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MEBACA-Modeling of Emotion Base Attitudes for Cognitive Agents

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Abstract: With the recent increase in the demand of the humanité base agent technology, competent and efficient instructors are equipped to deal with societal issues based on former and current events. These agents can only endure such complicated alarming world, by the capacity of taking applicable attitude and operation according to the changes in surroundings. When we talk about mental construct, a large number of the models of cognitive agents are still found missing with such attitude and emotion that helps to solve the conflict of decision making to improve the human-like decision making in cognitive agents. For improving, this needs to be addressed by the researcher. In this paper, I purpose the hybrid model for cognitive agents that carrying attitude with emotions that allow an agent to take action and handle the different critical, harsh, and aggressive situations in the surrounding. In our study, we also purpose some mathematic equations proves for rules-evaluation and graphs for showing the working of this model by using Mamdani fuzzy logic techniques in MATLAB R2017a. The purpose of this work is to formulate a model based on emotion-base-attitude and its pretense for agents that can aid them to solve problems, accomplish determined goals and survive in this complex antagonistic world.

Keywords: Beliefs; Emotion; Attitudes; Behaviors; Motivations; Decision-Making; Human-Like Cognitive Agent.

1. Introduction

The cognitive agents are such entities that can sense and act according to circumstances [1]. These agents can only endure such complicated alarming world, by the capacity of taking applicable attitude and operation according to the changes in surroundings. So, they are not remote entities and have the capacity of decision making and performing human-like intelligent actions to survive in different environments [2]. To build human-like cognitive agencies requires the modeling of motivations, memories, emotions; decision-making etc. So, emotion and attitude-based decision making can analyze the behaviors and attitude that help agent to fix complications and take action for problems effectively [2].

When we talk about emotion, previous work shows that the emotion-based agents strengthened the belief ability of their behavior [3]. Marvin Minsky [4] confidently definite that "the question isn't whether or not intelligent machines will have any emotions, however, whether or not machines will be intelligent with none emotions" Emotion or Feelings are a basic piece of the credibility of typified characters that associate with people. Eckman purpose that there are six basic emotions that helps us to identify the human behavior these are as follow: [5] Fear, Disgust, Anger, Surprise, Happiness, and Sadness.

According to previous research the OCC theory is the most particularly used theory, developed specifically for integrating the emotions in Artificial Intelligence [6]. The OCC theory has eleven pairs of twenty-two emotions according to the cognitive survey of surrounding by an agent. This Cognitive survey is based on three factors: Action taken by other agents, aspects of objects and the results of happening [7].When we talk about previous research on attitude so many researchers can say that attitude is most important part to find the behavior of the humans. Dr. Albert Ellis [8] developed the ABC model, through this model we can observe the human behavior or reaction (A- adversity, B-belief, C- consequence). Drs. Karen Reivich and Andrew Shatté [9], are creating a useful tool "B-C Connections" from the use of ABC model. This tool is a chat, in which we make a decision on the behalf of some predefine belief types and emotion types. We try to implement this approach inside a cognitive agent that according to human psychology. In cognitive artificial intelligence [10] they explore for a stronger understanding of human thought and behavior, and ways in which to implement their findings in artificial devices like computer programs, agents, virtual characters or robots.

Different works have demonstrated that adding feelings to agent builds the conviction capacity of their behavior [3] we say, that Cognitive agent is an autonomous base agent that act and react automatically [11] when the condition is changed and can't get instructions from any other source. Thus, the cognitive agent is defined as a virtual human that take a decision on the behalf of emotion and attitude and then show our behavior.

2. Related Work

In the previous research Emotion is an indistinct idea that isn't easily describable and are inseparable and crucial parts of human cognition, Emotions influence cognitive courses and vice-versa. Different definitions and critical duties have been assigned to emotion. Yet, no agreement has been made on a single definition [12]. One of the definitions has been given by Darwin. He outlined that emotion is the name of endurance and conformability for living beings. He delineated that emotions are inborn, ubiquitous and sociable things. As of behavioral stance, emotions are likely to develop our way of behaving which sway one's adaptation of decision, learning and consideration. As of sociological view point, feelings5 can be interpreted as part of emotions. To feel pain, induced by headache, or the sentiment of sorrow at the death of some loved one, is individuals' response to the internal impulse. Hence, emotions which are part of our associations and bonds, serve us to engage with others. Consequently, emotions subsist in the social and personal capacity of a human. As a matter of fact, emotions enable humans to adjust and acknowledge recent developments in our vital surroundings [13]. Paul Ekman delineated six fundamental emotions: happiness, anger, surprise, sadness, disgust and fear. Which are definite to each person and impact humans' cognition in person [5]. Modern studies in neurobiology exhibits that, the origin of emotions is an amalgamation of numerous socio-cultural, biochemical, and neurological elements [14] [15]. Purves further categorized emotions into three subsequent processes: 1) a behavioral action: agitation, escape, and aggression; 2) a conscious experience of an event or situation: anger; 3) a physiological expression: trembling, blushing, paleness and feeling of discomfort. It is unc1ear to tell how these three processes are relevant [16]. The physiological effects of emotions are described by Damasio. He opined that our body carries the feelings and emotions which are the constant outcome of them. During this research, the physiological facets of emotions would not be examined but the feelings only as what part do they play in emotional condition of an agent [17].

2.1. Psychological Theories of Emotional Organization

Many approaches, regarding establishment of emotions and their mutual relation, have been outlined by the scientists. Three of them are succinctly expounded below:

i. Categorical Theory: According to Izard, emotions are seen as obvious units and divided into "basic" and "complex" emotions. He is of the view that basic emotions are taken as inborn, developmentally antediluvian and considered common in distinct cultures. On the contrary, complex emotions are learned, developmentally recent, impacted by language and carved out in an individual society and culture [18].

ii. Dimensional Theory: It is a framework, developed by Russell that says, there are two significant items in this, which are 'arousal' and 'valence'. In a certain state, arousal is an emotional vehemence which is a response to a particular situation and valence is a response either positive or negative to a given context [19].

iii. Component Theory: In contrast of both Categorical and Dimensional theories (which examine emotions as autonomous entities), this theory relies on "appraisal". Which examines the approaches and delineates the numerous amenable traits of emotions. Appraisal is stated as a cognitive elucidation of one's sense or perception towards something [20].

