

X-HuBIS: A Fuzzy Rule based Human Behaviour Identification System based on Body Gestures

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Abstract

Objectives: In this paper, an attempt is made to identify the behaviour of human based on his/her body gesture. Body gesture recognition is very important and prime feature to detect the behaviour of the human being so behaviour and frame of mind of any person can be judged from one's body gesture. **Methods/Statistical Analysis:** Our proposed system captures an image of a person and recognizes different gestures related to head, hands and legs positions. The different types of rules are defined in fuzzy system that will produce the behaviour and mood after analysing the captured image with knowledge base. **Findings:** The result is produced in the form of classes which tells the behavior and other characteristics of the person. There are 3 main classes that describe the behavior of the person that is: Positive mood, Negative mood and Neutral mood. These three gestures are matched in the database. Name of gestures are passed to fuzzy system and fuzzy system will produce the result. **Application/Improvements:** This system can be used to identify the behavior of a person. So it can be used to identify any criminals and terrorists. This proposed system can be used to analyse psychological behaviour of human being which may help in different medical treatments.

Keywords: Fuzzy System, Frame of Mind Identification, Gesture Recognition, Image Processing, Psychological Behaviour Tracing

Introduction

The objective is to design an automated system that may take RGB image of human being as an input, recognize the body gesture and tell the human behaviour and present mindset in the form of different categories. Human behaviour is the term that is used to describe a person, his action and conduct. Observing and understanding human nature or behaviour is a crucial part of psychology. Intelligence system is defined as the capability to complete the task¹. IS achieves the goal in an indefinite environment. An intelligent system is a machine with an embedded computer that has the capacity to gather and analyze data and communicate with other systems². The behaviour can be judged from body language. One can read others thoughts and mind by their body gestures³. An intelligent system can be designed that can tell behaviour by capturing human gesture like hand gestures, leg

gestures, head positions etc. The main challenge of this system is to make the computer on which we rely so much more intelligent. On the other hand one wants system to be more autonomous, robust and adaptive.

Input of the system may be full image of human being. From the input image different types of body gestures are extracted like hand gestures, leg gestures and head positions etc. After that extracted gesture is matched in database by calculating histogram of the input image and the images in database. Similarity is calculated by finding Euclidean distance. Most similar image in database is used as the final image and the name of the most similar image is given as gesture name. These gestures name are processed by fuzzy system to classify the behaviour⁴. It is a causal rule based human behaviour identification system whose "IF" part truly causes the "THEN" part to happen as a result.

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2. Overview of System

This system is causal rule based human behaviour identification system. The image of human is taken by the system as input. Then image is cropped / segmented so that cropped image contains only head or leg or hand. After that the histogram of cropped image and the images that are in database is calculated in MATLAB⁵. Similarity of cropped image and the images in database is calculated by finding Euclidean distance. Most similar image in database is used as the final image and the name of the most similar image is given as gesture name. Then it will pick the behavior of the human according to the gesture. To recognize the behavior based on the body gesture is defined in the fuzzy system. The different If Then rules are defined in the database which is used to produce the result after mapping the actual image with the image stored in the database as per the already defined condition⁶. Then the result is produced in the form of classes which tells the behavior and other characteristics of the person.

2.1 Body Language

Body language means the non verbal signals of human being that we all use to communicate with each other. According to the researchers⁷, the non verbal signals or gesture make up a large part of daily communication. These body gesture and signals define the nature and attitude of the human being. According to many experts, body language is thought to account for between 50 to 70 percent of all inter communication⁸. It is very essential to understand body language but it is important to remember to note other cues and to check other signals as a group rather than focusing on a particular gesture. One can get benefit if he or she has the knowledge about body language like:

- We can change our gesture according to the situation.
- We can able to send our message.
- We can easily understand the message from others.
- We can able to read the signals that the other person is sending⁹.

In this paper, the behaviour is identified from different body gestures. There are 3 main gestures that are used in this paper that are hand gestures, head gestures and leg gestures. Further hand gestures include hand and palm positions that include steeping, hand clenched together,

rubbing palm, palm up and down and arm crossed over chest¹⁰. Head positions include head up, tilt and down. Figure 1, the hand gesture of the person is arm crossed over chest and the leg gesture is ankle crosses gesture and roughly, I can say that this person is defensive or the person is disagreeing with the opinion of other individuals with whom he is communicating.

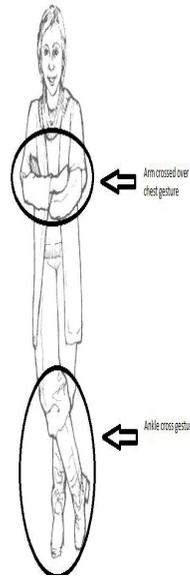


Figure 1. Ankle crossed gesture and arm crossed over chest.

