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EMOTION RECOGNITION BASED SMART WHEELCHAIR FOR DISABLED PERSON

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Abstract - *One of the major concerns, that was and still posing as a challenge is a disability. Disability was and still a thorn in the flesh for it is considered as a restriction, a mental, physical, and cognitive impairment that limits the individual's participation and development, therefore a tremendous effort is dedicated to eradicate this form of limitation. This project addresses the challenge faced by the disabled persons. Disabled persons have to depend on other individuals to get their needs, hence this project develop an emotion recognition based wireless transmission to update the needs to the care taker. This project planning to understand the disabled person emotions based on python script and wireless transmission using Serial transmission. The existing system can figure out only wireless button-based transmission is there which can alarm the care taker that the disabled person needs something. In this the disabled person should be in conscious state to give the command, which is a disadvantage. Also, as of now Assistive Technology is not been integrated for the disabled person to provide automated service based on their moods. This project makes use of Linear Classifier, Facial landmark extraction, Emotion classification and SVM classification. Finally, the emotion value is transmitted from the system wirelessly to the care taker. Thus, our proposed system addresses the challenge if the care taker is not nearby also the disabled person can convey his needs and depending on the disabled person mood the wheelchair movement takes place accordingly.*

Key Words: Emotion Recognition, Wireless Transmission, linear classifier, Facial Landmark Extraction, SVM Classification.

1. INTRODUCTION

In today's world, physically handicapped person & elder peoples are depending on others peoples. The purpose of this project is to design & develop an emotion-based wheelchair or smart wheelchair which can be easily controlled by the help of physically disabled person face recognition system. This project is very helpful to movement of physically handicapped or elder people to understand their emotions and based on that the wheelchair takes them to the respective location to keep them happy always. The human emotion is detected and recognized using human faces by a webcam.

The emotion-based wheelchair reduces the extra effort of the physically handicapped person and elder peoples so they can live freely and independently in the today's fast world and it is very easy to use by the disabled person. Also, it would help in getting know their emotions and based on that the wheelchair automatically takes them to the place to keep them happy all time without stress. The aim of this work is to develop an emotion recognition-based wheelchair which is control by the physical disable person or needed person with the emotion only they would move front, back, left and right direction with ease. The main purpose of this work is to provide support or help the physically challenged person who cannot move from one place to other places without another person help.

2. OBJECTIVE

1. To assure a safe navigation for an electric wheel chair user.
2. To detect, exploit and evaluate the emotional state of the user.
3. To eradicate the limitations posed by the psychophysiological, technological and clinical endeavor.

3. RELATED WORK:

In [1] Anagha S. Dhavalikar* *PG Student, Electronics & Telecommunication Department, Vivekanand Institute o/Technology, Mumbai, India (2014): "*Face Detection and Facial Expression Recognition System*", 2014 International Conference on Electronics and Communication System (ICECS**)** A great attention has been made on human-computer interaction system from researchers in psychology, computer science, neuroscience, and related disciplines. In this paper, an Automatic Facial Expression Recognition System (AFERS) has been proposed. The proposed method consists of: (a) face detection, (b) feature extraction and (c) facial expression recognition. The first phase of face detection involves detecting of skin tone using YCbCr color model, getting uniformity on face and morphological operations for retaining the face portion that are required. The first phase is for extracting facial features like eyes, nose and mouth by AAM (Active Appearance Model) method. In next stage, simple Euclidean Distance method is involved using automatic facial expression recognition. Based on minimum Euclidean distance, expression of the output image is decided. True recognition

rate is around 90% - 95%. Further modification is done using Artificial Neuro-Fuzzy Inference System (ANFIS). This non-linear recognition system gives recognition rate of around 100% which is acceptable compared to other methods.

