An Intelligent Security System for Violence against Women in Public Places

Remya George, Anjaly Cherian.V, Annet Antony, Harsha Sebestian, Mishal Antony, Rosemary Babu.T

Abstract*—This paper describes about an intelligent security system for women. Women all over the world are facing much unethical physical harassment. This acquires a fast pace due to lack of a suitable surveillance system. Our project is a venture to resolve this problem. The systems mainly consist of a monitoring device, the output of which is processed to identify insecure environments. Upon identifying unsafe environments system will send message to near-by control room also turn on alarms placed all around the area letting help from others. This system can be positioned in public places such as railway stations, bus stands, foot paths and shopping mall, where women are commonly experiencing attacks. We really believe that this endeavor will make a difference in the life of many and dream about seeing this world with individuals walking fearlessly.

***Index Terms*— women security, face recognition,**

I. INTRODUCTION

Women all over the world are facing much unethical physical harassment. Women and girls experience and fear various types of sexual violence in public spaces, from sexual harassment to sexual assault including rape and femicide. It happens on streets, public transport and parks, in and around schools and workplaces, in public sanitation facilities and water and food distribution sites, or in their own neighborhoods. In India, every day more than 30 women were murdered and many are suffering austere mental and physical trauma[1]. According to a new report from the World Health Organization (WHO), 35% of women worldwide have experienced violence. In India, according to the National Crime Records Bureau's (NCRB) 2005 Crime Clock, there is one crime committed against women every three minutes, one molestation case every 15 minutes; one sexual harassment case every 53 minutes, one kidnapping and abduction case every 23 minutes and one rape case every 29 minutes are reported. Shocking as these figures are, they are actually a gross underestimation of the actual situation, because crimes against women are highly under-reported.

Rape and violence against women are among the most under-reported crimes worldwide because of the social stigma attached to the nature of the crime.

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This situation has to be changed. Major reason for the increase in rape statistics is the nonexistence of a suitable surveillance system to ensure the safety of women. Implementation of a real time monitoring device can solve the problem to an extent. With an efficient and effective monitoring device, public place can be continuously kept under surveillance there by ensures safety. This system has to monitor the environment and need to identify unsafe situations. This can be achieved by processing the images of the situation to identify chaos and recognizing facial expressions of individuals in the environment. The facial expressions that would be analyzed here are fear, anger, sad and happiness.

II. EXISTING SYSTEMS FOR WOMEN SECURITY AND FACIAL EXPRESSION RECOGNITION

Women security is a topic well discussed in the current scenario. Many mobile applications are developed so far. These applications do have arrangements for sending messages to selected persons when a person feels that she is insecure. Codes like *91# is used to provide emergency services, which will alert police control. Free mobile application 'Help me on mobile' to ensure safety of women was launched to assist those who need emergency support [8]. The one which is using now is a mobile application namely "with u app, which needs the pressing of power button 2 times. These applications need a single click to do this task. But when a girl is in trouble, there can be times that the girl is not capable of taking the phone and pressing button. Personalized devices like pepper spray, laser guns were developed to enable security. Such devices do have even fingerprint scanner, so others can't use the equipment. Recently developed application by CanvasM is very helpful for women, who will have some emergency contact selected and it will also retrieve GPS information. In case of emergency, a panic button provided in this app will send SOS message to all the trusted contacts immediately and also inform the correct GPS location of the person facing trouble. Wearable and easy-to-operate electronic device exists that will help girls and women to trigger communication with family and police when in distress. The device will remain invisible to the offender and yet can easily be triggered by its user with multiple options to ensure stealthy and secure communication [9]. Devices are developed that measure the pressure difference in body to take actions such as informing parents, police etc. This will be attached to subjects body in the form of watches, bangles etc. Also there are monitoring systems with a database of criminals so that when a criminal enter into systems view point it will alert the authority.

