an ongoing research project of for elder people. The core of this research is to apply intelligent techniques to meet particular needs of cognitive deficits patients and assess interplay adjustments based totally on his or her behavior in diverse disease stages. The aim of this paper is to provide an effective and usable framework for elderly; the proposed framework is divided into three main phases, evaluation phase, data mining phase and assistance phase.

It starts with little symptoms and gradually increases.
These are the main stages of dementia diseases like Alzheimer

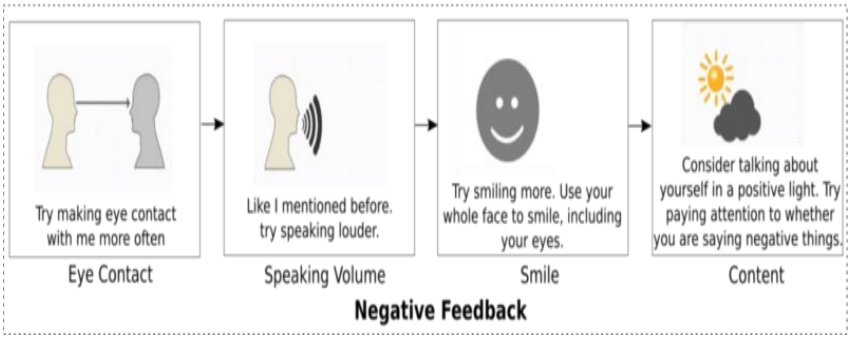


Stage	Duration	Symptoms	Requirements
Mild-cognitive	7 years	Diseases begins in medial temporal lobe	- Short-term memory loss
Early-stage	2 years	Diseases spread to lateral temporal & parietal	- Previous stage problems - Reading problems - Poor object recognition - Poor direction sense
Moderate-stage	2 years	Disease spread to frontal lobe	- Previous stage problems - Poor judgment - Impulsivity - Short attention
Serve-stage	3 years	Disease spread to occipital lobe	- Previous stage problems - Visual problems

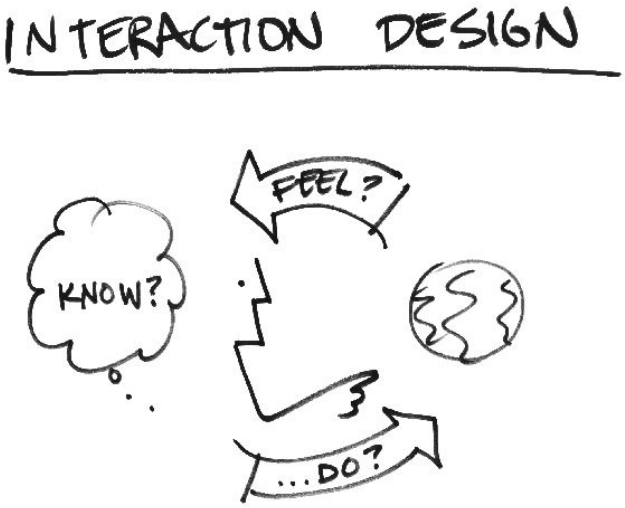
HCI -Human-Computer Interaction

Assistive technologies that based on HCI models are facilitators that can be utilized to improve the quality of life for patients, disabled, and elderly.

It can assist human in a more natural way to interact with his environment.



HCI points out the design and implementation of computer-based systems that different types of people interact with.

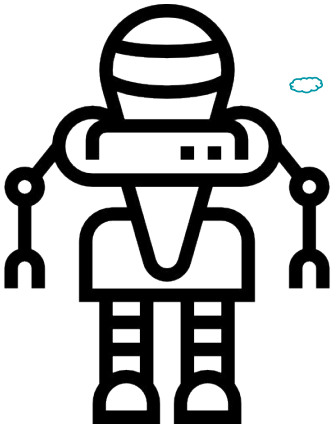


3. The sequence of using the system over time and its impacts on the society, group, and individual

1.The user interface between computer and user for designing of the menus and screens,

2. The dialectics for building the functionality into the system.

System provide facilities to caregivers and doctors to monitor patient and deal with his needs
symbio music,symbio games..



speech and gesture

↓

extract features for emotional patterns

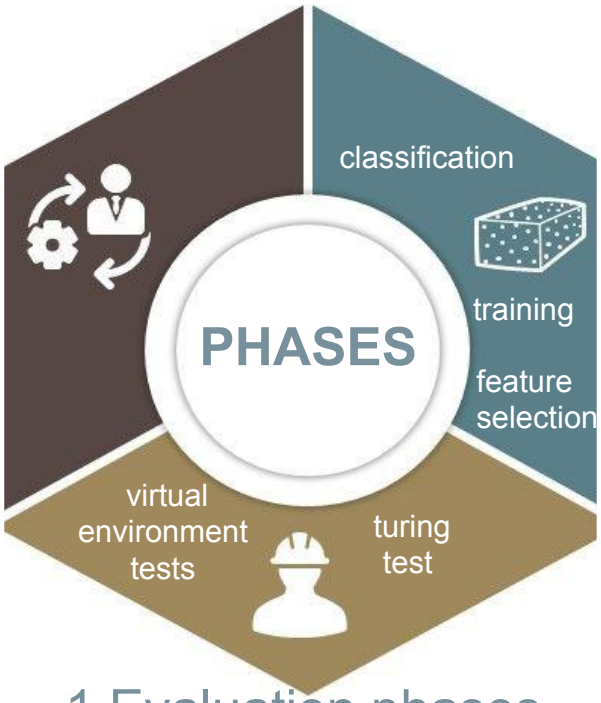
↓

Extreme machine learning (ELM)

↓

predict emotions

3:Assistance phase



2: Data mining phase

1.Evaluation phases and Acronyms

Phase 1: Evaluation phases and Acronyms

This phase will focus on the evaluation of cognitive abilities using games and tests that evaluate short-term memory, attention, and concentration, the proposed test will focus in the evaluation of memory functions which related to recent events and conversations.