In [2] Vahid Kazemi and Josephine Sullivan KTH, Royal Institute of Technology Computer Vision and Active Perception Lab Teknikringen 14, Stockholm, Sweden (2014): "*One Millisecond Face Alignment with an Ensemble of Regression Trees* ", IEEE Conference on Computer Vision and Pattern Recognition. This paper addresses the problem of Face Alignment for a single image frame. We show how together of regression trees can be used to estimate the face's landmark positions directly from a pixel intensity of a sparse index, attaining real-time efficiency with better quality predictions. We present a general frame work based on gradient boosting for learning a collective of regression trees that reduces the sum of square error loss and naturally handles missing or semi-partially categorized data. We show how using suitable priors manipulating the structure of image data helps with efficient feature selection. Different regularization approaches and its importance to contest overfitting are also investigated. In addition, we analyze the effect of the quantity of training data on the predictions accuracy and explore the effect of data augmentation using processed data.

In [3] Bharati A. Dixit Dr. A. N. Gaikwad Department of E&TC Department of E&TC Sinhgad College of Engineering DnyanGanga College of Engineering Pune, India Pune, India (2015):" *Statistical Moments Based Facial Expression Analysis*", IEEE International Advance Computing Conference (IACC) Facial expression analysis plays pivotal role for all the applications which are based on emotion recognition. Some of the important applications are driver alert system, animation, pain nursing for patients and clinical practices. Emotion recognition is carried out in varied ways and facial expressions-based method is one of the most projecting in non-verbal sort of emotion recognition. This paper presents detection of all the six universal emotions based on statistical moments. The features mined by Zernike moments are then classified over Naïve Bayesian classifier. Rotation Invariance is one of the important properties of Zernike moments which is also experimented. The simulation-based investigation provides average of the detection accuracy as 81.66% and for frontal face images, the recognition time will be less than 2 seconds. The average precision regarding positives is 81.85 and average sensitivity is as 80.60%. The detection accuracy varies with reference to emotion but the average accuracy and detection time remains at equality with frontal face images.

In [4] HaoWei-Dong Associate Professor Guilin University of Electronic Technology, Guilin, China (2016): "Smart *Home Wireless System using ZigBee and IEEE802.15.4*", Sixth International Conference on Instrumentation & Measurement, Computer, Communication and Control WPAN and wireless sensor networks are fast gaining popularity, and the IEEE802.15 Wireless Personal Area Working Group has defined no less than different standards so as to cater to the requirements of different applications. Wireless sensor network(WSN), is a set of sensor technology, Network technology and communication technology in the combination of evolving disciplines ,in military, commercial, and other fields has overseas application outlook and great application value .Smart home wireless system is to develop a new smart home system that are useful in day-to-day life .Green home network increasingly formed a complex system to pact with a versatile tasks .Developing this trend, I suggest a new Smart-Home Wireless System (SHWS) based on anIEEE802.15.4 [5][6]and ZigBee . ZigBee could form a point-to-point and mesh network. This thesis has done following researches: 1. The role of the sensor2.ZigBee Devices and Data Transfer model3.Disjoint Multi Path Routing Protocol –(DMPR) Keywords—Smart Home; ZigBee; Sensor; Wireless; mesh network

In [5] Yong-Hwan Lee Dept. of Applied Computer Engineering Dankook University Yongin, Korea (2013): "*Emotional Recognition from Facial Expression Analysis using Bezier Curve Fitting",* 16th International Conference on Network-Based Information System Extracting and considerations of emotion is of high importance for the communication among human and appliance communication systems. The most communicative way to exhibition the human's emotion is over facial expression analysis. This paper offerings and outfits an automatic extraction and recognition method of facial expression and emotion from still image frame. To evaluate the presentation of the proposed algorithm, we evaluate the ratio of success with expressively expressive facial image database. This result shows approximately average 66% of success to analyze and recognize the facial expression and emotions. The attained result shows the good performance and applicable to mobile environments.

