Cognitive agent based on the 16PF, for analysis of human personality

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ABSTRACT

This paper presents the development of an architecture for a Multi-Agent System Based on Social-Rational Personality, which seeks the human personality empathy, based on the 16 Personality Factor (16 PF) of Raymond Cattell, and the primary emotions methodology of Paul Ekman. Intelligent Agents will be used for learning and knowledge acquisition, Vision Techniques for pre-processing images, Neural Networks for people and gestures recognition, Fuzzy Logic to ponder emotions and Clustering for grouping similar personalities.

INTRODUCTION

Robots are becoming part of our daily life, there are increasingly more ordinary people using them and in a few years robots will be in hospitals, schools, nursing homes and even in our homes. For robots to interact effectively with people need to behave like human beings, however it may be difficult for humans to accept robots that can fully understand a conversation and even execute tasks that only them could do in the past.

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The creation of robots with humanoid appearance goes hand in hand with the development of cognitive and social robots with perceptual abilities; in this paper we describe some interesting and well known examples.

Another interesting work is the creation of a virtual DNA with which virtual creatures are created, it's called Rity and takes place in a virtual world, the DNA has 14 chromosomes, these creatures have their own personality and ultimately can reproduce their own species or even evolve in a distinct specie. Rity has internal components similar to human internal states such as motivation, homeostasis and emotion, the robot interacts with the environment through sensors attached to peripheral equipment and also interacts with real humans based on stimuli received by peripheral sensors, of the three internal states mentioned above motivation consists of six states including: [13]

- Curiosity
- Intimacy
- Monotony
- Avoidance
- Greed
- Desire to control

Personality

An investigation was conducted to find personality study tools because there are a variety of them, we will briefly describe those evaluated for use.

Reliability and Validity

We'll start by saying that all questionnaires or personality tests are evaluated by certain criteria such as test reliability and validity.

Reliability

Formula 1 is commonly known as the "20 of Kuder-Richardson formula" is the one with greater application

and is used in tests with answers of all or nothing, yes or not, etc.

$$r_{tt} = \left(\frac{n}{n-1}\right) \frac{DE_t^2 - \Sigma_{pq}}{DE_t^2} \qquad (1)$$

Formula 2 is known as alpha coefficient, the procedure is to find the variance of all individual scores for each question and variances amounts of all questions.

$$r_{tt} = \left(\frac{n}{n-1}\right) \frac{DE_t^2 - \Sigma(DE_i^2)}{DE_t^2} \qquad (2)$$

Formula 2 applies to personality inventories in which the subject may receive a different numerical grade in a question depending on whether the answers were checked "regularly", "sometimes", "rarely" or "never".

Below are the personality inventories studied that used the reliability formulas 1 (MMPI-2) and 2 (16 PF). [1]

Determining the degree of validity of a particular test requires some evidence accumulation, such as the scores obtained with the test, to support inferences that can be made. The type of evidence that will be used depends on the test type and implications and applications assign to it.

There are three classes of evidence considered:

- Content description. These methods involve mainly systematic test content examination to determine whether it covers a representative sample of the behavior area to be measured.
- Criterion-prediction. These procedures indicate the effectiveness of the test to predict the performance of an individual in specific activities.
- Construct. This process focuses on the psychological theory roll involved in the development of the test and the need to formulate hypotheses that can be proven or refuted in the validation process.
- These three kinds of evidence at the same time have a variety of tools that can evaluate each of the classes. [1]

16 PF

The 16 Personality Factors questionnaire (16 PF) is an instrument designed for personality research in

a short time. The PF 16 questionnaire is based on the measurement of 16 functionally independent dimensions psychologically significant.

Personality factors measured in the 16 PF are not unique to the test but are inserted within a general personality theory context, Table 1

These 16 dimensions or scales are essentially independent. Besides the 16 main personality factors, the instrument can be used to measure four additional secondary dimensions whose scores are obtained by the primary features components. Table 1 shows the 16 factors evaluated in a questionnaire which are identified by a letter.

Table 1
PRIMARY SCALES COMPOSING THE 16 PF

A Affability	L Surveillance
B Reasoning	M Abstraction
C Stability	N Privacy
E Dominance	O Apprehension
F Animation	Q1 Change aperture
G Norms attention	Q2 Self-sufficiency
H Audacity	Q3 Perfectionism
I Sensibility	Q4 Tension

Table 2 shows the sixteen test factors and both low and high poles that define a person.

