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Detection bodily expressions by using kinect

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ABSTRACT
Create a program to analyze a person's emotions through his body language is the purpose of this research. This has given answers on the efficiency of the physical appearance and the estimation of the degree to which the gestures and movements of a person influence the understanding of emotions compared to other sources of emotional expressions as voice or facial expression. It elaborates on emotions and their operations, for the great importance in this project. In one-second part talks smart system, which uses a detection algorithm, and model OSCeleton emotions. Finally, it presents an application developed for detecting emotions from the body and shows the results of monitoring for "Detecting emotions". This paper presents the results of location and prediction of movement made by a body. This probability by calculating a matrix made of 5 x5 with the use of Markov processes. Increasing the size of the matrix is possible, but requires more calculations.

KEYWORDS: *Kinect, Osceleton, transition matrix, facial expression, detecting emotions.*

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I. INTRODUCTION

Today, more than 200 million computers are installed worldwide. The fact attracts stores that sell televisions. Their number is increasing due to the development of equipment and low cost of the components through the years. Therefore, it also has become more powerful. The performance of microprocessors has followed an exponential growth due to the data storage disks physically smaller, faster and cheaper. Hardware development parallel computer architecture, the software has also expanded. Over the years, we have moved to software programming procedures for object-oriented languages. This has favored the approach of artificial intelligence systems that perform tasks pending, according to Marvin Minsky, an American scientist and co - founder of the MIT Artificial Intelligence, more satisfaction has been achieved by humans, since they require high-level mental processes, such as perceptual learning, memory organization and critical thinking [1]. Clear from the point of view of the variables aware artificial intelligence. Most think it is possible, but still must evolve computer technology. By contrast, the problem of solipsism seems more complicated and controversial. We have two questions. Does the AI (Artificial intelligent) actually allow the generation of feelings or simulation accurately? Is it possible to differentiate the two states?

This report presents one of the most interesting devices participating in an artificial intelligence system: affective computing. It is a discipline that involves programming AI computational methods to recognize human emotions and emotions generate synthetic natural response to emotional states.

Discipline is fairly recent and comes from researchers at MIT (Massachusetts Institute of Technology) [2]. The scientist Rosalind W.Piccard is considered the founder of affective computing. In 1995, she published his first paper on affective computing entitled "Affective Computing". His ideas and objectives revolve around the belief at a sugar behind human creation, and system naturally developing intelligent systems that create men. In this he was inspired to carry out research and development work significantly affecting the scientific world, demonstrating the importance of the use of human emotions in the development of new technologies. This is where the concept of affective computing goes beyond man-machine interface simple. In other words, a change of man-machine approaches an interaction between two human beings [3].

II. DEFINITION OF EMOTION

The emotion comes from the Latin "motio" meaning "movement". It can be defined as the manifestation of a feeling or state of mind of an individual in response to internal and external environmental influences and biochemical. That is, it is a physical and psychological response to a situation of high intensity or reflecting the response to physiological changes that occur in the body. It is in the brain in all its complexity and its many connections that capture these inner feelings, which can then be read on our faces and bodies. In fact, any spinal cord, whose primary function is the transmission of nerve signals between the brain and the whole body, greatly reduces emotional expression.

Furthermore, the limbic system plays an important role in the behavior and emotions. It consists of subcortical structures such as the hippocampus, amygdala and hypothalamus, it are involved in the formation of long-term memory or emotions such as fear and aggression [4].

III. PHYSIOLOGICAL ASPECTS OF EMOTIONS

Reflects emotional arousal through sympathetic and parasympathetic systems and prepares the individual for fight or flight. The body prepares for action and a series of internal reactions are caused. Emotions can be addressed in three ways: the concepts of consciousness, emotional and expressive behavior. See table 1.