Proposed cognitive evaluation test based on turning test and virtual environment tests. This stage will be considered as an input to the third stage. System in the third stage will vary and dynamically change according to cognitive abilities.

Phase 2: Data mining phase

In this phase, the system will try to capture data from patient sensors and analyze it in the real time with the clinical and the in a middle data mining layer. Physiological and vital data will be analyzed, and key features will be extracted using feature selection techniques, then training and on time classification. This stage has a great importance in understanding and developing of usable and accessible HCI interface that will assist in improving cognitive abilities of the patient.

Phase 3: Assistance phase

This phase is the most important phase of proposed system. It provides the following possibilities:

-Use data mining from the previous step to predict patient needs.

- Provide mental activities to develop awareness and recognition.

- Make periodically assessment to the patient.

- Provide feedback and automatically adapt system according to patient status.

An Introduction To

Natural Language Processing

Components of NLP

Natural Language Understanding

Mapping the given input in the natural language into a useful representation.

Different level of analysis required:

- **morphological analysis,**
- **syntactic analysis,**
- **semantic analysis,**
- **discourse analysis, …**

Natural Language Generation

Producing output in the natural language from some internal representation.

Different level of synthesis required:

- **deep planning (what to say),**
- **syntactic generation**

Let’s Converse with The Machine

Raw speech signal

Speech recognition

Sequence of words spoken

Syntactic analysis using knowledge of the grammar

Structure of the sentence

Semantic analysis using info. about meaning of words

Partial representation of meaning of sentence

Pragmatic analysis using info. about context

Final representation of meaning of sentence

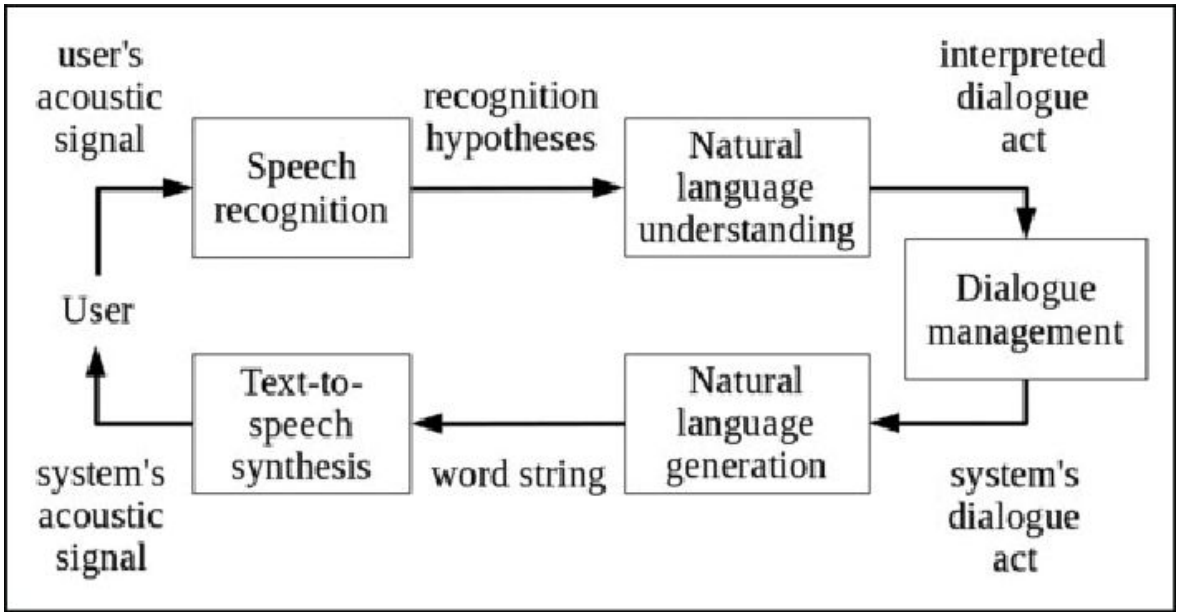
Natural Language Understanding

- Input/Output data

	Processing stage	Other data used
Frequency spectrogram		
	speech recognition	freq. of diff. sounds
Word sequence		
"He loves Mary"	**syntactic analysis**	grammar of language
Sentence structure		
	semantic analysis	meanings of words
He loves Mary		
Partial Meaning		
Ξx loves(x,mary)	**pragmatics**	context of utterance
Sentence meaning		
loves(john,mary)		

Architecture of the components of a conversational agent

- It has six components.
- The speech recognition and understanding components extract meaning from the input.
- The generation and TTS components map from meaning to speech.
- The dialog manager controls the whole process, along with a task manager which has knowledge about the task domain (such as air travel).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CONCLUSION

Elderly people constitute a significant percentage of the population all over the world. The aim of the study is to explore needs of patients with cognitive deficits and understand the need to help in patient's daily activities.This paper reports an ongoing research project of for elder people. The core of this research is to apply intelligent techniques to meet particular needs of cognitive deficits patients and assess interplay adjustments based totally on his or her behavior in diverse disease stages.

THANK YOU

Useful Links :
https://www.researchgate.net/publication/328145920_A_Proposed_Effective_Framework_for_Elderly_with_Dementia_Using_Data_Mining_Technique/link/5c5c752fa6fdccb608af35fb/download

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