2.2 Human Behaviour

Human behaviour means the array of every natural act and noticeable emotion combined with human beings. Some behaviour may change with the time and age. Sometime one's personality remains almost consistent; other behaviours will morphs as one person moves from childhood through adulthood. Behaviour can be dictated by thoughts and feelings which show other things attitudes and values. Social behaviour tells about the social interaction and the culture. Additional characters include rapport, ethics, hypnosis, authority, coercion and persuasion. Human behaviour falls within wide range with some behaviour being uncommon, some usual, some grateful, and some outside the acceptable limits. In sociology, human behaviour usually contains actions or act having no meaning. Human behaviour is more advanced social act so doesn't compare or mix it with social actions¹¹. The acceptability of behaviour relies greatly upon social models and is directed by several means of social control. Human behaviour is learned by the specialized academic instructions of psychology, psychiatry, social work, sociol-

ogy, anthropology and economics¹². Human behaviour is practiced throughout one's entire life. It contains the way the person acts based on many different factors such as social norms, attitude, core faith, and genetics. Behaviour is impacted by fixed traits each person has in¹³. The traits vary from individual to individual and can show different acts or behaviour from each individual. Social norms also affect behaviour. Due to the inseparably conforming character of human society in common, humans are distressed into following different rules and show fixed behaviours in society, which states the way people act. Different behaviours are judged to be either unacceptable or acceptable in different cultures and societies. Core belief can be seen through the philosophy and religion of that person. It regulates the way an individual thinks and this in turn arises in many different human behaviours. Attitude can be explained as "the degree to which an individual has an unfavourable or favourable valuation of the behaviour in question". Person's attitude is really a reflexion of behaviour she or he will depict in particular situations. Thus, human behaviour is highly influenced by the attitudes that a person uses on a daily basis. Human behaviour is the term that is used to describe a person, his action and conduct. Observing and understanding human behaviour is a crucial part of psychology. The behaviour of human can be judged from their body language. One can read others thoughts and mind by their body gestures. An attitude is an expression of disfavour or favour toward an event, place, individual or thing. The exciting thing about human beings and attitude is that it varies between each person. Every person has a different attitude towards different stuffs or things. The major factor that limits attitude is dislikes and likes. The more one person likes someone or something the more one is ready to or willing to open up and accept all the offers given by that person. When one person dislikes something or someone, person is more likely to get defensive and shut down. The simple example of how someone's attitude affects the individual's human behaviour could be as simple as taking a child to the doctor or to the park or garden. Child knows he has fun at the garden so their attitude becomes positive and willing, but when the name of doctor comes, the child shut down and become unhappy with the thought of ache. Human beings with uniform attitudes want to stick together as their hobbies and interests are common¹⁴. But it does not mean that the individuals with different attitudes don't interact. They do interact with each other. Attitude has a lot to do with

someone's mind which highly refers to human behaviour. The way a person behaves depends a lot on how he or she looks at the condition and what he expects to gain from it¹⁵. All know that Positive attitudes are better than negative attitudes as negativity can carry on negative emotions that are mostly avoided by everyone. It is up to human beings to make their attitudes positively reflect the behaviours they want to show¹⁶.

3. Technical Approach

The main focus of this work is to understand the behaviour of human being on the basis of body language. The name given to this system is Human Behaviour Identification System based on Body Language. The image of human is taken by the system as input. Then image is cropped so that cropped image contains only head or leg or hand. After that the histogram of cropped image and the images that are in database is calculated in MATLAB. Similarity of cropped image and the images in database is calculated by finding Euclidean distance. Most similar image in database is used as the final image and the name of the most similar image is given as gesture name. Then it will pick the behavior of the human according to the gesture. To recognize the behavior based on the body gesture is defined in the fuzzy system as in Figure 2. The different If Then rules are defined in the database which is used to produce the result after mapping the actual image with the image stored in the database as per the already defined condition. Then the result is produced in the form of classes which tells the behavior and other characteristics of the person.

3.1 Algorithm to Find Out Behaviour

- Step 1: Input full body image of any person in .jpg format.
- Step 2: Segmentation of the image in three equal parts in which 1st includes head position, 2nd includes hand positions and 3rd includes leg positions.
- Step 3: Save these three cropped image in different variables.
- Step 4: Calculate the histogram of the entire segmented image and the image stored in database.
- Step 5: Set threshold value (T_h) for the histograms of segmented images
- Step 6: Find the similarity or difference (D_s) between segmented images and images stored in database using Euclidean distance.