In this questionnaire was necessary to use two kinds of evidence of construct and criterion validity.

The 16 PF construct validity addresses the faithfulness to the original proof of factors. [6] Provides an extensive review of studies focused on the verification and validation of the test structure. Several studies performed with thousands of people from different cultures and different demographic parameters indicate that the basic factor structure of the test is correct.

Using the test and re-test method, the 16PF is applied to the same sample on two separate occasions; correlations between scores obtained on both occasions are the reliability estimate. The time interval between the two applications can be short (from immediately to two weeks) or long (from several weeks to several years later). The average short interval of reliability for Forms A and B is .80; the long interval is .78. Form A particularly has .80 reliability in the short interval and .52 in the long interval. [14]

PROPOSAL

Having as basis the psychological work of personality, the human emotions and the Intelligent Agents paradigm; an architecture for SMA that could be able to find empathy with other agents or SMA will be developed to carry out common tasks. The study case is focused on mobile robotics.

General overview

The best suited definition of personality to our work is the one of Raymond Cattell who says that personality is a determining factor in behavior in a given situation. The basic components of the personality are the features. Cattell believed that there is a personality structure underlying the language describing the features, representing it as follows.

$$R=f(S,P) \tag{1}$$

R = nature and magnitude of the response or behavior of a person, is a S function, a stimulating situation that it is in, and P or nature of his personality.

The basic unit of analysis: the feature

The feature is the basic structural element of Cattell's theory. It's defined as a relatively permanent and wide trend that reacts in a certain way. It implies a certain regularity of behavior over time and situations. However on the other hand emotions are a fundamental part in decision making every day.

We can define emotion as nonverbal expressions that allow the human being to demonstrate the mood in which it is in. [8]

Table 2

16 PF PRIMARY SCALES SUMMARY

Scale		*Poles low (-) and high (+) define a person ....*
Affability	A-	Cold, impersonal and distant
	A+	Warm, affable, generous and attentive to others
Reasoning	B-	Concrete thinking
	B+	Abstract thinking
Stability	C-	Emotionally reactive and moody
	C+	Emotionally stable, adapted and mature
Dominance	E-	Respectful, cooperative and avoids conflicts
	E+	Dominant, assertive and competitive
Animation	F-	Shy, repressed and careful
	F+	Spirited, spontaneous, active and enthusiastic
Norms attention	G-	Unconventional, very own and indulgent
	G+	Attentive to the rules, dutiful and formal
Audacity	H-	Shy, fearful and inhibited
	H+	Daring, socially confident and entrepreneurial
Sensibility	I-	Objective, unsentimental and utilitarian
	I+	Sensible, esthete and sentimental
Surveillance	L-	Confident, without suspicion and adaptable
	L+	On watch, cautious and skeptical
Abstraction	M-	Practical, down-to-earth, realistic
	M+	Abstracted, imaginative and idealistic
Privacy	N-	Open, genuine, plain and natural
	N+	Private, calculator, discreet and does not open
Apprehension	O-	Confident, carefree and happy
	O+	Apprehensive, insecure and unconcerned
Change aperture	Q1-	Traditional and attached to the familiar
	Q1+	Open to change, experimenter and analytical
Self-sufficiency	Q2-	Follower and is integrated into the group
	Q2+	Self-sufficient, individualistic and lonely
Perfectionism	Q3-	Flexible and tolerant with disorder or failures
	Q3+	Perfectionist, organized and disciplined
Tension	Q4-	Relaxed, placid and patient
	Q4+	Tense, energetic, impatient and restless

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Thus, emotions take control of the person's behavior when facing emergency situations, is too important to be left solely in the hands of the intellect. [9]

In psychology the way that a person can communicate their emotions and the way that can be understood by another person is related to the concept of empathy. There are various definitions of empathy although we are taking as the most representative for this research the next two:

"The action and ability to understand, be aware, be sensitive or experience variant feelings, thoughts and experiences of another, without these feelings, thoughts and experiences have been communicated in an objective or explicit way" [10].

"It's the mental function that allows us not to be centered in ourselves and see things from the point of view of another. Through them we can be partakers of other's experiences and develop common experiences. "[11].

Table 3 shows emotions that different theorists take as basic or primary emotions, we will work with the Ekman's methodology (anger, revulsion, fear, happiness, sadness, surprise).

