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Intelligent Software Agent in E-Health System: - Review

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ABSTRACT

The field of medical care is characterized by complexity, dynamism, and variety. Different challenges occur in healthcare (increasing cost of care, population growth and lack of caregivers). For that, intelligent applications with Agent Technology can provide better health care than the conventional medical system. In fact, the characteristics of Intelligent Agents (proactivity, sociability, autonomy) are a good choice to solve many problems in this regard, since the key success parameter it was the natural mapping for real-life medical issues into electronic life. The design of Multi-agent architecture will effectively paradigm the heterogeneous, distributed, and independent health treatment systems. The multi-agent systems have been used of individual healthcare processes such as a knowledge-depend medical system for complex, multi-parties depend on systems such as a total healthcare where The applied from multi-agent systems(mas) in health treatment sector also has been opened avenues for discovering innovative applications such as socialized and personalized health care models. Therefore, when creating an agent-depend simulation, one of the most important questions to consider is how to model the decision decision-making operations for the agents in the model. In the literature, the wide There are a variety of agent decision-making models available, all of them motivated by multiple goals and study questions. The research explains the advances made so far in the development of regulatory frameworks for deliberative autonomous software in a partially observable environment. In this paper, we display an overview for some of an agent that has attracted attention (Beliefs Desires and Intentions (BDI) and its derivatives such as Extensible Beliefs Desires and Intentions (EBDI), Beliefs-Desires-Obligations-Intentions (BOID)).).

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1. INTRODUCTION

The controversy about how best to model human decision-making is continuing. the modelled entities must be provided with only those characteristics that are relevant in the given scenario of the real humans they represent must be provided with the modelled species and not less or more. Therefore, the question is, "What is a good model of human?" and its decision making. A significant the some of models and architectures have been formulated that aim for reflecting human decision making. Despite their shared purpose, each has subtly different objectives and such as a result, consists of multiple simplifications and assumptions. Therefore, it is important to be aware of these distinctions when choosing an agent decision-making system. Since the main issue and core point of focus for all human efforts are human health which considers as human capital. Therefore, much of the focus and concern of people are also geared at health care and social well-being. computerization or Computation is one of the

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innovations that have demonstrated it is an effect on people life by delivering collaborative, automated and assistive, healthcare models (Isern, Sánchez, and Moreno 2010).

Multi-Agent Systems are the natural option to unpredicted and open environments explored by heterogeneous models with their interactions, enterprise-wide range, effectively processing in randomly changing environments (Balke & Gilbert, 2014) ,

quickly increasing data quantity, the use of intelligent agents has added value for their main job. In literature, the applying of automated agents has been suggested for dealing with a different of issues associated about medical and the health-pertained such as decision support systems, senior older care, self-treatment and automatic health observing access to patient's records and treatment information, taking into account the confidentiality of patient records, societal, legal, concerns issues. The design and implementation of health care services is one of the challenges and difficulties of Mas. (Al-Azzawy & Diwan, 2017)

The Agent-based systems are one of the most current architectures that is the development, design, implementation, and deployment paradigms for distributed and dynamic systems. It often uses an independent manner for working with dynamic environments (Al-abraheemee, n.d.).

an adaptation, merits, limitations, relevant challenges, and potential study directions from intelligent agents of health treatment domain systems are discussed in this article. The remainder of this paper is structured as bellow: in Section two, motivation, in section three (Background) the Definition of intelligent software agent and it is characteristic, in section four review of multi-agent framework and Some of the deliberative agent systems, especially, the belief-desire-intention concept and some of the models that derivatives from it (BDI and its Derivatives), and finally section five conclusion.

2. Motivation of using the intelligent agents in E-health system

Since the health care field dynamic various challenges faces in healthcare (population growth increasing cost of care and lack of caregivers). Therefore, the intelligent software with Agent Technology can deliver the best health care than the traditional medical system.

For: enable surgeons, nurses and health professionals to gather and track patient data on a regular basis regularly, to optimize treatment choices, maximize hospital quality, and help them control procedures.