In [6] YASSINE Rabhi*, MAKREM Mrabet, FARHAT Fnaiech, MOUNIR Sayadi (2018) "*A Real-time Emotion Recognition System for disabled persons*", Sousse, Tunisia. The main objective is to develop an intelligent navigation system that assist the disabled individuals in order ensure their safety. We will present in this article a real-time emotion recognition application that will be installed on the wheelchair to monitor the emotional state of the user and interfere whenever an emotional disturbance is detected that may cause any sort of harm to the user or the individuals in his surroundings. ATs are the devices, equipment, or any sort of item that improve the functional capabilities of the disabled individual we mention, for instance, the hearing aids, voice recognition software, and wheelchairs. Drive the electric wheelchair with one of three emotions: anger, fear or being surprised presents a danger to the user. Indeed, these emotions create a panic for the user and reduce these abilities to control safely his electric

wheelchair and especially when driving at high speed. As a result, we created a system to detect these emotions and then perform a preventive safety action by reducing the speed of the wheelchair until these emotions disappear.

4. PROPOSED SYSTEM:

The proposed work is to design & develop an emotion-based wheelchair using face recognition System. Wheelchairs are used by disabled person who cannot walk because of physiological, injury or any disability. Recent development promises a wide scope in developing emotion-based wheel chair or smart wheelchairs. The proposed system presents Face based emotion recognition system to move their wheelchair automatically to the places which they feel like moving on based on their emotions.

This project presents a model for emotion-controlled user interface and identifies trends in current technology, application and usability. We present very useful an integrated approach to real time detection, emotion-based technique is very used which controls the wheelchair using their emotions for movements.

The outcome of the project is split into 2 phases:

1. Develop software to recognize user emotion based on facial expression using Python.
2. Integrate the python code into raspberry pi and control the wheel chair based on the facial expression.

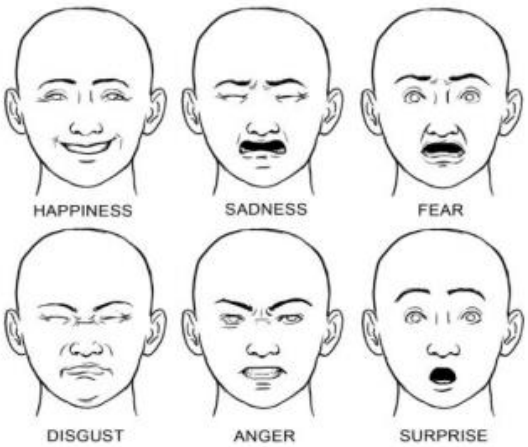

Fig -1: Different Types of Emotions

5. SYSTEM ARCHITECTURE:

The face of the person is recorded in the web cam. The recorded video is converted in to frames. Using Pre-processing the facial expression can be decomposed in to a sequence of Action Units (AUs). The Facial Action Coding System (FACS) is a system that describes all the facial expressions using combinations of the 64 AUs. After Feature Extraction, the Emotions are classified whether it is Happy, Angry, Sad and Surprise faces. The emotions are transferred using ZigBee transmitter and receiver and Wheelchair is moved accordingly.

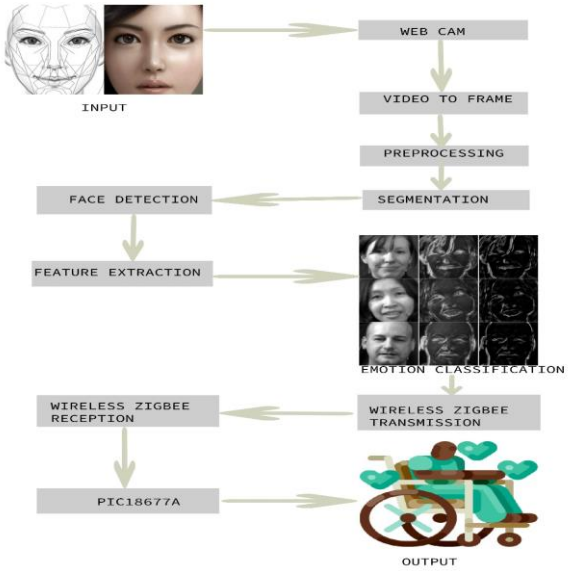

Fig -2: Overall Architecture Diagram of the SMART WHEELCHAIR

6. METHEDOLOGY:

A. FACE DETECTION:

The main objective of face detection technique is to identify the face in the frame by reducing the external noise. The steps involved in the FACE DETECTION PROCESS are