2.2. Emotional Model

Two principal computational models established on appraisal theory, are discussed precisely hereinbelow:

i. OCC Model: OCC Model -Orton, Collins and Core- is amongst the absolute and ubiquitous model ever used in AI (Artificial Intelligence) (1988). In this model, emotions are taken as "valenced response to the intrinsic or extrinsic impulses built on the course in which the affairs are inferred." [6]. Under this framework, behavior is deliberated over as a reaction to evoked mental state, which is pertinent to obtained intrinsic or extrinsic stimulation. Twenty two (22) emotions have been classified into three (3) principal categories in OCC model. (1) Emotions that complies with entities: affection (love) and aversion (hate); (2) those emotions which are the outcomes of developments: being delighted or peeved-these include well-being (e.g. happiness, anguish), prospect grounded (for instance: hope, relief, fearsome), fate of others (as pleased for someone or something, indignation, compassion); (3) attribution composites which includes honour, respect, disgrace, and scolding.

ii. The Lazarus Model: The persistent sequence between the elements of this model, acts in the subsequent way: individual's environmental interactions provides appraisal erratically in a person. This steers to the creation of impactful responses that occur with certain degree of intensity and triggering behavioural and cognitive results [21, 22]. There are some crucial parts of this theory, (1) the appraisal part in which evaluation provided by a person to diverse situations based on their belief, desires and intent. In this theory, appraisal variables illustrate certain computations made by a human to elicit specified emotional responses; (2) this involves, how copying determines to respond to an already appraised situation. As an illustration, experiencing pain in a state (appraisal) perceived by an individual may evoke feelings of guilt (coping), which could later result in feeling of annoyance in that individual (re-appraisal).

iii. Top of Form

iv. Model of Knowledge, Skills, and Attitude (KSA): The KSA model depends on three components: Knowledge, Skills and Attitude. It is a structure for individuals to maintain proper attitude on the correct time. It is represented in the shape of pyramid, also, states that knowledge is memorized and knowing about information related to something that is determined by surroundings. However, skills are the capacity to perform explicit work. While attitudes allude to emotions or full of feeling capacities that how somebody respond to certain circumstance. Here is the KSA model pyramid diagram

Below is the comparison between OCC and Lazarus models. The model of occ covers a broad range of emotions; whereas, Lazarus provides a further detailed explanation of appraisal variables to make out between distinct emotions. Despite that, few emotions included in the OCC model, are expelled in Lazarus' one e.g., reproach, remorse, admiration etc. [23].

2.3. Cognitive Agent

Russell calls such agent an intelligent. The basic notion, chalked out by Franklin it this definition, is that, the agent supposed to be an active constituent of its ambient, capable of perceiving it, autonomously act upon it and maintain temporal continuity. This can happen once an agent may possess sensors for environmental insight, having effectors to enact modifications within it and primal motivators to spur its actions [24]. As an illustration, an antivirus installed in a computer harness its sensors to identify potential threats, effectors to eliminate malignant files; the motivators to safeguard the system from toxic software. Likewise, an agent must possess the proficiency to learn from its environment and conform to changes. Thereby, adaptive learning arises amongst the highly crucial characteristics of an agent. An agent learning should be progressive and ongoing [25]. Given types of agents have been categorized by Wooldridge below. [26]

i. Reactive: An absolutely reactive agent is one whose actions are merely intended by its present sensory input. This kind of agents, does not store any inner information. When making decisions, it does not take into account the history of previous actions.

ii. Deliberative: These agents can monitor their environment and get their internal representation. They can generate strategies to achieve their objectives.

iii. Hybrid: Such agents behave as a combination of reactive agents; deliberate agents thereby can generate new plans and immediately respond to external stimuli. They can generate plans to meet their goals

The spectrum of this study does not encompass extensive topics of cognition; the role of cognitive systems and their functioning. An agreement has been made, if a system was equipped with cognition, it would hold the following capabilities: learning, adaptation, anticipation, autonomous behaviour, natural language, creativity and self-reflection [27]. Researchers attempt to merge essential aspects of both emergent and cognitivist systems. In hybrid systems, the representations of system are generated autonomously over its contact with the surroundings, in place of being pre-programmed [28]. Hence, an object's representation is formed through a perspicacity action process and direct contact with the object. In the course of learning stage, such systems lack direct accessibility to internal semantic representations of objects, though the embodiment is necessary.

Top of Form [29].

2.4. Cognitive Architecture

From Massachusetts Institute of Technology Mr. Cynthia Breazeal in his paper 'Robots in society, friend or appliance [30], review the role of artificial emotions that will be useful in engaging people in social interaction style like human beings and talk about problems in constructing socially intelligent cognitive robots. Its software architecture model is dependent on numerous systems to accomplish objectives of social collaboration in robots that perceptions system, motivation system, attention system, emotion system, motor system skills and internal drives and utilizing settled attitudes to perform behavior. Recent researchers have identified that attitudes can directly and intentionally and indirectly influence behavior [31]. In model [32], in order to influence decision making, multiple mental state motives, social pressure, and stress are used. In [33] Helbing, a model that is represented by Helbing and Johansson, it is a behavior model of the crowd in fear situations, he uses mathematics to achieve this. This model is based on the logic of physics. This is a particle system that uses collision phenomena between particles.

The previous work shows that the working of emotion and attitude base model and different behaviour and architecture of cognitive agent also this study focus on the limitation of mental constructs that computational cognitive agent are facing. These literature works show the construction and mental features of the map that disappears from human behaviour in the computing model. Our study identifies the limitations for the psychological structure faced by computational cognitive-agent. Human-based agent's found in psychology literature describe the interaction of multiple psychological structures. Our purpose study designs the missing psychological structures and human Emotion-Base-Attitudes characteristics in computational models.

3. Materials and Methods

On the Bases of literature, when we talking about human behavior and humanistic system and mental construct, a large number of the models of cognitive agents have still missing with such attitude with emotion that helps to solve the conflict of decision making. Fig-1 an image of a model to simulate an attitude in a cognitive agent based on situations and scenarios. The model focuses on five different types of mental states: beliefs, emotions, motivations and attitudes.

