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Modified Survey of a Multiagent Technique for Guiding the Elderlies

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ABSTRACT:There has been an alarming increase of mortality rate of the elderly in remote and rural areas; as a result of non-operational healthcare infrastructure and unavailability of doctors. Several elderlies in Nigeria are plagued with major health issues that require consistent medical solutions; this is due to lack of a robust information system for visualized activity guidance of the elderly. The study proposed a modified approach to surveying a multiagent technique for guidance of the elderlies.

KEYWORDS: Elderlies, Guidance, Modified Survey, Multiagent, Technique

I. INTRODUCTION

Health challenges, such as loss of sight, loss of hearing, etc. have always been the case of most elderlies in Nigeria especially in the rural areas. This is due to the absence of a health activity guidance system. An activity guidance system can simply be defined as a group of services to individuals to assist them in securing information and skills needed in making plans and devices, and the interpretation of life. In Nigeria, a lot of elderlies have died due to enduring health challenges such as diabetes, cancer, stroke, pneumonia, and mental disorder. A foremost cause of these illnesses is due to the limited health-care facilities in remote and rural areas.

Furthermore, care for the elderly seems unimportant due to the absence of an enforced policy that governs the affairs of the elderly; and the elderly population is rapidly on the increase (Tanyi et al, 2018). The most recent policy was the Senior Citizens Centre Bill signed by the Nigerian President, Muhammadu Buhari on 28th January, 2018. However, implementation and functionality of this bill is the crux of the matter (Abayomi&Adetayo, 2019). Recent research records have shown that Nigeria has over nine million (9, 000, 000) elderly population who are sixty (60) years and above. However, by the year 2030, it will increase to twenty million (20, 000, 000) as recorded by Global Age Watch Index (Nigeria Health Watch, 2018). The obvious challenges linked with ageing require the enactment and execution of a working policy in order to cushion the negative effects of ageing in Nigeria. Several researchers, organizations and concerned persons have tried to project this impending issue by way of carrying out studies on the implications of the neglect of the elderly and the possible solutions, publishing of articles on the subject matter, organizing seminars and symposiums to create this awareness in order for the population not to experience an extreme drop, due to low fertility rate and increased mortality rate due to abandonment and lack of good care (Tanyi et al, 2018).

The aim of the study is to carry out a modified approach to surveying a multiagent technique for guidance of the elderlies. The study intends to review existing multiagent-based models for health activity guidance of the elderlies and analyze expert system methods for aid activities of the elderlies.

II. CONCEPTUAL DESCRIPTION

Agent-Based Systems as Tools for Guiding the Elderlies

Agents are required to accomplish particular tasks in the real world and these requirements have to be constructed into their underlying design architecture. Hence, many agent systems architecture and organizational setup for different application have been developed as a result consistent research and development in the aspect of agent-based software engineering. Agents are semi-autonomous or autonomous hardware or software systems that accomplish tasks in complex, continuously changing environment. A Multi-Agent system consists of a group of agents that can take specific roles with an organizational structure (Wanyama, n.d.).

Multi-Agent systems involve the breaking down of

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the problem and assigning the sub-problems to the respective solution agents with the best abilities to solve the particular sub-problem. However, each agent has its own goal and interests; the allocation of the sub-problem is done in a manner as to solve the super problem in the most appropriate and effective approach.

Single Agent Systems

Single-Agent Systems are basically focused on the centralized process model. These systems have a single agent who takes all the decisions and other agents in the system act as remote slaves. Hence, these systems can have a number of entities such as transducers, actuators and/or robots; and these entities send their perceptions to, and receive their actions from the same central processor. This means that the environment of a single-agent system may have other agents and acts as actuators or sensors because they do not have goals of their own.

Agents exist based on performing tasks for which they are designed and as such they have the following features:

i. Reactive: They must react in a timely fashion and appropriately to unexpected events, changes in the environment.
ii. Goal Oriented: They are usually designed for a purpose and so they act in a purposeful manner.
iii. Communicative: They have the capacity to communicate with the environment, other agents and/or people.
iv. Adaptive: They are able to adapt to changes and hence change their behaviour based on previous experience.
v. Autonomous: They are able to control their actions with regards to changes in the environment.
vi. Continuous Activeness: They are able to run continuously in the system.