3. Background

3.1 intelligent Software agent and it is characteristic

3.1.1 definition of an agent

There is no agreed definition to the term agent. a concept 'an agent' or the term software agent, has made its approach into a many from technologies and has become widely used, For instance, in artificial intelligence, databases, processing systems and computer networks literature. While there is no single definition of an agent (look, (Jennings & Wooldridge, 1995), (Wooldridge & Jennings, 1995), (Bringsjord & Schimanski, 2003)), all meanings accept that an agent is mainly a particular software component which that has independent independently that introduce a device interface that is interoperable or/and acts such the human agent, operating with several clients in and following its special objectives A The main dictionary definition of agent concept is one who acts. An agent, then, can be a person, a machine, or a part of software (Jennings & Wooldridge, 1995). if an agent model able to depend on the single single-agent operating inside an environment and if needed engaging with its users, they are typically made up of several agents. These multi-agent models capable model difficult systems and produce the ability of agents having opposing or common interests. These agents perhaps communicate with each other both directly or indirectly (through operating on in an environment). There is a consensus that an independent, the capability to operate without the intervention of humans or another model is the main characteristic for the agent. In addition, that various properties reconsider various significance depend on the space of an agent. Figure 1

depicts a high-level show of the agent inside its environment. An agent receives input from its environment and of a repertoire from actions possible for it, responds for it to modify it. Generally, in the domain of possible difficulty, the

agent not capable each control on its environment. As a consequence, the same action achieved twice in the same situations seemingly perhaps give for have integrate various results, Failure also is a probability, which means the response achieve through the agent perhaps not result in the desired effect at whole. (Obied et al., 2019).

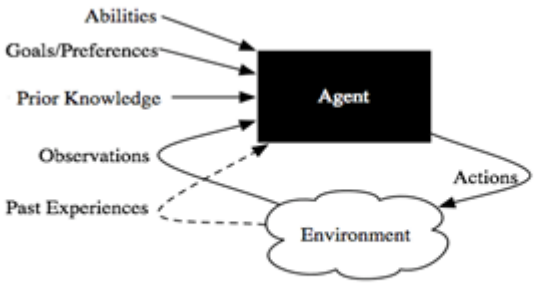


Figure 1Intelligent software agent(situated agent) adapted from DL Poole, AK Mackworth ,2010

3.2 Agent's Application in Healthcare Domain:

the given scenario, a component of software that operates independently on a given environment obtains environmental perception. Converts to a representative model depended on it is knowledge base, and executes actions to perform its design objectives. It is called a software agent (the agent is a software structure that uses Artificial Intelligent)

Although Health care issues are very difficult, and it is not easy to find traditional software engineering solutions for them. In recent several years that has been A change in health treatment practice in order to health care improve, joint patient-provider decision-making and managed care has been taking place generating a growing need to information and online services joint activities and decisions for those concerned need in order to be organized to be ensure that treatment is effective and reliable. And to be promote that decision-making mission, and in order to the smooth execution of contact and coordination procedures, software systems are required to minimize diagnosis and treatment errors and deliver them. (Borowczyk et al., 2008)

Develop medical education and preparation, and make health sector knowledge more available to patients, their families caregivers alike.

the Automated systems required to be previously in anticipating the knowledge and information required for patients also deliver it in a timely way, enabling synchronous and in synchronous contact, (Jemal et al., 2015).

and easily mutual decision-making between implementation process of the health care sector program and the different individuals participating in the management. There is a big amount of medical information online on the Website. It is vital to produce an approach of arriving as possible more appropriate information as timely and simple. This approach for medical knowledge is important for both patients and medical practitioners.

at the previous situation, both the latest drugs, strategies and treatments must be known to them in the case. Showing in their field of specialization; however, more professionals the time for s does not have for search about all this data and filter which one they required exactly. In the above, persons request for a more active part in their treatment administration of care and aim in order to find relevant important information as soon as possible (but they usually do not have the skills for the search to the most adequate information relevant to their particular personal needs). In both situations, it is necessary to proactively obtain appropriate knowledge of useful and trustworthy sources without needing to devote time and effort to search for them. It must be analyses, screened, evaluate and needing to filter it(Lieberman & Mason, 2002). Intelligent agents have been

played a crucial role in providing correct information for diagnostic, monitored the patients and treatment, etc. They work on behalf of human agents asking charge of routine activities, thereby the speed and efficiency of the information exchanges. There are some of Application of an agent in healthcare sector such as:

• **AGALZ (Autonomous agent in order to monitoring Alzheimer patients):** that an automated intelligent agent was created for monitoring to track Alzheimer patients' health treatment in current time. Inside geriatric homes are an independent deliberative case- depended on manager agent that is programmed to schedule the nurses' operating time dynamically, for keeping the standard operating reports the activities of the nurses, and for ensure that patients dedicated for the nurses which they are given the appropriate treatment. an agent works in wireless component and is combined with integrally agents into a multi-agent structure, called ALZ-MAS "Alzheimer Multi-Agent System" which able of responding to the environment. The ALZ-MAS system, after tested the ALZ-MAS has shown it assists the nurses to obtain time that able to be used for the care from specific patients, in order to learn or for present new tasks. The time used for monitoring and management the jobs it is decreased substantially, also the time used for responding to incorrect alarms, while the time that used to direct patient treatment will be increased. That The jobs implement through nurses are split into two types, action is taken directly jobs and action taken indirectly jobs. action taken directly jobs are those which need the nurse working directly on the patient through the whole job (feeding, posture change toileting, medication, etc.). In the action taken indirectly jobs are not the nurses require to operate directly with the patient's whole the time (visits, monitoring, reports). AGALZ agents able to take care of several of these indirect tasks, also nurses able to devote more time to personal patient's treatment (Corchado et al., 2008).

• **IBAC security architecture** aims to prevent these using intelligent agent based technologies This paradigm is novel because it employs the intelligent agents for the entire process for providing access management and exchange. The model contains of agents, every one of them is response for different task. This approach is an easy and efficient access management mechanism depend on the agent's functionalities. a new Intelligent-depend Access management Security Model (IBAC) depend on multi-agents is suggested to keep and support the security (Iqbal et al., 2016).

- **A Canonical Agent Model to Healthcare canonical**, agent architecture that's mean in order to be both theoretically well-motivated and technically well-defined with allowing for alternative instantiations. The domino agent model was the starting point where Advanced Computation Laboratory enhanced this model in order to healthcare uses, but its architecture lends itself to general-purpose cognitive agents. The domino model is similar to analogous to the traditional beliefs desires- intentions paradigm, but it moves beyond BDI through defining a complete collection of processes for transform between mental states, including a fluid decision-making framework depend on logical argumentation. The domino paradigm reflects recent trends in software A Canonical Agent paradigm for Healthcare. agent Architecture, but it has wider justification in its embodiment of characteristics common for many fields and theories of cognitive systems, containing neuroscience and cognitive psychology For instance, a variety of main cognitive functions are commonly held to be needed by any intelligent agent: Goal-setting and maintenance, problem-solving, decision-making, , task assembly, plan implementation, and action detection are all aspects of the agent's context perception and understanding of its environment There is also agreement on the kinds of representations based on which these processes operate: beliefs, goals, and plans are supposed in a wide range of methods. In general concepts, these functions and representations are produced through many theoretical methods to cognitive agents. The domino agent also produced the basis to a practical agent language, preform has been widely Used to establish healthcare applications for instance decision support and clinical workflow control. Within the Argumentation Services Platform with Integrated Components project the domino paradigm has been greatly extended. Funded from the European Commission, ASPIC include a broad combination of partners interested with the uses of argumentation in agent systems, involving integrant dialogue, decision making, learning and, no monotonic reasoning, the canonical paradigm captures the extended paradigm in commonly, implementation-autonomies approach which provides a practical basis to special system execution and agent-execution tools in order to achieve the require for canonical abstraction. (Fox et al., 2006).

- **Decision support system (DSS):** Ideally, this system involves an agent-depend on paradigm of different Motivations by stakeholders and micro-decision-doing like a Sim City to health – which permit users for simply visualize and simulate whole from the effective components and that way aspect costs, results enhancements, in addition utilities from alternative health enhancing projects in. Through using methodical designing which contains the more salient domains of social parameters from systems and health science, a

DSS assists a managers standardize helping also decisions concerning expenditures also programs and after that administer scarce resources many effectives and perform desired results and effects. After each modeling is costly also simulation is using a long time (though not designing capable be far more expensive)

- **CBR methodologies** to improving significantly distributed healthcare systems where each data transactions are processed through agents, thereby, enhancing efficiency, availability and response time, CBR is used to provide advices to certain electronic healthcare problems through analyzing solutions provided to previously solved problems and to create intelligent systems in order to disease diagnostics and prognosis. With the strong support of like infrastructure, the healthcare processes could be facilities and enhanced, and the healthcare systems from various information systems from various manufacturers could be produced in an integrated manner. Also is uses for another main contribution of this method is the cost effectiveness of its implementation in concepts of using and adoption of the current healthcare services together with information facilities. CBR in the healthcare system for help medical actors in them processes to optimization diagnostics abilities, plying agent technology in healthcare enhance its quality through providing specific healthcare professionals (nurses, physicians and another authorized medical staff) with the correct information at the appropriate time, sharing up-to-date patient's data in current-time and making healthcare operations more effective. across a hospital system. (Al-Sakran, 2015).