The Amrita Personal Safety System (APSS) is a security device which promises to offer women the chance of alerting their families when attacked. This system is wearable and

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easy-to-operate electronic device that will help women to trigger communication with family and police when in distress. The device will remain invisible to the offender and yet can easily be triggered by its user with multiple options to ensure secure communication. This device provides flexibility in design so it can be easily worn, and integrates more than 15 features pertaining to women's safety and security. The current devices in women security are self-operating. There can be conditions when the victim is not able press a switch or application button in her mobile phone. The self-security devices for women may not affordable for all because of its cost and complexity. Here comes the importance of a centralized device which can ensure the safety all women in our society [3].

The automatic recognition of facial expressions has been an active research topic since the early nineties. There have been several advances in the past few years in terms of face detection and tracking, feature extraction mechanisms and the techniques used for expression classification. Facial expression recognition is concerned with the recognition of certain facial movements without attempts to determine or imagine about the underlying emotional state of the agent. For example, facial expressions may result from physical exertion rather than emotional state; in this case, emotional state is hidden or overridden from expressing itself through the face. For this reason, some have argued that facial expression interpretation must rely on more than just visual information.

A beginning acquisition step detects the face and crops the image so that the facial features are aligned. This step may also determine head pose but nearly all techniques assume a frontal view. This step also involves the detection of a face. The prevalent method for facial detection is explained by Viola Jones algorithm, 2001[5]. Next, there is an extraction step where the features of interest are acquired from the raw image data. The techniques at this step can be grouped into those using geometric features and those using appearance features. The latter group involves estimating the shape of the face and extracting features from that shape estimate. Finally, the recognition step classifies these features as one of several emotions.

Gesture recognition is an important technique that can provide intelligent and flexible ways to implement many tedious tasks. Analysis on the online finger gesture recognition using multi-channel sEMG signals was explored recently. Nine types of gestures were applied to be identified, involving six kinds of numerical finger gestures and three kinds of hand gestures. The time domain parameters were extracted to be the features. And then, the probabilistic neural network was utilized to classify the proposed gestures with the extracted features. Most of gestures could acquire the acceptable classification performance and a few elaborate gestures were hard to acquire the effective identification [6]. There have been several advances in the past few years in terms of face detection and tracking, feature extraction mechanisms and the techniques used for expression classification. Traditionally facial expressions have been studied by clinical and social psychologists, medical practitioners, actors and artists. However in the last quarter of the 20th century, with the advances in the fields of robotics, computer graphics and computer vision, animators and computer scientists started showing interest in the study of facial expressions. The first step towards the automatic recognition of facial expressions for analyzing facial expressions from a sequence of images (movie frames) by using twenty tracking points was taken in 1978 by Suwa and his colleagues. Researchers working on these fields realized that without automatic expression and emotion recognition systems, computers will remain cold and unreceptive to the users' emotional state[7]. In more recent years, there have been attempts at recognizing expressions other than the six basic ones. One of the techniques used to recognize non-basic expressions is by automatically recognizing the individual action units which in turn helps in recognizing finer changes in expressions. An example of such a system is the Tian et al.'s AFA system[8]. All of these factors led to a renewed interest in the development of automatic facial expression recognition systems expression recognition systems find uses in a host of other domains like Telecommunications, Behavioral Science, Video Games, Animations, Psychiatry, Automobile Safety, Affect sensitive music juke boxes and televisions, Educational Software, etc[9].

The various facial behaviors and motions can be parameterized based on muscle actions. This set of parameters can then be used to represent the various facial expressions. Till date, there have been two important and successful attempts in the creation of these parameter sets:

1. The Facial Action Coding System (FACS) developed by Ekman and Friesen in 1977 [12] and
2. The Facial Animation parameters (FAPs) which are a part of the MPEG-4 Synthetic/Natural Hybrid Coding (SNHC) standard[13] .

Multi-camera networks provide rich visual data spatially and temporally. Human posture estimation can be described incorporating the concept of an opportunistic fusion framework aiming to employ manifold sources of visual information across space, time, and feature levels. This method reduce raw visual data in a single camera to elliptical parameterized segments for efficient communication between cameras. A 3D human body model is employed as the convergence point of spatiotemporal and feature fusion. It maintains both geometric parameters of the human posture and the adaptively learned appearance attributes, all of which are updated from the three dimensions of space, time and features of the opportunistic fusion. In sufficient confidence levels parameters of the 3D human body model are again used as feedback to aid subsequent in-node vision analysis. Color distribution registered in the model is used to initialize segmentation. Perceptually Organized Expectation Maximization (POEM) is then applied to refine color segments with observations from a single camera. Geometric configuration of the 3D skeleton is estimated by Particle Swarm Optimization (PSO)[10].