Multiagent Agent Systems

The concept of an intelligent agent is a concept that emanates from the area of artificial intelligence; in fact, a generally accepted definition links the discipline of artificial intelligence with the analysis and design of autonomous entities capable of exhibiting intelligent behavior. From that perspective, it is assumed that an intelligent agent must be able to perceive its environment, reason on how to achieve its objectives, act towards achieving them through the application of some principle of rationality, and interact with other intelligent agents, being artificial or human (Julian and Botti, 2019). Multi-agent systems are a specific aspect of a distributed system, and its particularity lies in the fact that the components of the system are autonomous and self-centered, seeking to satisfy their autonomous objectives. In addition, these systems also are distinguished for being open systems without a centralized design. From Distributed Artificial Intelligence (DAS) concept, a multi-agent system is a loosely grouped network of problem-solving agents for the purpose of working together to solve problems that could not be solved by an individual agent. In multi-agent systems, many agents exists and they are aware of each other' goals and actions. In addition, agents also communicate with one another either to help an individual agent achieve its goal or help to prevent it (in a rare case) It is seen as an enabling technology for complex applications that require distributed and parallel processing of data and also its operation is autonomous in complex and dynamic domains; hence, it has attracted great interest and attention in various field of research. Multi-Agent Systems (MAS) are comprised of several autonomous entities which have the following generic characteristics:

a. Each agent has incomplete capabilities to solve the problem
b. There is no global control
c. Data is not centralized
d. Computation is asynchronous

Research in the discipline of multi-agent systems (MAS) is based on the results of distributed computing asking new questions about how agents must interact with each other in order to coordinate their activities and solve complex problems. Most current research focuses on designing appropriate coordination mechanisms for managing coalitions or teams of agents. The programming of intelligent agents generates complex challenges to engineers because the complexity of designing concurrent and distributed systems, there is the added complexity that the components must have an architecture that includes aspects such as reactivity, proactivity, and sociability. These properties are difficult to program when the environment is dynamic and complex. In order to achieve real agent programming, several proposals have been made, by many researchers, for agent architectures, communication languages, and decision-making and coordination mechanisms.

Fuzzy Logic as a Tool for Guiding the Elderlies

Fuzzy logic is a branch of science that is extended to handle the concept of partial truth, where the truth value may range between

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completely true and completely false (Figure 2.4). Fuzzy logic may be applied to many fields, including control systems, neural networks and artificial intelligence (AI).

It is straightforward to formulate a set of fuzzy rules for this task, but it is not immediately obvious to show how to build a network to do neither the same nor how to train it. Fuzzy logic is now being used in many products of industrial and consumer electronics for which a good control system is sufficient and where the question of optimal control does not necessarily arises. The difference between crisp (i.e., classical) and fuzzy sets is established by introducing a membership function. Consider a finite set

$$X = \{x_1, x_2, ..., x_n\} \quad (2.1)$$

which will be considered the universal set in what follows. The subset A of X consisting of the single element x1 can be described by then-dimensional membership vector

$$Z(A) = (1,0,0,...,0), \quad (2.2)$$

where the convention has been adopted that a 1 at the ith position indicates that xi belongs to A. The set B composed of the elements x1 and xn is described by the vector

$$Z(B) = (1,0,0, ...,1). \quad (2.3)$$

Any other crisp subset of X can be represented in the same way by an n-dimensional binary vector. But what happens if we lift the restriction to binary vectors? In that case we can define the fuzzy set C with the following vector description:

$$Z(C) = (0.5,0,0, ...,0) \quad (2.4)$$

Mathematical Modelling of a Machine Learning Technique for Guiding the Elderlies

To ensure integrity and maintain unique instances to guiding the elderlies, datasets were collected from health agencies in order to formulate the model.