Table 1. Sympathetic and parasympathetic

Sympathetic system (excitation)		Parasympathetic system (raisin)
Pupils dilate	Eyes	The pupils contract
Decreases	Spit	Increases
Transpires	Skin	Dry
Increases	Breathing	Decreases
Accelerates	Heart	Slows
Inhibited	Digestion	Activates
Secret stress hormones	Adrenal Glands	Decreased secretion of stress hormones

Emotional expression is universal. Scientists Plutchik and Izard defined between 8 and 10 great emotions: joy, fear, anger, surprise, sadness, disgust, shame, guilt and contempt. They can be divided into two broad categories: the category calm / excited or negative / positive [5]. This classification remains vague and correctable, but it is necessary in affective computing. It is imperative to enumerate the various laws to simplify the problem of emotional analysis. All other emotions can be derived from the main basic emotional states. For example, melancholy is a mixture of love and sadness.

The behavior of individuals is associated with experiencing different emotions and reaction. Facial expressions or body allow the recognition of emotions expressed by others. See figure 1.

Fig. 1. Bodily expressions. In order: neutral, happiness, sadness, surprise, and fears.

These expressions depend on the cultural and educational elements of a person. That is, the meaning of gestures can vary: different people may express the same emotions differently and with varying intensity. For example, in cultures that emphasize individualism, emotional displays are long and intense. In focusing on the interdependence and group cohesion, certain emotions like compassion and respect are amplified while others, such as negative emotions are contained [4].

According to Manfred Clynes [6], it is impossible to express an emotion if you have another. The muscles obey genuine feelings and may, for example recognize fake a genuine smile (Beethoven [4]). However, physical, social or environmental factors may have an impact on the emotional expressions.

In case of any physical impairment nonfatal brain, behavioral changes are recorded and emotions. The case of Phineas Gage is very representative. In 1848, when he was 25 and was a foreman in an accident caused an explosion that threw an iron bar which pierced his skull and left frontal lobe of his brain. After this accident, in addition to the child's physical, social and personal changes in emotional behavior arose, it became more unstable and irritable; sometimes showing excessive emotional expressions, and other occasions were absent [7].

IV. INTELLIGENT SYSTEMS: MACHINES TO SERVE MEN

In the table 2 it is possible to see:

1) Many teams fall into this category, with just the recognition of emotional expression of a dog. These teams are not considered personal and friendly.
2) This category aims to develop the voice of the computer in natural tones and facial expressions.
3) This allows a computer to perceive the emotional state of a person in order to respond optimally: in short, to be a good teacher or a great wizard.
4) This last category maximizes communication between a human and a computer; personal machine friendly. This does not mean that a team is driven by emotions.

Table2. Machine to serve men

Computer	You can not express human emotions	You can express human emotions
One can perceive human emotions	III	IV
It can not perceive emotions human	I	II

V. METHODOLOGY

Division intends any surface, which generates Table 3. If we move any object on this surface, different frequencies will then step in the boxes. Matrices frequency and probability are constructed considering the positions and changes from one period to another between them, generating an array of 5 x 5.

Table 3. Frequency matrix

	A	B	C	D	E
A	408	62	0	0	0
B	61	406	68	0	0
C	0	63	402	60	0
D	0	0	59	301	55
E	0	0	0	55	256

In this matrix we find that the cell in row A to column B indicates how many times the ball is in B since it was in A, the cell located in row D and column D indicates the time that the continuous ball D because D was in previously. The transition probability matrices likely handle as shown in Table 2.

Table 2. Likelihood matrix of transition one-step or first order.

	A	B	C	D	E
A	0.8680	0.1319	0	0	0
B	0.1140	0.7588	0.1271	0	0
C	0	0.12	0.7657	0.1142	0
D	0	0	0.1421	0.7253	0.1325
E	0	0	0	0.1612	0.8387

The above matrix called transition matrix is a step and gives the probability that the system moves from one state to another in a step that is in a transition. Also be used to specify the probability that a system moves from one state to another in any number of steps or transitions, if a step is not likely to change with time. Using the following example you can see how they relate Bayes networks and answer the question: If the system is in state B, what is the probability that the state is in C after two stages? Figure 2 shows the calculations.