1. Image pyramid
2. Histogram of Oriented Gradients
3. Linear Classifier

An image pyramid is a sampling image technique, used to decompose the image into data at multiple scales. The use of this technique is simply to extract features while reducing the noise. The low pass image pyramid technique (also known as Gaussian pyramid) consists of smoothing the frame and subsampling it by decreasing its resolution, the process needs to be repeated a few times in order to obtain a perfect result that in the end of the process we obtain a frame similar to the original one but with a decreased resolution and an increased smoothing level.

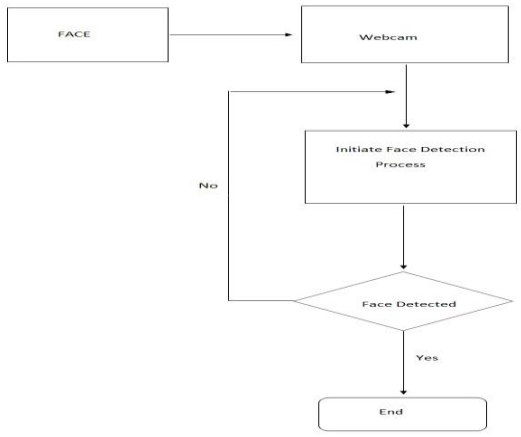

Fig -3: Flow diagram of the module – Face Detection

Commonly used to detect objects in images in the field of image processing, HOG is a feature descriptor, a technique that counts occurrences of gradient orientation in a localized portion of an image. The main objective of using this technique is to describe the face within the image with a set of distributions of intensity gradients.

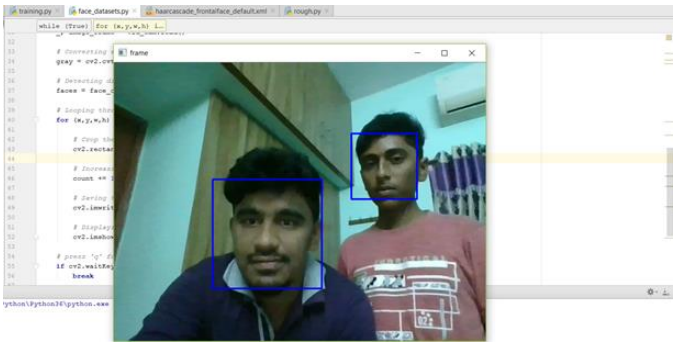

Fig -4: Face Detection Process

The linear classification step is the last step in the face detection process. We simply used the linear classifier instead of the SVM to decrease the computational time that the classification process will take and so to guarantee a faster face detection operation.

B. EMOTION CLASSIFICATION:

When the face is successfully detected, a bounding box will be applied as an overlay on the image to extract the ROI (face) for further analysis. The extracted ROI will next be processed using the "Predictor" function which is also a called script to extract the 68 facial landmark points and save them in an array. Next, the data stored in the features array will be put in as an input into a PCA reduction code that will reduce the size of data and eliminate any correlated coordinates leaving only the necessary points as principal components. The data is a 68x2 array; 68 points, each point with coordinates on x-axes and y-axes. The array will be converted into a vector containing 136 row and 1 column. The facial landmark extraction code "Predictor" is trained with a set of images and landmark maps for each image.