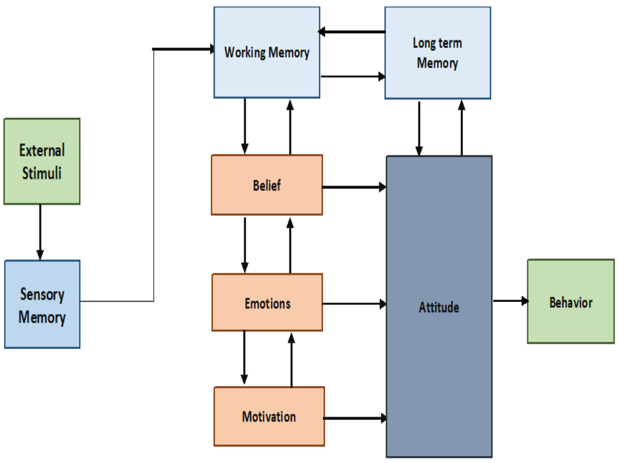


Figure 1. Modeling of an "emotion-based attitude" for cognitive agent

In this model, cognitive agents obtain information from the outside world that may be agents or direct observation inputs. First, the external stimulus is transferred to the sensory memory of the agent, where the detection of the data will occur. It will sense new data and save it with the new date detection value and then compare it with the previously stored sensory data. The sensory memory then transfers the processing of the detected data to the working memory for further processing of the information.

3.1. Purposed Rule-based System for Hybrid Model

There are many types of model, which have contributed to the popularity of cognitive-agent base related questions. The motivation behind this purpose model is given by researcher shows in related work. We analyze the working of purpose model by using example in which we create virtual comical factory in MATLAB 2017a and testing the impact of emotion base attitude on cognitive agent.

We purpose some mathematic equations prove for rules-evaluation for showing the working of purpose model by using fuzzy logic techniques by following Mamdani model steps these are as follows:

Step 1: Identify input and output variables and decide descriptor

- Here inputs are "Fire, Leakage, Damage and Explosion" Assume in %.
- Outputs are Anger, Depression (lose), Anxiety (Fear), Happy, Panic, Motivation, Attitude.

1. Anger
2. Sadness (lose)
3. Anxiety (Fear) Emotion Generated by BC model
4. Panic
5. Motivation
6. Happy
7. Attitude

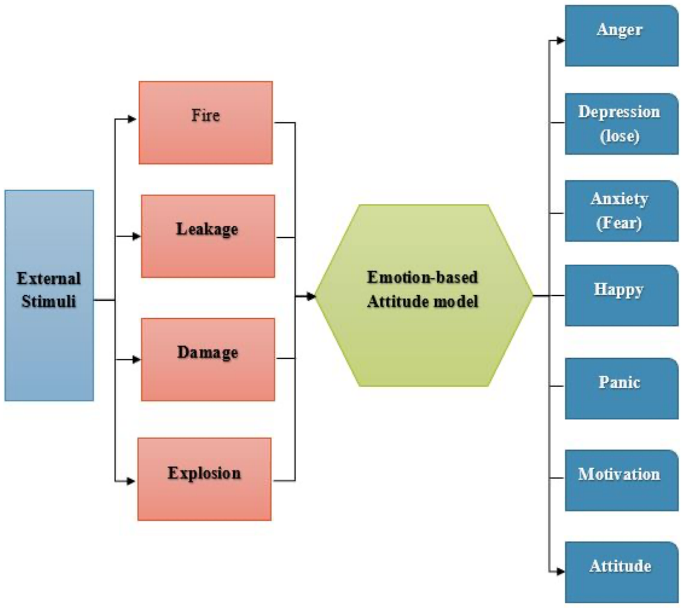


Figure 2. Flow diagram of Hybrid model of agent working in a chemical factory

We purpose some mathematic equations prove for rules-evaluation for showing the working of purpose model by using fuzzy logic techniques by following Mamdani model steps these are as follows:

Descriptor for Input variable:

1. Fire: {RF, LF, MF, HF, DF, W
2. Leakage: {RL, LL, ML, HL, DL, WL}
3. Damage: {RD, LD, MD, HD, DD, WD}
4. Explosion: {RE, LE, ME, HE, DE, WE}

R=Rumor; L=Low; M=Medium; H=High; D=Danger; W=Warning

Descriptor for Output variable:

1. Anxiety: {NA, SA, LA, MA, HA, EA}
2. Panic: {NP, SP, LP, MP, HP, EP}
3. Sadness: {NS, SS, LS, MS, HS, ES}
4. Anger: {NA, SA, LA, MA, EA,}
5. Motivation: {NM, SM, LM, MM, EM}
6. Happy: {NH, SH, LH, MH, EH}
7. Attitude: {Causal, Safe, Slow, Cautious, Quickly, Evacuate}

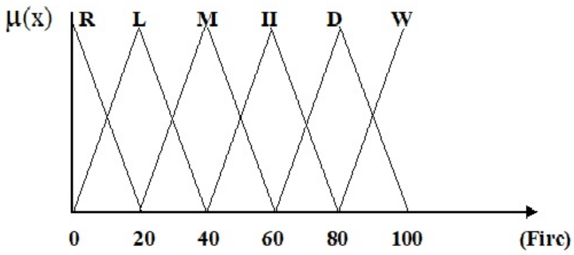
N=None; S=Slight; L=Low; M=Medium; H=High; E=Extreme

Step 2: To define membership function for each of the input and output variable we use triangular MFs

A MF's is a bend that characterizes how each purpose of the info space is appointed to the esteem (or level of enrollment) of each point somewhere in the range of 0 and 1. The information space is at times called the universe of discourse, an idea that gets the name of a straightforward idea.

For input variable:

1) MFs for Fire:



μRF(x) = $\frac{20-x}{20}$, $0 \le x \le 20$

μLF(x) = $\frac{x-0}{20-0}$ => $\frac{x}{20}$, $0 \le x \le 20$ = $\frac{40-x}{40-20}$ => $\frac{40-x}{20}$, $20 \le x \le 40$

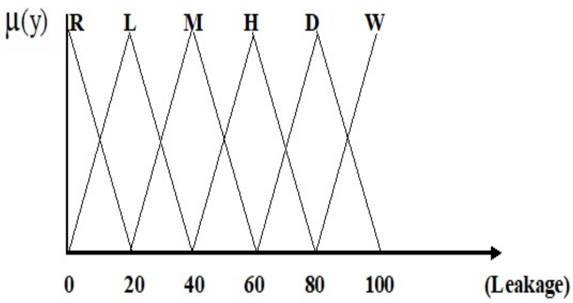
μMF(x) = $\frac{x-20}{40-20}$ => $\frac{x-20}{20}$, $20 \le x \le 40$ = $\frac{60-x}{60-40}$ => $\frac{60-x}{20}$, $40 \le x \le 60$