In the personality area we will work with personality profiles based on the 16PF test because the way to work since its creator (Raymond Cattell) is closely related to what we will use, since the answer depends on the situation and personality of the individual as represented in formula 3.

The whole system consists of the structure where the model works having two main blocks, the one which is responsible for learning and knowledge (Intelligent Agents paradigm) and the other one of control and vision (fuzzy logic), which we describe below, the first module contains 4 Agents:

- AN [Node Agent],
- AT [Task Agent],
- AS [System Agent],
- AA [Support Agent]

The System Agent (AS) contains and knows at all times the performance of the other agents. Sensing a change

Table 3

Theorists Basic emotions table

Theorist	Basic Emotions
Plutchik	Acceptance, anger, anticipation, disgust, joy, fear, sadness, surprise.
Arnold	Anger, aversion, anger, dejection, desire, despair, fear, hate, hope, love, sadness.
Ekman, Friesen, and Ellsworth	Anger, revulsion, fear, happiness, sadness, surprise.
Frijda	Desire, happiness, interest, surprise, amazement, sadness.
Gray Gris	Rage and terror, anxiety, joy.
Izard	Anger, contempt, revulsion, distress, fear, guilt, interest, joy, shame, surprise.
James	Fear, sadness, love, anger.
McDougall	Anger, revulsion, joy, fear, submission, offering of emotion, amazement.
Mowrer	Pain, pleasure.
Oatley and Johnson-Laird	Anger, revulsion, anxiety, happiness, sadness.
Panksepp	Hope, fear, anger, panic.
Tomkins	Anger, interest, contempt, revulsion, distress, fear, joy, shame, surprise.
Watson	Fear, love, anger.
Weiner and Graham	Happiness, sadness.

in the environment the Node Agent [who is in charge of the sensors (ultrasonic, camera and two light sensors)] with the ultrasonic sensor and the two light sensors, starts its operation beginning in reactive control state, that because it has to move forward and sense at the same time until it encounters an obstacle, once this happen a photo is taken, which is sent to the images database (IDB).

A pre-processing is applied to the image to be able to do the recognition and then know if it is the object to be found, and depending on this recognition if it is negative then it has to avoid the object otherwise it has to go ahead and take it, here is where the path control process enters indicating engines speed values to the Task Agent (which is responsible for servomotors).

Once all necessary parameters are defined for the robot's performance the System Agent (AS), which is the coordinator, executes instructions in the robot, if at some point all this is not enough for the robot to perform its task and gets stuck the Support Agent is responsible for getting it out of stagnation or also called moment of chaos.

AC: Cognitive Agent responsible of the robot's personality and emotions

Where the System Agent, Task Agent, Node Agent and Support Agent still have the same tasks and within the Cognitive Agent (AC) are new modules presented next in a breakdown, being this the part where, as mentioned above, the emotions and personality module will be developed.

The first one is Expression where the Node Agent (AN) is responsible for providing input to the first module where is perceive what the robot is seeing, which is an emotion, to be later passed to the Emotion Multi-Agent System where we get the degree in which the emotion is to, then move to the third module Personality Profile (Profile-P) where according to a defined personality profile and the emotion with which we are in the world we begin to choose with whom we can work. In Figure 1 the Cognitive Agent architecture is presented, which has three modules

Figura 1
Cognitive Agent Architecture (AC)
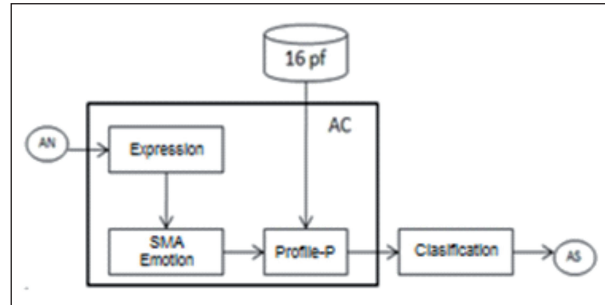
Next is the breakdown of the Emotions Multi-Agent System which is where the emotion is grouped.

We start by saying that human behavior has been studied for many years in several research areas and what motivated us to focus on this line is that science, two thousand years ago, told us that emotions were not involved in decision making, that only the intelligence and reason were, but now the same science tells us that we cannot live or decide without emotions.

There have been and are being carried out several projects and research projects that work with individual emotions, we propose teamwork that is the way to work normally today and we do that by emulating the behavior of human beings as the way you use empathy for these activities, the force of the personality and the emotions that affect at an specific moment.

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