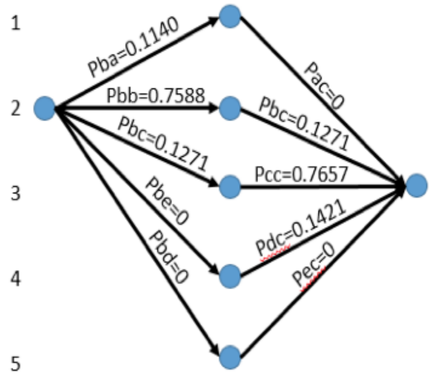

Fig. 2. Movement from "b" to "c".

The number of each arrow represents the probability of taking that particular step. For example in one of the arrows, B the system goes to B and then from B to C. The probability of the first step is 0.7588 and the second step is 0.1277. Then multiply the two probabilities that the trip system that route. The probability of any possible route may be calculated in the same manner.

$P^2_{B,C}$= (0.1140x0)+(0.7588x0.1271)+(0.1271x0.7657)+(0x0.1421)+(0x0)
= 0.1937

In general terms, if $P_{i,j}$ is the probability that the system will pass from state i to j in a step and $P^2_{i,k}$ is the probability that the system will pass i to k in two steps, then:

$$P^2{}_{i,k} = \sum_{todo\ j} (P_{i,j})(P_{j,k}) \qquad (1)$$

Equation 1 can be used to calculate $P^2_{i,k}$ for all possible combinations of i k. Values may occur after in matrix form as shown in Table 3 and will have built a transition matrix in two steps [6].

Table 3. Likelihood matrix of a Markov chain of second order.

	A	B	C	D	E
A	0.7685	0.2146	0.0168	0.0000	0.7685
B	0.1855	0.6061	0.1938	0.0145	0.1855
C	0.0137	0.1829	0.6178	0.1703	0.0137
D	0.0000	0.0171	0.2119	0.5636	0.0000
E	0.0000	0.0000	0.0229	0.2521	0.0000

The process shown in equation (1) can be used to calculate the transition matrix of three steps. If $P^3_{i,j}$ is the probability of moving from i to j in three steps, then:

$$P^3{}_{i,j} = \sum_{todo\ k} (P_{i,k})(P_{k,j}) \qquad (2)$$

By calculating the transition probabilities of two, three or n steps, we obtain a list of all routes. It can give you a simple way to get the transition probabilities by matrix multiplications.

Transition matrices and especially the multi-step transition is not only useful for finding a number of questions on the control system, is also a basic building element to answer questions about the powerful system called steady state.

Steady state occurs when stationary probabilities are in the transition probability matrix; the stationary probabilities have the following properties:

1. Not dependent on the initial state, therefore the probability that the system is in state i after many transitions is the same if the system starts in the state 2, 3 or any other.
2. No changes from one transition to the next, thus the probability that the system is in state i is always the same.

VI. RESULTED

The result of the algorithm for calculating the distances of the "joints" of the person at a time "x" filmed with other "joint" positions at other times shown in Figure 3 [8, 9, 10].

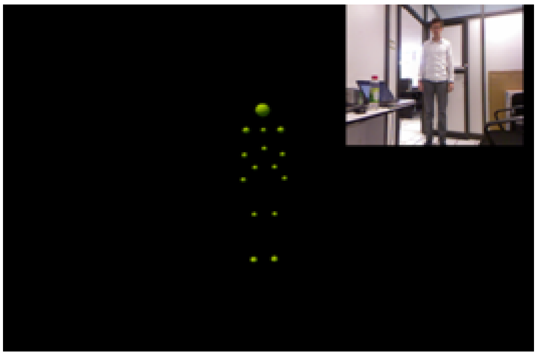

Fig.3 Initial position A

An experiment was conducted with 38 images recorded during a period measured in seconds. The person part of the initial position "A" before lifting the arms (position B). Thereafter, it returns to its original position before stopping recording (position values 37 and 38). X is the position 10 in the program. Position 10 is compared with all other positions. See figure 4 and 5.