μHF(x) = $\frac{x-40}{60-40}$ => $\frac{x-40}{20}$, $40 \le x \le 60$ = $\frac{80-x}{80-60}$ => $\frac{80-x}{20}$, $60 \le x \le 80$

μDF(x) = $\frac{x-60}{80-60}$ => $\frac{x-60}{20}$, $60 \le x \le 80$ = $\frac{100-x}{100-80}$ => $\frac{100-x}{20}$, $80 \le x \le 100$

μWF(x) = $\frac{x-80}{100-80}$ => $\frac{x-80}{20}$, $80 \le x \le 100$

2) MFs for Leakage:



μRL(y) = $\frac{20-y}{20}$, $0 \le y \le 20$

μLL(y) = $\frac{y-0}{20-0}$ => $\frac{y}{20}$, $0 \le y \le 20$= $\frac{40-y}{40-20}$ => $\frac{40-y}{20}$, $20 \le y \le 40$

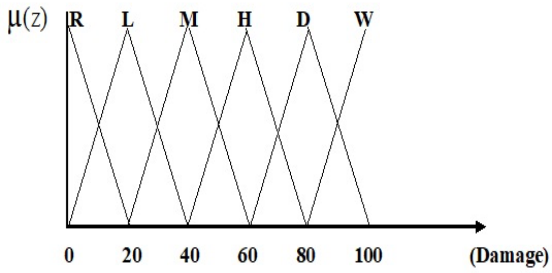
μML(y) = $\frac{y-20}{40-20}$ => $\frac{y-20}{20}$, $20 \le y \le 40$ = $\frac{60-y}{60-40}$ => $\frac{60-y}{20}$, $40 \le y \le 60$

μHL(y) = $\frac{y-40}{60-40}$ => $\frac{y-40}{20}$, $40 \le y \le 60$ = $\frac{80-y}{80-60}$ => $\frac{80-y}{20}$, $60 \le y \le 80$

μDL(y) = $\frac{y-60}{80-60}$ => $\frac{y-60}{20}$, $60 \le y \le 80$ = $\frac{100-y}{100-80}$ => $\frac{100-y}{20}$, $80 \le y \le 100$

μWL(y) = $\frac{y-80}{100-80}$ => $\frac{y-80}{20}$, $80 \le x \le 100$

3) MFs for Damage:



μRD(z) = $\frac{20-z}{20}$, $0 \le z \le 20$

μLD(z) = $\frac{z-0}{20-0}$ => $\frac{z}{20}$, $0 \le z \le 20$ = $\frac{40-z}{40-20}$ => $\frac{40-z}{20}$, $20 \le z \le 40$

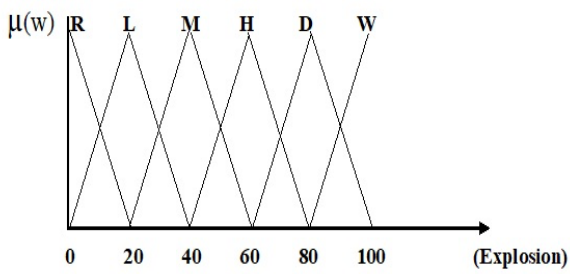
μMD(z) = $\frac{z-20}{40-20}$ => $\frac{z-20}{20}$, $20 \le z \le 40$ = $\frac{60-z}{60-40}$ => $\frac{60-z}{20}$, $40 \le z \le 60$

μHD(z) = $\frac{z-40}{60-40}$ => $\frac{z-40}{20}$, $40 \le z \le 60$ = $\frac{80-z}{80-60}$ => $\frac{80-z}{20}$, $60 \le z \le 80$

μDD(z) = $\frac{z-60}{80-60}$ => $\frac{z-60}{20}$, $60 \le z \le 80$ = $\frac{100-z}{100-80}$ => $\frac{100-z}{20}$, $80 \le z \le 100$

μWD(z) = $\frac{z-80}{100-80}$ => $\frac{z-80}{20}$, $80 \le z \le 100$

4) MFs for Explosion:



μRE(w) = $\frac{20-w}{20}$, $0 \le w \le 20$

μLE(w) = $\frac{w-0}{20-0}$ => $\frac{w}{20}$, $0 \le w \le 20$ = $\frac{40-w}{40-20}$ => $\frac{40-w}{20}$, $20 \le w \le 40$

μME(w) = $\frac{w-20}{40-20}$ => $\frac{w-20}{20}$, $20 \le w \le 40$ = $\frac{60-w}{60-40}$ => $\frac{60-w}{20}$, $40 \le w \le 60$

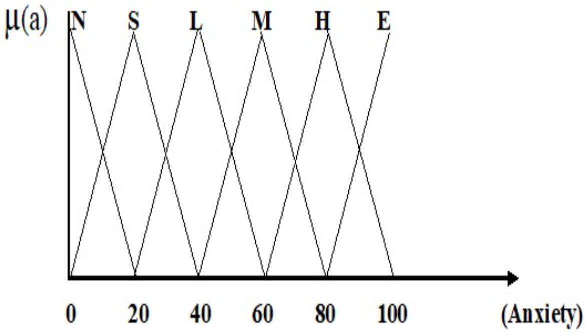
μHE(w) = $\frac{w-40}{60-40}$ => $\frac{w-40}{20}$, $40 \le w \le 60$ = $\frac{80-w}{80-60}$ => $\frac{80-w}{20}$, $60 \le w \le 80$

μDE(w) = $\frac{w-60}{80-60}$ => $\frac{w-60}{20}$, $60 \le w \le 80$= $\frac{100-w}{100-80}$ => $\frac{100-w}{20}$, $80 \le w \le 100$

μWE(w) = $\frac{w-80}{100-80}$ => $\frac{w-80}{20}$, $80 \le w \le 100$

For output variable:

1) MFs for Anxiety:



μNA(a) = $\frac{20-a}{20}$, $0 \le a \le 20$

μSA(a) = $\frac{a-0}{20-0}$ => $\frac{a}{20}$, $0 \le a \le 20$ = $\frac{40-a}{40-20}$ => $\frac{40-a}{20}$, $20 \le a \le 40$