The Fuzzy Model

An Interval Type-2 Fuzzy Set (IT2FS) characterized by $\tilde{A}$has a FOU bounded by a lower and upper membership functions, $\underline{\mu}_{\bar{A}}(x,\mu)$ and $\underline{\mu}_{\bar{A}}(x,\mu) \forall x \in X$ respectively, is expressed as:

$$\tilde{A} = \left\{ \left((x,\mu), \underline{\mu}_{\tilde{A}}(x,\mu), \bar{\mu}_{\tilde{A}}(x,\mu) \right) \middle| \forall x \in X, \forall \mu \in J_x \subseteq [0,1] \right\}, \quad (2.5)$$

Where, $\underline{\mu}_{\bar{A}}(x,\mu)$ and $\bar{\mu}_{\bar{A}}(x,\mu) \forall x \in X = 1$

$x \in X$and$\mu \in J_x$ are defined as a continuous universe of discourse (UoD);

x denotes the primary variable in domain X

μdenotes the secondary variable in domain J_x at each $x \in X$

$J_x$is called the primary membership of x as defined in (1), which symbolizes the interval set.

The secondary grades of $\tilde{A}$ is unity, thus reduces IT2FS to:

$$\tilde{A} = \int_{x \in X} \int_{\mu \in J_x} {}^{1}/_{(x,\mu)}. \quad (2.6)$$

Now, the FOU of $\tilde{A}$ is the union of all primary membership grades and is given by:

$FOU(\tilde{A}) = \cup_{x \in X} J_x$,

The Upper Membership Function (UMF) $\bar{\mu}_{\bar{A}}(x)$ and Lower Membership Function (LMF) $\underline{\mu}_{\bar{A}}(x)$ are type -1 membership functions (MFs) marking the FOU boundary of interval type-2 MF. The UMF represents the subset that has the maximum membership grade of the FOU; and the LMF is a subset that has the minimum membership grade of the FOU $\forall x \in X$.

Thus

$$\bar{\mu}_{\bar{A}}(x) \equiv \overline{FOU(\tilde{A})}, \forall x \in X,$$
$$\underline{\mu}_{\bar{A}}(x) \equiv \underline{FOU(\tilde{A})}, \forall x \in X, \quad (2.7)$$

$$J_x = \left[\bar{\mu}_{\bar{A}}(x), \underline{\mu}_{\bar{A}}(x) \right].$$

The triangular membership function (TMF) was adopted to evaluate each input and output MFs for the IT2FL system. The description of the TMF using a line or curve is based on three parameters a_1, p and a_2 , and specifies the mapping of each input or output parameters, to obtain membership values for n membership grades MG_n; n: 1, …, n

Thus,

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$$\mu(x) = \begin{cases} 0; if\ x < a_1(MG_1)\{NIR\} \\ \frac{x - a_1(MG_1)}{a_2(MG_1) - a_1(MG_1)}; if\ a_1(MG_1) \leq x < a_2(MG_1) \\ \frac{a_2(MG_1)\ -x}{a_2(MG_1) - a_1(MG_2)}; \text{if } a_1(MG_2) \leq x < a_2(MG_2), \\ \ldots \\ \frac{a_2(MG_n)\ -x}{a_2(MG_n) - a_1(MG_n)}; \text{if } a_1(MG_n) \leq x < a_2(MG_n) \\ 0; \text{if } x \geq a_2\{NIR\} \end{cases} \quad (3.4)$$

where a_1 and a_2 are the triangular end points defined by the FOU – region consisting of all the points of primary membership of elements, and NIR signifies values that are not in range. The equations illustrate a triangular shape IT2FLS with its principal T1FS, showing the end point, and P, the triangular peak location.

Related Works

Hannah and Julie (2019), proposed a Review of Age-friendly Virtual Assistive Technologies and their Effect on daily living for care givers and dependent adults. The study uniquely drew together the small volume of literature from the fields of gerontology, gerontechnology, human computer interaction (HCI), and disability. The authors did a good job but could not implement the discussed review to a model to show more clarification and understanding.