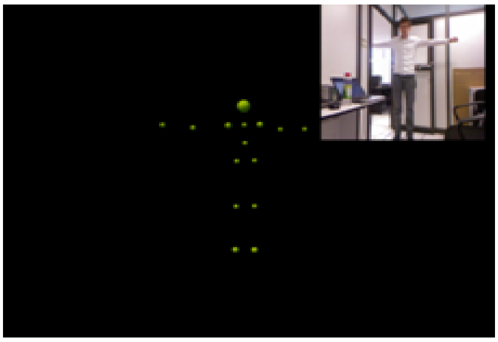

Fig.4 Arm movement position B

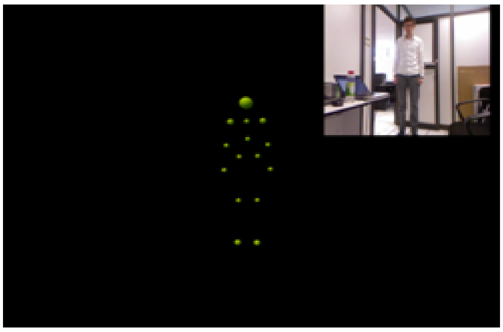

Fig.5. Back to position A.

In a histogram can easily locate the three positions. See A position is identifiable in the image bar (0 to 12) and (28 to 37). Position B is identifiable in the bars (13 to 27). Finally, when the person moves out of the recording is visible on bars (37 to38). See figure 6.

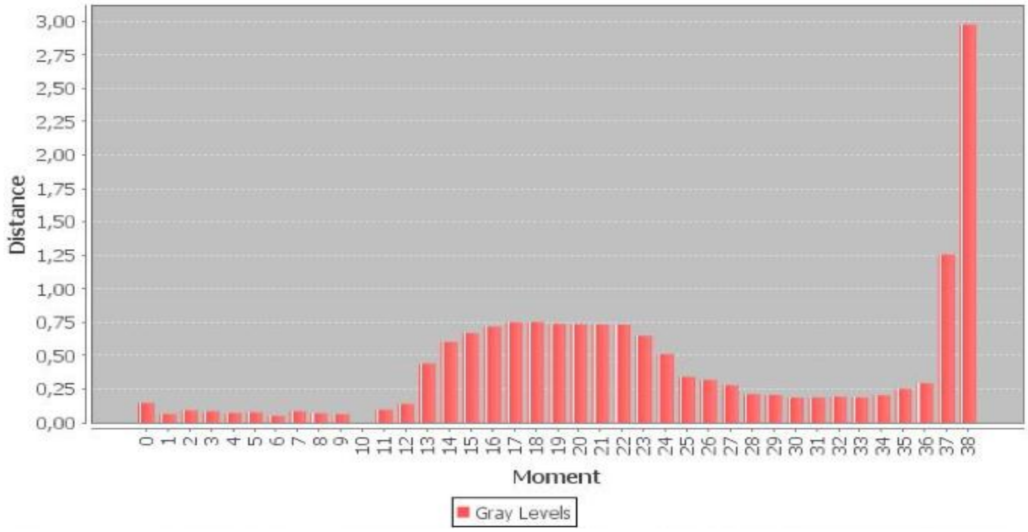

Fig. 6. Histogram associated with registration.

The probability transition algorithm is a good first approach to affective computing. It can detect the number of positions that have been taken and the distance between it and the default position. Therefore, an additional analysis work, the program can detect by comparing the default state to the other states of the person. For example, if the default position is "happy", situated at a great distance from the default position could be described as “sad". A position at a reasonable distance could be defined "neutral” position given the two previously analyzed.

When cutting the recording into several parts and restore the positions of each joint at all times, it should be possible to quantify the number of times a link through a given point in the plane defined by the Kinect camera. We May create sets of positions detected by the 23 points Kinect and convert into a probability matrix to obtain the required percentage on each plane. Then it is sufficient to compare the matrices of a recording session and analyze the default recording matrices of the state several times, to see the evolution of the similarity between the two states.

The results of the recording session provide interesting information for the analysis of the user's situation, which are also used by the program itself to give a percentage of probability of similarity to the selected state by default. The user also has the ability to see the evolution in time, the percentage of similarity between the state of the selected session and the default state. The figure 7 shows the points 1-4 that indicate:

1. User
2. Interface "emotion detector"
3. OSCeleton console interface, the sensor joint, implemented simultaneously with the program.