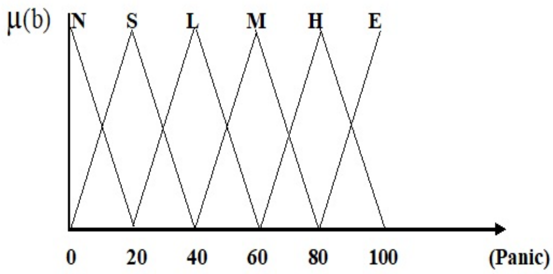
μLA(a) = $\frac{a-20}{40-20}$ => $\frac{a-20}{20}$, $20 \le a \le 40$ = $\frac{60-a}{60-40}$ => $\frac{60-a}{20}$, $40 \le a \le 60$

μMA(a) = $\frac{a-40}{60-40}$ => $\frac{a-40}{20}$, $40 \le a \le 60$ = $\frac{80-a}{80-60}$ => $\frac{80-a}{20}$, $60 \le a \le 80$

μHA(a) = $\frac{a-60}{80-60}$ => $\frac{a-60}{20}$, $60 \le a \le 80$ = $\frac{100-a}{100-80}$ => $\frac{100-a}{20}$, $80 \le a \le 100$

μEA(a) = $\frac{a-80}{100-80}$ => $\frac{a-80}{20}$, $80 \le a \le 10$

2) MFs for Panic:



μNP(b) = $\frac{20-b}{20}$, $0 \le b \le 20$

μSP(b) = $\frac{b-0}{20-0}$ => $\frac{b}{20}$, $0 \le b \le 20$ = $\frac{40-b}{40-20}$ => $\frac{40-b}{20}$, $20 \le b \le 40$

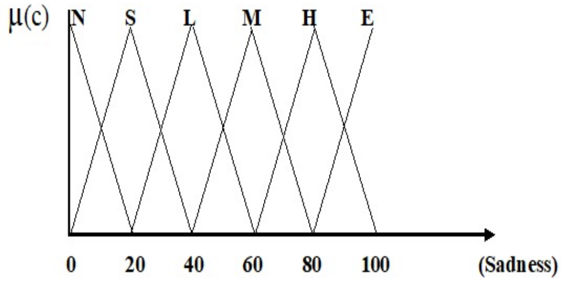
μLP(b) = $\frac{b-20}{40-20}$ => $\frac{b-20}{20}$, $20 \le b \le 40$ = $\frac{60-b}{60-40}$ => $\frac{60-b}{20}$, $40 \le b \le 60$

μMP(b) = $\frac{b-40}{60-40}$ => $\frac{b-40}{20}$, $40 \le b \le 60$ = $\frac{80-b}{80-60}$ => $\frac{80-b}{20}$, $60 \le b \le 80$

μHP(b) = $\frac{b-60}{80-60}$ => $\frac{b-60}{20}$, $60 \le b \le 80$ = $\frac{100-b}{100-80}$ => $\frac{100-b}{20}$, $80 \le b \le 100$

μEP(b) = $\frac{b-80}{100-80}$ => $\frac{b-80}{20}$, $80 \le b \le 100$

MFs for Sadness:



μNS(c) = $\frac{20-c}{20}$, $0 \le c \le 20$

μSS(c) = $\frac{c-0}{20-0}$ => $\frac{c}{20}$, $0 \le c \le 20$ = $\frac{40-c}{40-20}$ => $\frac{40-c}{20}$, $20 \le c \le 40$

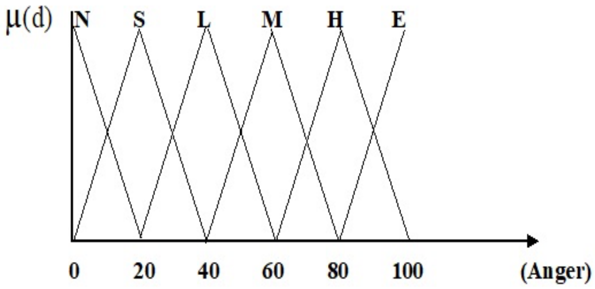
μLS(c) = $\frac{c-20}{40-20}$ => $\frac{c-20}{20}$, $20 \le c \le 40$ = $\frac{60-c}{60-40}$ => $\frac{60-c}{20}$, $40 \le c \le 60$

μMS(c) = $\frac{c-40}{60-40}$ => $\frac{c-40}{20}$, $40 \le c \le 60$ = $\frac{80-c}{80-60}$ => $\frac{80-c}{20}$, $60 \le c \le 80$

μHS(c) = $\frac{c-60}{80-60}$ => $\frac{c-60}{20}$, $60 \le c \le 80$ = $\frac{100-c}{100-80}$ => $\frac{100-c}{20}$, $80 \le c \le 100$

μES(c) = $\frac{c-80}{100-80}$ => $\frac{c-80}{20}$, $80 \le c \le 100$

3) **MFs for Anger**:



μNA(d) = $\frac{20-d}{20}$, $0 \le d \le 20$

μSA(d) = $\frac{d-0}{20-0}$ => $\frac{d}{20}$, $0 \le d \le 20$ = $\frac{40-d}{40-20}$ => $\frac{40-d}{20}$, $20 \le d \le 40$

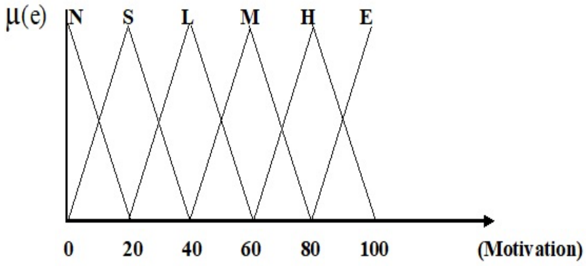
μLA(d) = $\frac{d-20}{40-20}$ => $\frac{d-20}{20}$, $20 \le d \le 40$ = $\frac{60-d}{60-40}$ => $\frac{60-d}{20}$, $40 \le d \le 60$

μMA(d) = $\frac{d-40}{60-40}$ => $\frac{d-40}{20}$, $40 \le d \le 60$ = $\frac{80-d}{80-60}$ => $\frac{80-d}{20}$, $60 \le d \le 80$

μHA(d) = $\frac{d-60}{80-60}$ => $\frac{d-60}{20}$, $60 \le d \le 80$ = $\frac{100-d}{100-80}$ => $\frac{100-d}{20}$, $80 \le d \le 100$

μEA(d) = $\frac{d-80}{100-80}$ => $\frac{d-80}{20}$, $80 \le d \le 100$

4) MFs for Motivation:



$\mu NM(e) = \frac{20-e}{20}$, $0 \le e \le 20$

$\mu SM(e) = \frac{e-0}{20-0} \Rightarrow \frac{e}{20}, 0 \le e \le 20 = \frac{40-e}{40-20} \Rightarrow \frac{40-e}{20}, 20 \le e \le 40$