- Step 8: Identify Minimum $D_s < T_h$ then
- Step 9: assigns the name of gesture as folder name, in which the image having minimum difference lies.
- Step 10: all recognized gestures are passed in fuzzy system which tells the behaviour of the person.
- Step 11: behaviour classification in three forms positive, negative and neutral attitude.

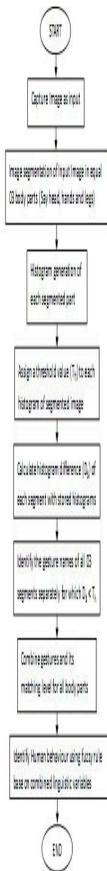


Figure 2. Block diagram of human behaviour identification system based on body language.

In this proposed system, there are two fuzzy system are used to identify the behaviour. First fuzzy system takes all the gestures as input and produces the result in the form of different behaviours like confident, submissive, dominant and brave so on. These behaviours are taken as input to the second fuzzy system which defines the classes as positive attitude, negative attitude and neutral attitude. In first fuzzy system the inputs are body gestures like head positions, leg gestures and hand gestures. This fuzzy system accepts six inputs and produce single output in the form of different behaviours. These are shown in Figure

3 and Figure 4. The output of this fuzzy system is passed to another fuzzy system that classifies the attitude in main three classes. The output of 1st fuzzy system is shown in Figure 5. Final output of the system Figure 6.

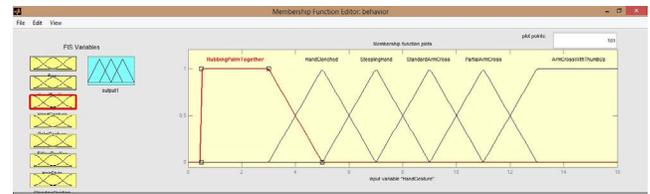


Figure 3. Plot of input membership functions of hand gestures.

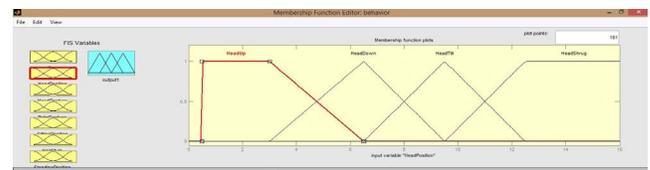


Figure 4. Plot of input membership functions of head position.

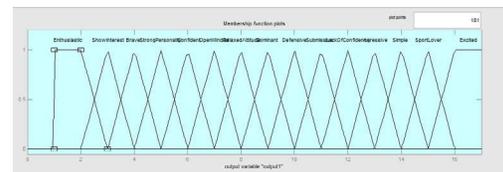


Figure 5. Plot of input membership functions of different behaviours.

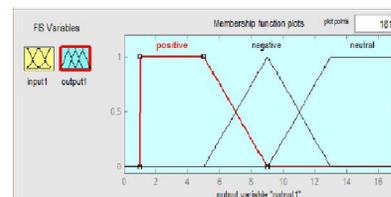


Figure 6. Plot of input membership functions of behaviour classes.

4. Database

The starting or very important point of this thesis is the creation of an image database that is used for finding

most similar gestures. The image database can have different formats. Images came from only one source that is photographs taken from android phone. This means that they have different sizes, but same resolution. First of all the images are converted to grayscale and the size of all the images are made equal. There are 5 to 7 images of a particular gesture in database. Some hand gestures that are in database Figure 7.



Figure 7. Various Hand Gestures (a) clenched together gesture (b) steeping gesture (c) rubbing palm together.

5. Results and Analysis

The result is produced in the form of classes which tells the behavior and other characteristics of the person. There are 3 main classes that describe the behavior of the person that is:

- Positive mood
- Negative mood
- Neutral mood

This is the simple and single platform of this system that is designed using GUI facility of MATLAB as depicted in Figure 8. When these three gestures are matched in the database, the Name of gestures is passed to fuzzy system and fuzzy system will produce the result. Figure 9 shows the final output the system produced. For the particular person the head gesture is head up, hand gesture is rubbing palm together and leg position is attention. The attitude of this person is positive attitude. Some more results that produce different gestures for another person are: Figure 10 shows the final output that is produced by the system. For the particular person the head gesture is head up, hand gesture is steeping and leg position is attention. The attitude of this person is positive attitude. Figure 11 shows the final output that is produced by the system. For the particular person the head gesture is head down, hand gesture is rubbing palm together and leg position is attention. The attitude of this person is negative attitude.