April. Kinect Camera.

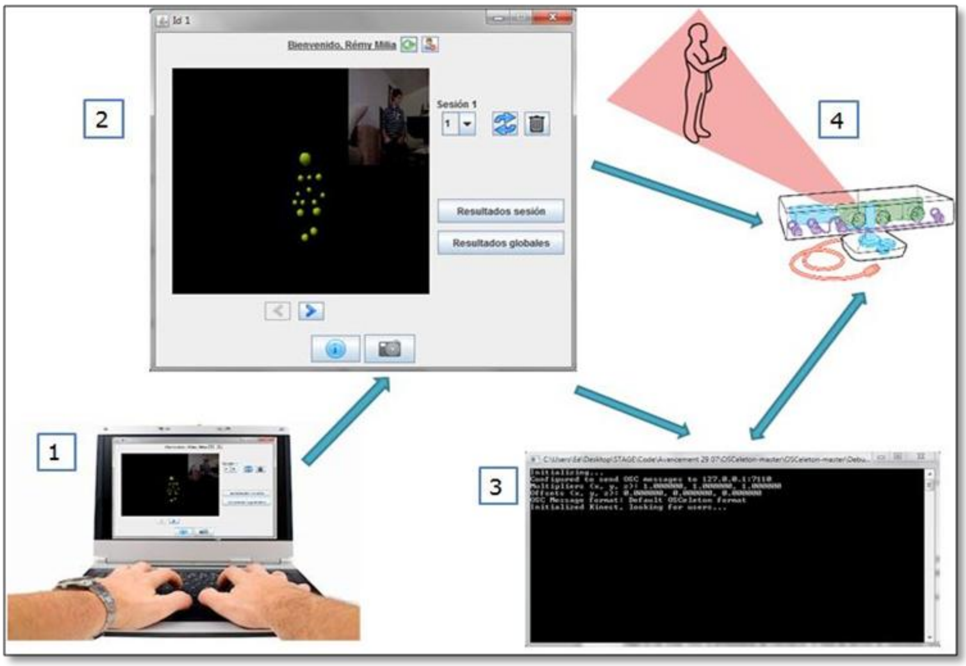

Fig. 7. Interaccion human versus machine.

The user interface 2 is accessible when the user has identified one or more records made during the previous sessions. It has several features. The user can choose between the sessions for which you want to see the drop down list of results. You can also delete the sessions did not want to, if there are several. You can scroll through the images stored in the selected session and access the results of the interface. The user has the option to switch back to the wall outlet or delete your account. Also, you can start a new recording session. A dialog box appears to indicate which session results will be available in the next connection. See figure 8.

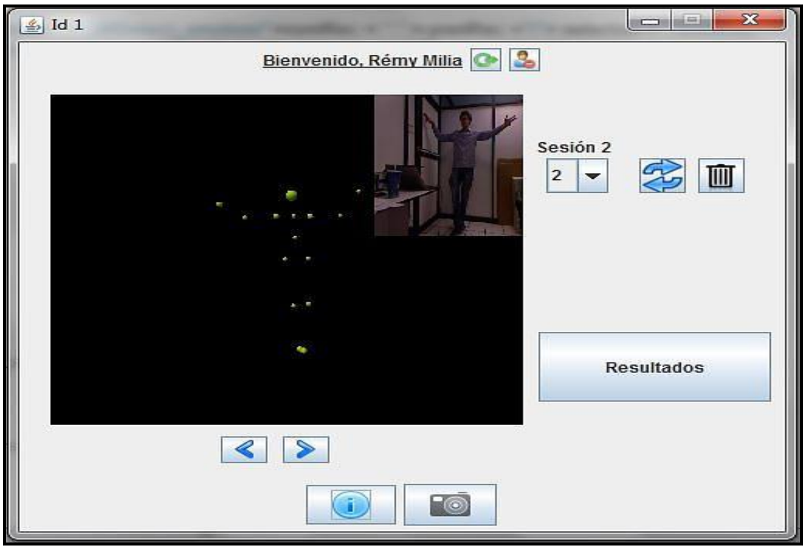

Fig. 8. Interface 2.