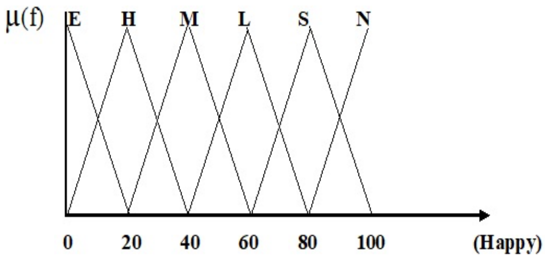
$\mu LM(e) = \frac{e-20}{40-20} \Rightarrow \frac{e-20}{20}, 20 \le e \le 40 = \frac{60-e}{60-40} \Rightarrow \frac{60-e}{20}, 40 \le e \le 60$

$\mu MM(e) = \frac{e-40}{60-40} \Rightarrow \frac{e-40}{20}, 40 \le e \le 60 = \frac{80-e}{80-60} \Rightarrow \frac{80-e}{20}, 60 \le e \le 80$

$\mu HM(e) = \frac{e-60}{80-60} \Rightarrow \frac{e-60}{20}, 60 \le e \le 80 = \frac{100-e}{100-80} \Rightarrow \frac{100-e}{20}, 80 \le e \le 100$

$\mu EM(e) = \frac{e-80}{100-80} \Rightarrow \frac{e-80}{20}, 80 \le e \le 100$

5) MFs for Happy:



$\mu EH(f) = \frac{20-f}{20}$, $0 \le f \le 20$

$\mu HH(f) = \frac{f-0}{20-0} \Rightarrow \frac{f}{20}, 0 \le f \le 20 = \frac{40-f}{40-20} \Rightarrow \frac{40-f}{20}, 20 \le f \le 40$

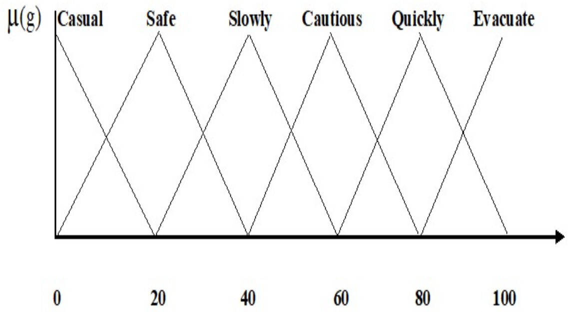
$\mu MH(f) = \frac{f-20}{40-20} \Rightarrow \frac{f-20}{20}, 20 \le f \le 40 = \frac{60-f}{60-40} \Rightarrow \frac{60-f}{20}, 40 \le f \le 60$

$\mu LH(f) = \frac{f-40}{60-40} \Rightarrow \frac{f-40}{20}, 40 \le f \le 60 = \frac{80-f}{80-60} \Rightarrow \frac{80-f}{20}, 60 \le f \le 80$

$\mu SH(f) = \frac{f-60}{80-60} \Rightarrow \frac{f-60}{20}, 60 \le f \le 80 = \frac{100-f}{100-80} \Rightarrow \frac{100-f}{20}, 80 \le f \le 100$

$\mu NH(f) = \frac{f-80}{100-80} \Rightarrow \frac{f-80}{20}, 80 \le f \le 100$

6) MFs for Attitude:



μCausal $A(g) = \frac{20-g}{20}$, $0 \le g \le 20$

μSafe $A(g) = \frac{g-0}{20-0} \Rightarrow \frac{g}{20}$, $0 \le g \le 20 = \frac{40-g}{40-20} \Rightarrow \frac{40-g}{20}$, $20 \le g \le 40$

μSlowly $A(g) = \frac{g-20}{40-20} \Rightarrow \frac{g-20}{20}$, $20 \le g \le 40 = \frac{60-g}{60-40} \Rightarrow \frac{60-g}{20}$, $40 \le g \le 60$

μCautious $A(g) = \frac{g-40}{60-40} \Rightarrow \frac{g-40}{20}$, $40 \le g \le 60 = \frac{80-g}{80-60} \Rightarrow \frac{80-g}{20}$, $60 \le g \le 80$

μQuickly $A(g) = \frac{g-60}{80-60} \Rightarrow \frac{g-60}{20}$, $60 \le g \le 80 = \frac{100-g}{100-80} \Rightarrow \frac{100-g}{20}$, $80 \le g \le 100$

μEvacuate $A(g) = \frac{g-80}{100-80} \Rightarrow \frac{g-80}{20}$, $80 \le g \le 100$

Once when the MF's are approved, the further step' is to set up rules for the attitude and behavior of the agent while changing numerous situations. The rules vary depending on the input variables & output variable. e.g. if the input signals are indicating of extreme fire, the agent needs to take an "evacuation" attitude. Agents must abandon from the place. If there are two or more input values “leakage", "fire", and "explosion" the circumstances becomes "unsafe", in which case the agent has to evacuate the place. Few of the rules are given in step-3.

Step 3: Form of rule base:

x.y \ z.w	R	L	M	H	D	W
R	N	N	L	M	M	H
L	S	S	L	M	M	H
M	S	L	L	M	H	H
H	L	L	M	M	H	H
D	L	M	M	H	H	E
W	M	M	M	H	E	E

Figure 3. Form of rule base

In this step we form the rule by using common sense and logics on the basis of input and output variable descriptor in figure 3 hear x, y, z, and w shows the input variable function along with descriptor and inside the figure shows output variable descriptor that is showed in step-1. On the basis of this step we calculate the value of output variables and step-4 and step-5 also base on this step.

Step 4: Rules evaluation:

On the basis of step-2, in this step, we evaluate the rules to assigning a different value to input variables and then check how membership function have given the best rule selection in multiple set of rules that are created by step-3.

When we assume to assigning the value to input variable for checking the working of own purpose model the system auto picked membership function according to the value that define in step-2 and on the basis of selected MFs we create some equation to the combination of MFs that auto makes the desire rule for the system.

Assume F=90%, L=30%, D=75%, E=70%

⇨ Fire=90% map 2MFs of Fire variables.