4.1. review of multi agent systems(mas):

The multi agent scheme it is consisting of a variety from an agent, communicating with each other, coordinating their knowledge/action to accomplish a goal or make a decision.an agents interact with each other through the applied of certain special connection languages, called agent connection languages, and usually interacting through the switching messages through the computer network structure.

Where they are working together in the system to fulfill shared objectives in the framework. The Agents' collaboration will process speed boost and increase consistency and reliability also enhance accuracy and efficiency of performance through its unique features such as information and knowledge base. However, in the most common scenario, of a multi-agent framework the agents would be acting or serve in the name of clients or possessors with various of objective also with motivations. for interact effectively, these an agent would need a capacity to collaborate, organize, and negotiate with each other that in the same manner we communicate (Singh et al., 2017) (Silverman et al., 2015). Thus it is capable of easily and rapidly adapting the modifications (Singh et al., 2017) (Al-Sakran, 2015). provided mission is categorized into sub-tasks that are further all agent provides results depend on allocated job which is integrated with result of another agent to make the output is a larger task larger job of a multi-agent system, all an agent could be modeled differently. This heterogeneity between an agent models, establishes flexibility in a system to work of heterogeneous environment using distributed cooperative methods of coordination. The assignment given is divided into sub-tasks that are further assigned to various an agents depending onto the coordination mechanism. each agent creates output that is integrated with the result of other agents to generate the output of a larger job. at a multi-agent scheme, each an agent able to be modeled in various way. This heterogeneity offers flexibility in the process for operating in heterogeneous environments amongst agent designs using distributed methods of cooperative cooperation approaches. (Nair & Tambe, 2005)Stakeholders, partners and aspects of a healthcare environment should be taken into account as an agent. This gives a natural planning of the manual healthcare schema also multi-agent framework through modeling real-world schema agents as software agents, and if the AI aspect is used, it will also be possible to make rational decisions.

4.2 some of deliberative agent models

4.2. 1 BDI model

The BDI paradigm was first proposed via Bratman (also referred to as BDI or Belief-Desire-Intention). It is one of the most general agent decision-making paradigms in agent culture (Bratman et al., 1988) where the design for deliberative software agents: Three basic mental attitudes are based on a (beliefs, Desire & intent):

- **Beliefs:** refer to service data gathered or/and arrived of a number from sources, like environment, domain, or other service beliefs (these are the internalized knowledge which an agent has around the world.)

- **Desires:** are every potential and future the state of affairs an agent ability like to achieve. They reflect an agent's motivational condition. The notion at desires is not mean that an agent will response on whole these desires, but sort of that they provide alternatives which could affect the actions of an agent. (Desires reflect the state of affairs in a perfect universe, always optimizing the aims of the service) By measuring the values of a system set against its expectations (observed model states), the system detects the mismatch also induces the series of intentions (Bratman et al., 1988).

- **An intention:** is a commitment for the specific plan from action in order in order to achieve the certain purpose (Cohen & Levesque, 1990).

  - **Situated intentions**: appear an action set to a system represent an action into be followed by the system to meet its specified desires in a given situation, and /or to resolve the mismatch among the model's goals (desires) and model's environment (beliefs).
  - **Normative intentions:** represent are a series from actions to be to be done to guarantee that the given collection of criteria, including obligations (deontic), are followed and rule representations are observed before a specific set of standards is observed. The intent is granted is implemented to Maintaining the legitimacy of new rules, too.
  - **Utility intentions:** a series of actions to optimize target-oriented intentions (Obied & Randles, 2004) Complementing these three items is a library with plans. In specific situations, the strategies identify procedural understanding of low-grade actions which are supposed for share to achieving an objective in particular circumstances, i.e. they specify strategic steps that define how to achieve it. (Balke and Gilbert) Goals are states in which an agent intentionally intends deliberately wishes to do (Dignum et al., 2002). the primacy of logical action principles desires, intentions and beliefs are recognized via The BDI agent paradigm. Intentions directed and limited restrict the strategy processes of an agent and are, a powerful abstraction for directing the agent's reasoning. To build single agent templates, this deliberate viewpoint has been successfully used to create single agent models (Obied & Randles, 2004) an agents are usually can be to think dynamically around their plans in the BDI framework. They are also able to learn about their own inner states which mean. to be inverted on their own beliefs, intentions and interests and, if possible, to change them. (Balke and Gilbert) and for implementing intelligent agents the BDI is one of the most popular due to it is robustness and simplicity.