The various image preprocessing methods that can be used are: edge detection, low pass filtering, histogram equalization, binary image processing (i.e. thresholding) in HSI color space, and desaturation[11].Method to distinguish skin color from different backgrounds comes under preprocessing techniques.

There have been several advances in the past few years in terms of face detection and tracking, feature extraction mechanisms and the techniques used for expression

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III. SOLUTION TO THE PROBLEM

A. *System components*

Intelligent security system for women mainly consists of two cameras and a processor.

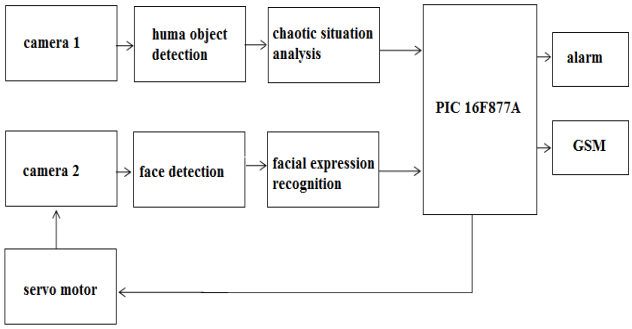

Fig 1 Block Diagram

The system having following features:

i. Chaotic situation analysis
ii. Male-female detection
iii. Facial expression recognition
iv. GSM module and alarm system

i. Chaotic situation analysis is done for identifying violence situation using human object detection. Camera 1 is used for the same. We divide the cameras field of view into two regions. Every human object in a particular region is identified and their motion is detected. If more than two persons are present in a region the camera is rotated using a servo motor to that region. We are finding the distance between each human object in a particular frame and if it is less than a threshold, the next section gender detection will be activated.

ii. The gender detection is done to identify how many males and females are present in a particular frame. The gender can be identified using correlation function of facial features .If atleast one female is present in a frame, the facial expression detection system gets activated and the control moves to the second camera.

iii. Camera 2 is used for facial expression recognition. Mainly three expressions are used in this system which includes smile, fear and anger. The expression recognition is done using correlation with an already created database. If fear or anger is detected in a female, the next section gets activated or else the condition is ignored. All these three sections are done in MATLAB.

iv. If a female's fear or anger is detected in camera 2, an alert message is sent to the control room using a GSM module and an alarm gets activated. This is done by interfacing MATLAB with a PIC microcontroller.

B. *System working principles*

Intelligent security system for women mainly consists of two cameras and a processor. Out of the two cameras one will be placed on the side wall to capture face and other in a higher altitude to obtain body movements. The vertical camera will capture the images of the entire system under surveillance. Number of individuals in the frame counted. This can be achieved by checking the texture variation and shape matching. If there are more than 15 individuals then such situations are avoided considering the fact that probabilities of attacks in such situations are low. If it contains less than 15 individuals the situation can be analyzed to check for random movements.

Chaos in the situation can be analyzed using an intelligent variance algorithm. This algorithm initially captures a sequence of images of the situation to be monitored. Then successive two images will be processed in such a way that each pixel of corresponding locations will be compared. Let *u* and *v* be the image matrices. These images are zero padded to make them equal in size. The following equation will be applied onto this M by N image.

$$y_{uv(i,j)} = \sum_{k=0}^{max(M_u,M_v)-1} u_{k,j}\, v^*_{(k-i),j} \qquad 0 \le i < M_v$$

$$y_{uv(i,j)} = Y^*_{uv(-i,j)} \qquad -M_u < i < 0$$

In the same manner all the so acquired images will be compared pixel wise and their correlation value will save in a matrix.