$\mu DF(x) = \frac{100-x}{20}$ $\mu WF(x) = \frac{x-80}{20}$

⇨ Similarly, Leakage = 30% maps 2MFs of Leakage variables

$\mu LL(y) = \frac{40-y}{20}$ $\mu ML(y) = \frac{y-20}{20}$

⇨ Similarly, Damage = 75% maps 2MFs of Leakage variables

$\mu LD(z) = \frac{80-z}{20}$ $\mu DD(z) = \frac{z-60}{20}$

⇨ Similarly, Explosion = 70% maps 2MFs of Leakage variables

$\mu HE(w) = \frac{80-w}{20}$ $\mu DE(w) = \frac{w-60}{20}$

For Fire:

⇨ Evaluate μDF(x) and μWF(x) for x = 90, we get

$\mu DF(x) = \frac{100-90}{20} = 1/2$ ________ 1

$\mu WF(x) = \frac{90-80}{20} = 1/2$ ________ 2

For Leakage:

⇨ Evaluate μLL(y) and μML(y) for y = 30, we get

$\mu LL(y) = \frac{40-30}{20} = 1/2$ ________ 3

$\mu ML(y) = \frac{30-20}{20} = 1/2$ ________ 4

For Damage:

Evaluate μHD(z) and μDD(z) for z =75, we get

$\mu HD(z) = \frac{80-75}{20} = 5/20 = 1/4$ ________ 5

$\mu DD(z) = \frac{75-60}{20} = 15/20 = 3/4$ ________ 6

For Explosion:

Evaluate μHE(w) and μDE(w) for z =70, we get μHE(w) = $\frac{80-70}{20}$ = 1/2 __________ 7

μDE(w) = $\frac{70-60}{20}$ = 1/2 __________ 8

The above 8 equations lead to rules we need to evaluate

1. Fire == dangerous & Leakage == low Damage == High & Explosion == High
2. Fire == dangerous & Leakage == Medium & Damage == dangerous & Explosion == Dangerous.
3. Fire == Warning & Leakage == low & Damage == High & Explosion == High.
4. Fire == Warning & Leakage == Medium & Damage == dangerous & Explosion == Dangerous.

Since the antecedent part of each of the above rule is connected by AND operator, we use min operator to evaluate strength of each rule. The MIN value of each rule is taken by the equation.

Strength of rule 1 DF, LL, HD, HE.

S1 = MIN (μDF (90) μLL (30), μHD (75), μHE (70))
= MIN (1/2, 1/2, 1/4, 1/2)
=1/4

Strength of rule 2 DF, ML, DD, DE.

S2 = MIN (μDF (90) μML (30), μDD (75), μDE (70))
= MIN (1/2, 1/2, 3/4, 1/2)
= 1/2

Strength of rule 2 WF, LL, HD, HE.

S3 = MIN (μWF (90) μLL (30), μHD (75), μHE (70))
= MIN (1/2, 1/2, 1/4, 1/2)
= 1/4

Strength of rule 2 WF, ML, DD, DE.

S4 = MIN (μWF (90) μML (30), μDD (75), μDE (70))
= MIN (1/2, 1/2, 3/4, 1/2)
= 1/2

After rules evaluation and taking out the Strength of this rule we get the values and put on this step-3 to finding the approximate value of output by using defuzzification step.

Step 5: Defuzzification:

In this step after getting the Strength of rules by step-4, we need to finding the resulting value according to input and now, we use "mean of max" defuzzification technique

Maximum of strength
= max (s1, s2, s3, s4)
= max (1/4, 1/2, 1/4, 1/2)
= 1/2 this is corresponded rule 2 and 4 and both have taken strength 1/2

Rule-2: Fire is dangerous and Leakage is Medium and Damage is dangerous and Explosion is Dangerous.

Rule-4: Fire is Warning and Leakage is Medium and Damage is dangerous and Explosion is Dangerous.

Firstly, we find out the rule-2 final defuzzification value we now take the average mean of

μHA (a) = $\frac{a-60}{20}$ and μHA (a) = $\frac{100-a}{100-80}$ (this value taken from output variable MFs)

We know that μHA (a) = 1/2 by getting in figure 3.

$1/2=\frac{a-60}{20}$, $1/2=\frac{100-a}{100-80}$

a= 70 , a= 90

by mean

$a^*=\frac{70+90}{2}$

a=80

Secondly, we find the rule-4 final defuzzification value

$\mu EA(a) = \frac{a-80}{20}$ (this value taken from output variable MFs)

$1/2=\frac{a-80}{20}$

a=90

According to rule evaluation we proved that the output MFs of anxiety, panic, sadness, anger, motivation, Happy and Attitude range of resulting value in between 80 to 90. If the sensor value is changed then this system also provides the approximate result according to input values of variables. This methodology also shows that the changing of emotion effect on attitude also provides better decision making for a cognitive agent in any kind of hostile environment.

4. Results

This section may be divided by subheadings. It should provide a concise and precise description of the experimenta+l results, their interpretation, as well as the experimental conclusions that can be drawn.

(As in Fishbein's, '1980') [34] It was noticed that; the value for the inputs or outer stimulation changed, the belief changed and the emotion, motivation & an attitude changed. Figure 4 show that rule-viewer of MATLAB2017b when the value of Fire==90, Leakage==30, Damage==75 AND Explosion==70.

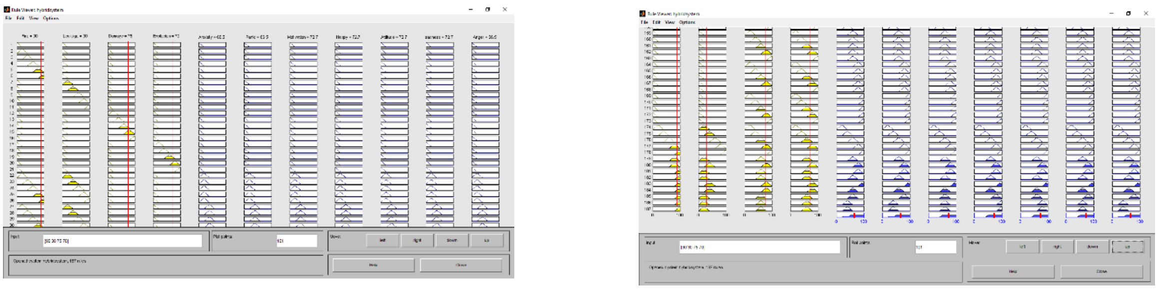


Figure 4. Results and Rule-viewer of Attitude simulation of Cognitive-agents in emergency conditions in MATLAB2017b

As the models describe the interrelationship of motivations, emotion, and belief on attitudes, their effects are shown graphically. Output variables' (anger, or anxiety, or panic, or, or happy, or motivation, or attitude) depend heavily on input variables. As depending upon severity' of input values (fire, chemical leakage, and damage, and explosion) increases, output variable (anger, or anxiety, or panic, or, or attitude) increase but output variable (motivation & happy) decrease with increasing input values. Shown graphically in figure 5 to figure 8.