Hayley et al., (2014), looked at The Role of Healthcare Robots for Older People at Home: A Review. The study aimed at identifying the areas of need that older people have, and the available solutions. In particular, the robotic solutions are explored and critiqued and areas for future development identified. Furthermore, the authors reviewed several literatures for factors that influence admission to nursing home care, and for technological solutions to these factors. The authors did a good job but the study could not be implemented with real-life health robotics.

Daniel et al., (2018), presented a study on Agent-based Modelling and Simulation of Individual Elderly Care Decision-Making. The authors developed an Agent-based model that enabled the simulation of individual decision-making processes. The presented model in the study was based on socio-demographic data to take systemic properties and individual situations into account. Additionally, sociological actor types were used to implement individual preferences and characteristics of care recipients. The authors did a good job. However, a major limitation of their study is that the developed model was deficient in benchmarking and cost benefits analysis.

Stefano et al., (2015), looked at an Agent-based Architecture for Adaptive Supervision and Control of Smart Environments. The study described architecture and functionality of a generic agent that is in charge of handling a given environment in an Ambient Intelligence context, ensuring suitable contextualized and personalized support to the user's actions, adaptively to the user's peculiarities and to changes over time, and automated management of the environment itself. Furthermore, the architecture was implemented in a multi-agent system, where different types of agents are endowed with different levels of reasoning and learning capabilities. The authors did a good job. However, the analysis of their adopted methodology showed that they only simulated the implementation, and failed to deploy the work to a real smart environment.

Juan et al, (2010), presented a study on an Agent-based Architecture for Developing Activity-aware Systems for Assisting the Elderly. The authors proposed an activity-aware computing that allows smart environments to provide continuous activity awareness and opportunistic offer assistance aimed at supporting the elders' current activity. The new paradigm called for novel tools to help developers mirror human activities in the digital domain, and adapt smart environments based on the activities executed by the users. The authors did a good job. However, they were unable to apply the developed system on other software engineering tasks that rely on text analysis using topic models.

Pekka et al., (2017), proposed a study on An In-home Advanced Robotic System to manage Elderly Home-Care Patients' Medication. The study examined the safety profile and usability of an integrated advanced robotic device and telecare system to promote medication adherence for elderly home-care patients. The authors did a good job. However, their developed model failed to proffer solution to identified cases of missed doses that were followed up in real-time.

Ayman et al., (2019), presented a study on An Adaptive Intelligent Alarm System for Wireless Sensor Network. The study proposed a basic and adaptable remote arranged for domestic computerization of temperature, moisture, gas, movement and light by executing dependable sensor hubs which can be controlled or observed. The innovation offered energizing and new chance to build the availability of devices inside the home for the home computing. The authors did a good job. However, they had a vague result due to their simulation and non-implementation with a real hardware sensor device.

Debajyoti et al., (2018), analyzed The Elderly Users' Adoption of Smart Home Services. The study proposed and validated a new comprehensive research model called the elderly smart home technology acceptance model by extending the original technology acceptance model that can explain the elderly intention to use the smart-homes. The authors did a good job. However, the analysis of their adopted methodology showed that they only simulated the implementation, and failed to deploy the work to a real smart home area.

Ashalatha et al., (2012), proposed a study on Architecture Modeling and Formal Analysis of Intelligent Multiagent Systems. According to the study, modern cyber-physical systems usually assume a certain degree of autonomy. Such systems, like Ambient Assisted Living systems aimed at assisting elderly people in their daily life, often need to perform safety-critical functions, for instance, fall detection, health deviation monitoring, communication to caregivers. The authors did a good job. However, the datasets used for training and designing their model was not a hybrid of supervised and unsupervised learning techniques which further resulted to latencies in their model performance.

III. CONCLUSION

The study proposed a modified approach to surveying a multiagent technique for guidance of the elderlies.A system that delivers services to individuals in order to assist them in securing knowledge and skills needed in making plans is known as an activity guidance system. In recent times, this system is being used to aid the elderlies in carrying out day to day activities and responsibilities such as urinating, eating, health checkup, communication, etc. Furthermore, an activity guidance system for the mentioned responsibilities is built based on artificial intelligence (AI). AI can be defined as the theory and development of computer systems that are able to perform tasks typically requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.

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