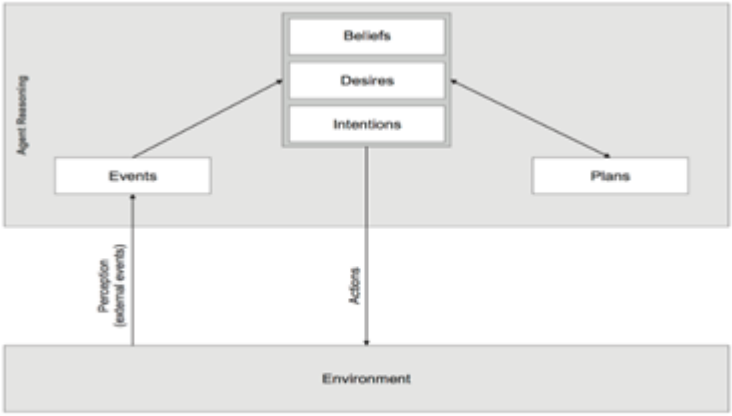


Figure2: The BDI Architecture

4.2.2 The Beliefs-Desires-Obligations-Intentions (BOID)

In fact, BOID is an expansion from the BDI concept in order to in order to take consideration for principles and criterion obligations terms, and within private obligations (Broersen & Dastani, 2000) (Broersen et al., 2001).It is based on the principles defined by (Dignum et al., 2002). also according to the mental situations for BDI, (social) rules and obligations (as one part from norms) are needed to take in consideration to the social behaviour for agents. The authors of BOID argue that a multi-agent structure needs for allow an agent to deliberate around whether or not for obey social norms and share to mutual switch in order to grant agents 'social capacity'. Usually, these deliberation is done through means of discussion among obligations, the actions an agent should achieve it (in

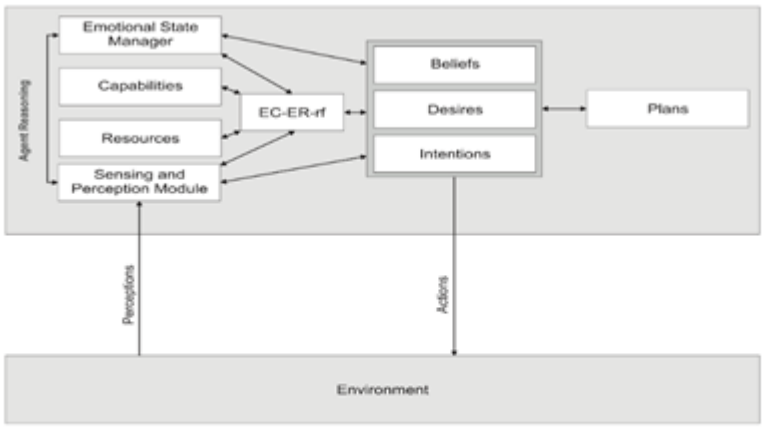
order to the social good), with an agents' personal desires. It is also not surprising that much of the literature at (Beliefs-Desires-Obligations-Intentions) is during the agent argumentation society (Dastani & Van Der Torre, 2004) (Boella & Van Der Torre, 2003). The decision-making of BOID is very such as that the BDI and differentiates itself only in terms of the purpose (or objective) generation of the agents. also the internalized social obligations are taken in account by the agent When generating goals, .The consequence of these deliberation based about an agent's situation towards its own objectives and social responsibilities (i.e. which one it perceives in order to be the highest priority).BOID has the same characteristic as BDI, but unlike BDI, it makes it possible to model societal norms In (The Beliefs-Desires-Obligations-Intentions) this requirements are represented only in concepts of obligations. The bulk of the work of BOID cantered on formalizing the theory (and in particular the deliberation process).