As can be seen in figure 5, a graphical representation plot between the levels of 'fire' created by the agent, 'leakage-level', & 'anxiety-level' of agents. When low fire-level & low leakage-level (oil and chemicals), the agent fear-level is also found to be low; as below the resistant surface for fear. Hence, when fire and leakage levels increase and reach to extreme levels, the fear level of agents becomes extreme.

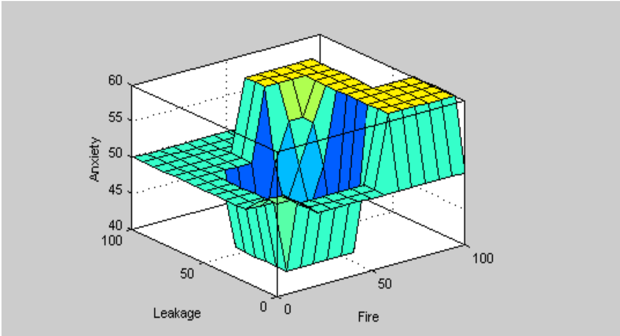


Figure 5. Graph between level of (fire, leakage and Anxiety)

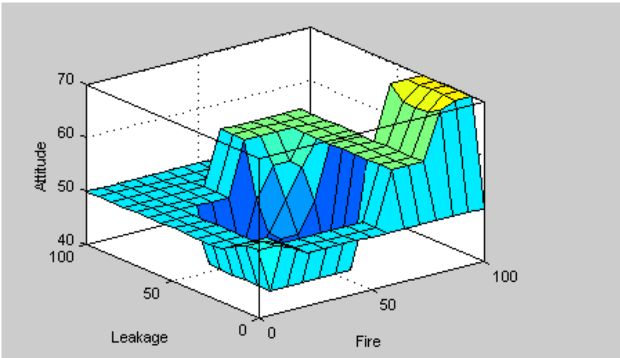


Figure 6. Graph between level of (fire, leakage and Attitude)

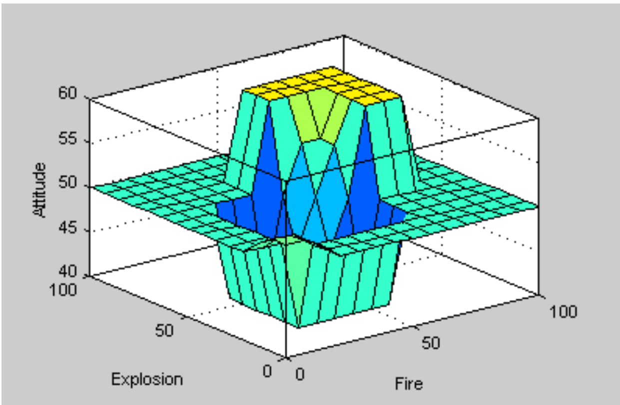


Figure 7. Graph between level of (fire, Explosion and Attitude)

As in figure 6 and 7, a graphical representation of plot between explosion-level and the leakage-level (for oil and for chemicals) and numerous attitudes has been created in response to these agents. Due to the low elimination rate of explosions and leaks, agents will have a slight negative attitude value, they will adopt an attitude (cautious attitude, or slow attitude, or safe attitude), although the degree of explosion and leakage is high, but the agent will have a negative attitude, they will take (cautions attitude, or quickly attitude, or evacuate attitude) attitude in such circumstances.

As shown in figure 8, graphically representation of the relationship between fire-level, explosion-level and panic-level among agents in the virtualized world of chemical factory. It was writing in chapter no 4 that emotion has a directly impact upon attitude, and vice versa. When the level of fire is low and also level of explosions are low (because of fire), then the panic-level between agents is also reduced because we know that it is lower than the stable panic surface. Hence, the fire-level and explosion-level increased and reached to extreme-level, the panic between the agents will also reach to extreme-level.

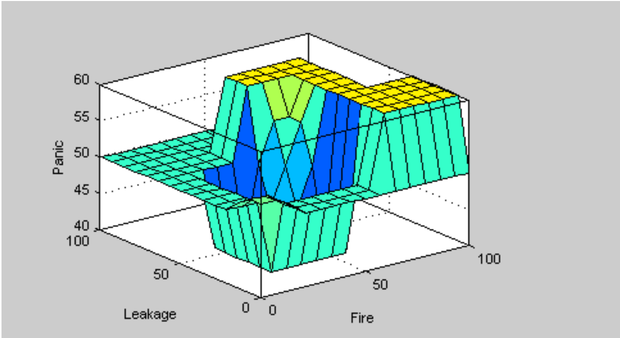


Figure 8. Graph between level of (fire, Leakage and Panic)

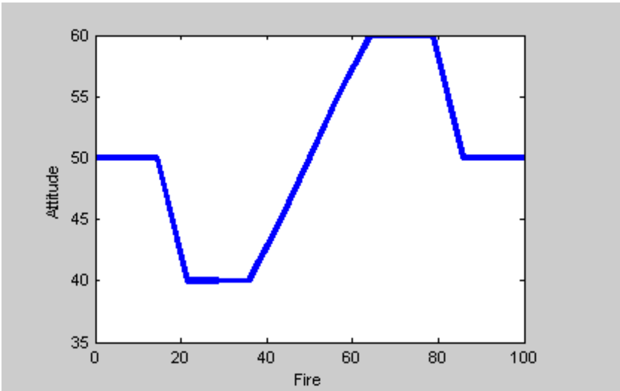


Figure9. Graphically representing the Levels between (fire and attitudes)

5. Conclusions

The objective of this paper aims to offer and execute an emotional apparatus within a cognitive agent drawing upon evidences from neuroscience. The proposed model addresses disasters such as chemical plant fires, chemical spills, building damage and explosions. On the bases of emotional mechanism, agents are capable of learning; influence various forms of solutions and decision making. It also proposes a universal approach to implement plan and causal learning in cognitive agents. Besides, it tells the way they (agents) are impacted by the given emotional mechanisms; the interaction of emotions; motivations and beliefs and the attitudes of agents, through emotional responses.

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