All the elements stored in this matrix will then allowed passing through a variance checking equation. This is to find how far a set of numbers is spread out. A small variance indicates that the data points tend to be very close to the mean that is situation is safe. While a high variance indicates that the data points are very spread out from the mean and from each other leading to chaotic situation.

$$y = \sigma^2 = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N} |u_{ij}|^2 - \frac{\left|\sum_{i=1}^{M}\sum_{j=1}^{N} u_{ij}\right|^2}{M^*\,N}}{M^*\,N-1}$$

The algorithm then find out which is the region of maximum population density. Camera movement is controlled in such a way that it will track random movement so that the next stage can be successfully executed. After the chaotic situation analysis the gender detection algorithm checks for women's presence. A strong data base of men and women along with normalized cross correlation will help in deciding whether the individual present is a women or men. If it contains no women the system will not take further action but in the presence of women algorithm make the second camera work.

This horizontal camera captures women's face and extract feature points to recognize expressions. Here we are interested in the fine details of image so sound preprocessing tasks are essential. This can be achieved by processing the histogram of the image and equalizing it. This will distribute the intensity levels in the image. Enhanced image then has to be converted into gray scale as it will avoid difficulties due to texture difference in different individuals. Threshold function is used to extract required details from face. The image processing tasks are performed in MATLAB 2012a.

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We are mainly interested in analyzing fear, angry, sad and happiness. If the expression in the women's face is sadness or fear then further actions will be taken. Also face expression of suspect is also considered. Messages are send to control room informing violence and alarms placed in surroundings are turned on.

VI. RESULT AND DISCUSIION

We successfully implemented the system and acquired the desired output. The intelligent security system women has been developed with such a motivation that the women are provide with safe environment under all circumstances. The chaotic situation within a particular video frame is detected using camera 1. The human object present in a frame is identified. If more than two persons are
present in a frame and the distance between two are less than a threshold, the servo motor will rotated to that region and their movement is tracked. If there is a random movement is present, the gender detection gets activated and atleast one women is present in that particular frame then facial feature points are acquired using the second camera. Within the system the real time acquired facial features are compared with a data base for identifying the current facial expression. If the facial expression of women is fear or anger the message will send to the control room and an alarm will activated in the surroundings. The system which we implemented is only a prototype as an initiative step towards women safety in public places.