4.2.3 EBDI (Extensible Beliefs Desires and Intentions)

That the suggested (Extensible Beliefs Desires and Intentions) introduce that the very appropriate structure to the creation from embedded intentional software which constantly observes or / and monitors its environment and behaves in compliance with its situated BDI, which is grounded in normative settings (Badr, 2003), (Obied & Randles, 2004) (Males & Ribology), the general norm group (shared ontology) and its obligations to itself and another agent. several of these competing intentions perhaps even be conflicting. Methods for enhancing an agent's decision operations, so that the action which has highest reward f

aric, 2016),. Beliefs according for duties information obtained or/ and retrieved of a number from exporters, such as the environment, domain, or the other services 'That the suggested (Extensible Beliefs Desires and Intentions) introduce that the very appropriate structure to the creation from embedded intentional software which constantly observes or / and monitors its environment and behaves in compliance with its situated BDI, which is grounded in normative settings (Badr, 2003), (Obied & Randles, 2004) (Males & Ribaric, 2016),. Beliefs according for duties information obtained or/ and retrieved of a number from exporters, such as the environment, domain, or the other services' beliefs. represent the state of affairs in an optimal world, that this frequently increasing the services have aims. through contrast a system's beliefs group (monitored system states) in opposition to it is desires, that the system discovers is not similar and triggers a collection of intentions (Obied, 2017), (Bratman et al., 1988), (Jiang et al., 2007). embedded intentions act as the job group to the system for taken in a specific situation in order to perform its selected desires, or /and to process the mismatch among the system's objectives (desires) and system's environment (beliefs). Normative intentions act as the group from actions for be taken in order to guarantee a particular group from rules including obligations (deontic), in addition rule's acting are monitored before a specified intention is enacted. Also, preserve on the integrity of emerging rules. Utility intentions acts as a group of actions to enhance goal-oriented intentions (Badr, 2003). Which means that at any point an agent perhaps find itself with a several of competing intentions. In the first instance this perhaps be a dispute about whether for act or for deliberate. More intentional dispute will occur as the agent seeks in order to comply with its personal norm group (ontology), the general norm group (shared ontology) and its obligations to itself and another agent. several of these competing intentions perhaps even be conflicting. Methods for enhancing an agent's decision operations, so that the action which has highest reward for the system is performed, have been studied to sometime. However, defining and applying functions that introduce a notion of action benefit is very problematic. The complete specification may be including a very large (even infinite) many of perception action pairs, which may be vary from one job to another (Vlassis, 2003). Also the both concepts 'agent' and 'environment' are inextricably related, so that cannot be described any one without the other. In reality, the difference between an agent and its environment is not usually observing, and drawing a line between them can be difficult at times. (Obied & Randles, 2004)

or the system is performed, have been studied to sometime. However, defining and applying functions that introduce a notion of action benefit is very problematic. The compleational Conference on Autonomous Agents, several of these competing intentions perhaps even be conflicting. Methods for enhancing an agent's decision operations, so that the action which has highest reward f



Figur3: The EBDI Architecture, reproduced from Pereira et .al (2005)

5. Conclusions

In this review, we have introduced various agent decision-making structures and discussed their goals and suitability for modeling agents at computational simulations. after comparing the various architectures, it became clear that the extent to which these different dimensions of decision-making are covered varied greatly.

by comparing between some of the deliberation agents table1. we show that The BDI model's drawback is its failure to respond to changes in a changing setting. an intention cannot be carried out where an unexpected situation happens and there is no applicable law for that situation. and in order to deploy agents in a bigger world, perhaps with many complicated jobs for the agent to achieve. This will also give more range for the different programs that would be applicable, and

the real strength of the EBD model could appear and because the EBDI model is adaptive in dynamic environments. and make reconsideration when it is necessary so we decide to implement this model in E_health.

1. Table 1: compare between some Deliberation agents:

Parameters	**Agents**		
	BDI	BOID	EBDI
Focus on	(Belief, desire, Intention)	adding social obligation to BDI	adding emotions to BDI
Environment	Static	Dynamic	Dynamic
Reconsideration	a main problem in the architecture of BDI agents was that on intention reconsideration. There is mean none in the original model	community norms take in account in form of obligations deriving of them (Boella & Van Der Torre, 2003)	Reconsider when it is necessary (Obied & Randles, 2004)

Adaptive with the environment	The failure of the BDI model to respond to changes in dynamic environment. is one of its drawbacks. (Sánchez et al., 2019)	/	Adaptive with the environment (Obied & Randles, 2004)
Deliberate	If the goal is not carried out, it will be ignored. This means that agents should pause from time to time to consider their plans and rethink them.	improving an appropriate intention reconsideration methods - which keeps an agent committed for its intentions just as long as it would be rational to perform that(Boella & Van Der Torre, 2003)	decision cycle with deliberation process possibility (Boella & Van Der Torre, 2003)

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