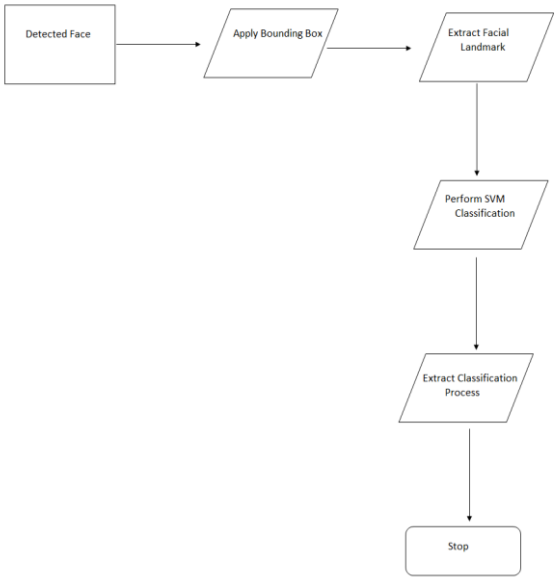

Fig -5: Flow diagram of the module – Emotion Classification

The code learns how to extract the facial landmark map of a given face image based on the pixel's intensity values indexed of each point using regression trees trained with gradient boosting algorithm. After the PCA reduction operation, the obtained data will be used for classification.

Fig -6: Emotion Classification Process

A multiclass SVM with a linear kernel is employed to compare the inputted data with stored one to see in what class (emotion) it belongs. If one of the three emotions anger, fear, or surprise is detected a speed decreasing command will be executed to reduce the speed of the wheelchair to prevent the user from endangerment.

C. WHEELCHAIR MOVEMENT:

The input is acquired in real-time so the RPI camera is used to capture the video and then followed by the framing of the captured video. The framed images are processed using the *hidden markov model* classification. The frames are considered in all frames and all pixel formats. The value of each landmark in the face is calculated and is stored for future use. The classifier works at an efficiency of 90-95% so that even when changes occur in the face due to environmental conditions then the system can still identify the face and the emotion being expressed using the facial landmark. The data are transmitted at a baud rate of 115200/s. The input data is transferred to the raspberry pi 3 where the code for analysis of expression is being dumped and the acquired input is processed using the python script and the predefined XML codes. The digital data is being transferred in serial so that the data that is acquired is being prioritized in the raspberry pi. The emotions are then identified using the values that are obtained that are being set and from the value of the pixel that is received is being compared to that of the values that is present as threshold in the code. The values are transferred to the relay board based on the comparison value and which emotion has a higher accuracy and the respective relay board is activated. The relay board acts as an electromagnetic switch which powers the motor that is assigned to the respective emotion. The wheelchair moves on the basis of the stepper motor. The emotions are assigned for every direction of motion. When the emotion is transferred the respective relay will be activated and the wheelchair moves. There are four emotions that can be used and the emotions are happy, anger, sad, surprise. When the happy emotion is recognized the wheelchair moves forward and the same happens with the other emotions as well that is it moves backward, left and right for the emotions sad, anger and surprise respectively.

7. FUTURE ENHANCEMENT

The smart wheelchair based on face recognition system is highly essential for the disabled person in modern day life ecology. This smart wheelchair further enhanced with benefitable features for upgrading in future. The methodology of enhancement in the movement of the wheelchair is promoted by detection of the iris movement. The iris movement is detected by mat lab programming interface with the RPI camera. An alternative method based on additional emotions which are excluded in our system as disgust and fear. On this emotion included to support the wheelchair movement system by diagonally in left and right respectively.

8. CONCLUSION

In this project, we presented a generic model to recommend emotion based automatic wheel chair movements. This project proposed designed & developed an emotion-based wheelchair using face recognition System. Wheelchairs are used by disabled person who cannot walk because of physiological, injury or any disability. Recent development promises a wide scope in developing emotion-based wheel chair or smart wheelchairs. Thus, the proposed system presents Face based emotion recognition system to move their wheelchair automatically to the places which they feel like moving on based on their emotions.

9. REFERENCES

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