The results interface provides information about the selected session, such as the date and time it was recorded the number of images saved, the backup frequency through the CPU capacity and recording time. It also contains two lists: the first list contains the captured frames with Kinect joints and you can select to view the corresponding positions matrices (see figure 9). The second contains the default states registered by the administrator. The user can obtain the percentage of equivalence between the selected state and selected default state "% end". Finally, it can also show the evolution of the histogram method.

Fig. 9. Session 2

The interface works well with all controls preventing accidents and program of exceptions. Multiple users can register and have their own interface to navigate the images recorded sessions and see the results. Queries and controls the database does not generate errors.

Interesting are results in detecting of emotional states of individuals. Final tests were conducted with three states neutral, joy, sadness and three recording sessions with the same user trying to imitate these states, the results
were:
- Session 1, state: neutral (user hardly moves)
• Neutral = 76.4 %
• Joy = 48.9 %
• Sadness = 32.1 %
- Session 2, State: Joy
• Neutral = 22.7%
• Joy = 86.6 %
• Sadness = 54.3 %
- Session 3 status: sadness
• Neutral = 14.9 %
• Joy = 47.3 %
• Sadness = 66.2 %

The computer has detected the user state without error, even taking into account that the final percentages are not 100 % sure.
Other tests were conducted with registered users default states, likewise with three recording sessions. See graph:

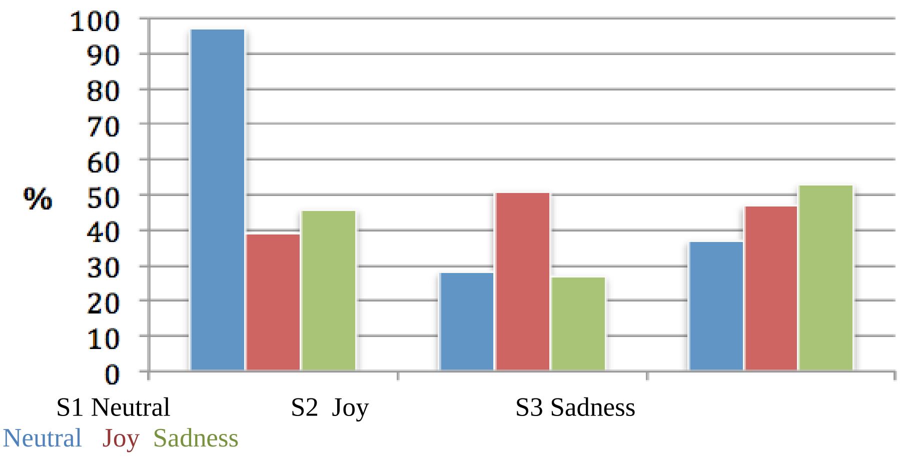

Fig. 10. Graph of three sessions.

You can see that the results are always positive. On all occasions, the program finds the correct emotional state without problem. In the third session, is detected well but is a little more complicated. Joy is difficult to distinguish from sadness.

VII. CONCLUSION

Several factors should be taken into account. The difference in height may cause errors if not done appropriate adjustment among users despite having similar gestures.
Another important factor is the cultural differences due to the fact that everyone has their own way of expressing joy or sadness.

The intelligent system shows its limitations, therefore should take into account the factors of size, culture or social status of individuals. From a technical standpoint, to take into account the size of a user, it is necessary to adopt a cut 2D to 3D. If the size of each user is known, then it is possible to calculate a coefficient for the variable depth.

As for the differences in body language between individuals of different cultures, it is essential to study the different continents and multiple social affiliations so that each person can be identified, given their origin. Each group has its own states and movements so it should be analyzed more efficiently.
Finally, in order to make more visible the human emotion in computers, not only must take into account body language. It can be an analysis of the waves emitted by the brain too.

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Biographies and Photographs

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