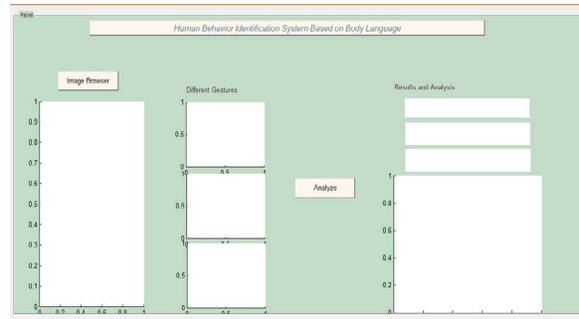


Figure 8. Interface of system.



Figure 9. Result shows positive attitude.

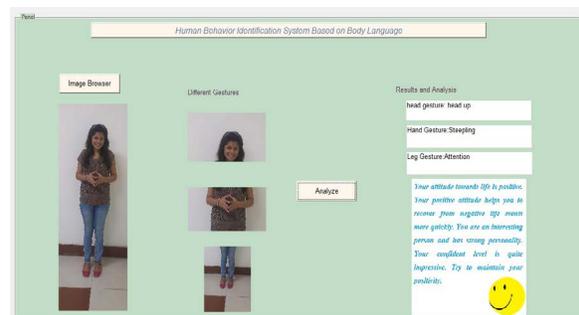


Figure 10. Second result showing positive attitude.

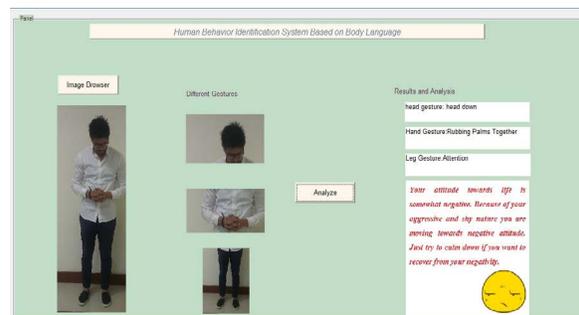


Figure 11. Third result showing negative attitude.

6. Conclusions and Future Scope

This system is used to identify the behaviour of a person by noticing his/her body language. It can also be used to analysis psychological behavior of the person and helps

in different medical treatments. This system can be used to identify the behavior of a person. So it can be used to identify any criminals and terrorists. If 2 or 3 people are sitting in a building or banks and they seem like the terrorists then with the help of the system we can capture the images of these people and can find out their behavior and nature. If we get negative attitude of these people then with the help of system we can say that they all are criminals. It can also be used to develop an intelligent system that can take decisions like humans.

7. References

1. Alex P, Andrew L. Modeling and prediction of human behavior. *Neural Computation*. 1999 Jan; 11(1):229-42.
2. Body posture recognition by means of a genetic fuzzy finite state machine. 2011. Available from: <http://ieeexplore.ieee.org/document/5949493/>
3. Project in lieu of Thesis. 2008. Available from: <http://imaging.utk.edu/publications/papers/dissertation/2008-aug-sitapi-pilot.pdf>
4. Multi model human gesture recognition combines dynamic programming and probabilistic methods. 2012. Available from: http://upcommons.upc.edu/bitstream/handle/2099.1/16087/victor_ponce.pdf?sequence=1
5. Chaaoui AA. A vision-based system for intelligent monitoring: Human behavior analysis and privacy by context. *Sensors*. 2014 May; 14(5):8895-925.
6. Zadeh L. Fuzzy sets. *Information and Control*. 1965 Jun; 8(3):338-53.
7. Allan P. *The Definitive Book of Body Language*. 1st ed. Bantam; 2006 Jul.
8. Gonzalez RC, Woods RE, Eddins SL. *Digital Image Processing using MATLAB*. 1st ed. Dorling Kindersley Pvt Ltd; 2006 Dec.
9. *Understanding Body Language and Facial Expressions*. 2016. Available from: <https://www.verywell.com/understanding-body-language-2795399>
10. *Free MATLAB Courses, Tutorials and Resources*. 2015. Available from: <http://www.skilledup.com/articles/free-matlab-courses-tutorials-resources>
11. *Expert System*. 2006. Available from: <http://searchhealthit.techtarget.com/definition/expert-system>
12. *Intelligent Systems*. 2005. Available from: <http://www.intelligent-systems.com.ar/defintsi.htm>
13. *Body Languages*. 2016. Available from: https://en.wikipedia.org/wiki/Body_language
14. *Gestures*. 2016. Available from: <https://en.wikipedia.org/wiki/Gesture>
15. *Fuzzy Logic*. 2008. Available from: <http://www.foretrade.com/fuzzy.htm>
16. *Human Behavior*. 2016. Available from: https://en.wikipedia.org/wiki/Human_behavior