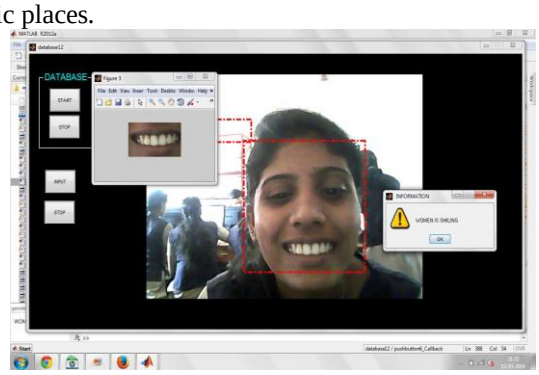

Fig 2 Snapshot of detecting smile in MATLAB

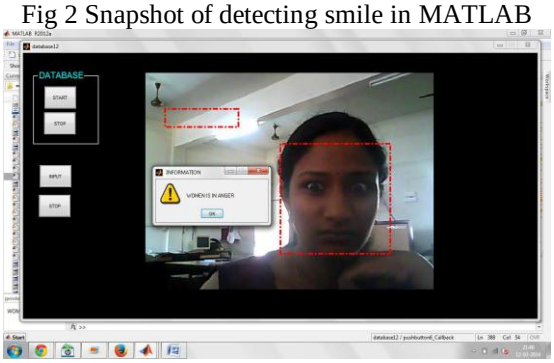

Fig 3 Snapshot of detecting anger in MATLAB

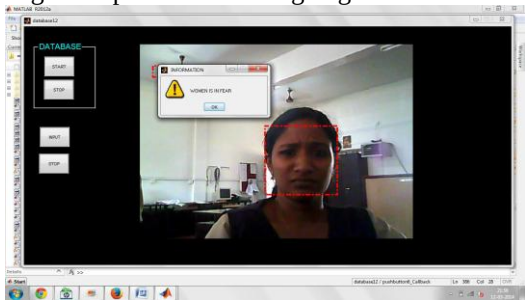

Fig 4 Snapshot of detecting fear in MATLAB

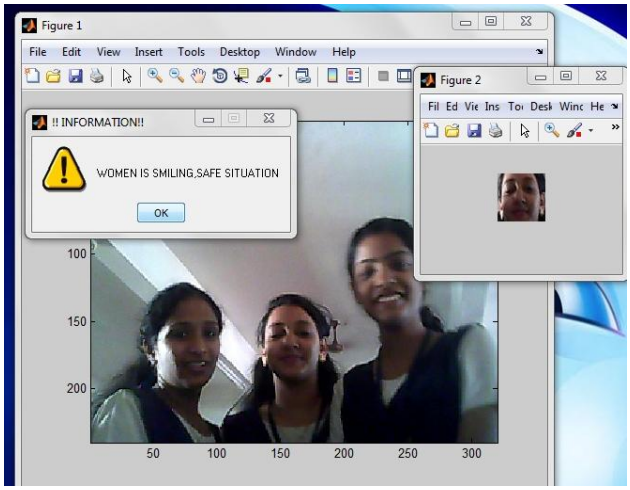

Figure 5: Chaotic situation with smiling women

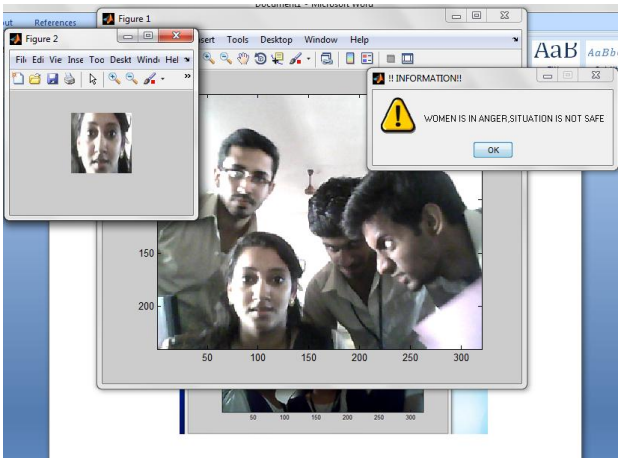

Fig 6 chaotic situation in women with fear

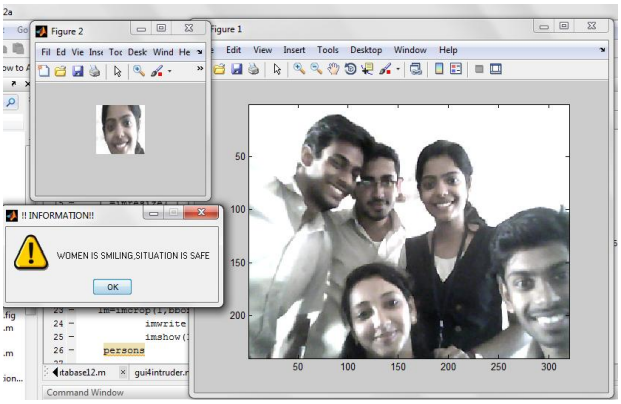

Fig 7 chaotic situation with women in smile

V. CONCLUSION

Intelligent security system for women is a surveillance system aimed to ensure the safety of women in public places. This real time image processing system makes use of random movement analysis and facial expression recognition by feature point extraction using MATLAB for ensuring the safety. Upon detecting violence situation the system will sent a message to the control room. Our project has been developed with such a motivation that the women are provide with safe environment under all circumstances. Implementation of this real time monitoring device can solve the problem to an extent. This device makes sure the safety of women in our public transport system and other public

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environment. With further research and innovation, this project can be implemented in different areas of security and surveillance. The system can perform the real time monitoring of desired area and detect the violence with a good accuracy. In a master console using the very high resolution camera and dedicated software for this application make system prefect to use in our public places. The gender detection algorithm and motion tracking will more precise for future real time monitoring application to prevent the generation of false alarm. More number of emotions of victim as well as suspect with precise accuracy makes the system robust in this application. It can be concluded by saying such a system can revolutionize the present scenario of women safety. It will make the women safe and secure in our public places.

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