Monitoring the Alone Living Elderly People at Home Using Surveillance System

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ABSTRACT

The revised version of World Population Prospects (2019) predicts that till 2050 one in sixth person will be above the age of 65. The problem of aging in population is faced by all over the world. The health care of this population becomes very crucial issue for the Nation. Monitoring these people via video surveillance system can be one of the affordable solutions to this problem. Video Surveillance can act as long distant eye for the family members staying away from family. This paper provides the affordable solution for elder person monitoring through home surveillance system. Since major accidents at home with elder person happen due to fall, our proposed system detects fall of person. The background subtraction becomes preprocessing step, human being detection, contour detection, classification and then alert generation if fall happens is the flow of our system. The system is tested on 30 videos and it gives accuracy of 90%.

KEY WORDS: FALL DETECTION; SMART HEALTHCARE; MONITORING ELDERLY PEOPLE; ASSISTIVE HOME MONITORING SYSTEM.

INTRODUCTION

The data provided by National Council on Aging gives the statistics of Aged population of United States of America. According to that every year, 25% population is forming the group where age is above 65 years. Fall is the most leading cause of injuries in this group of patients. Due to advancement in science and technology many methods are used to save the elderly people from the injuries. Some of the researchers have developed smart wearable gadgets to monitor the old people which are frequently used now days. Video surveillance systems have always been used for personal security and for asset security as the solution is cheaper and affordable by common man.

Previously, Image or Video processing domain was limited to industrial use, medical imaging, satellite imaging, etc. but in the last decade new field of Computer Vision has emerged which extended version of Image/Video is processing. The Computer Vision is extensively present in day to day life like traffic control, security systems, vision-based surveillance, etc. The smart homcare services has come to boom with the concept of smart cities. Assistive home monitoring systems are used for monitoring the patients. Smart floor, smart shoes, etc. are used in many countries as assistive technology. However they are very expensive.

Video Surveillance system has many applications like monitoring criminal activities; safeguarding home, work place and all the valuables. Video surveillance system can also be used for monitoring the safety of alone living elderly people, tracking their daily activities, monitoring the health or abrupt accidents like fall, attack, stroke, etc. at home itself. In comparison with ever growing population, the health practioners are very less and so there should be some mechanism for monitoring the elderly through technology. One of them is Smart homes, which is combination of IoT, Big Data and Artificial

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Intelligence. Alexa enabled facility is commonly used at smart homes now a days. These smart homes can be used by elderly people for living comfortable and quality life. It can be also used for monitoring their health. The main cause of accidents seen in elder people is fall due to weakness or sickness. Recently, the research on smart healthcare has led to innovative solutions of smart wearable devices. These devices are developed by some of the researchers which are described in further section and are used for fall detection. These devices are used to track heart rate, temperature, pulse rate, etc. to monitor their health condition. These wearable proves to be good solution but often elder people forget to wear them, or forget to charge them, and also it is expensive to maintain these wearables.

Related Work: Many researches on smart healthcare devices and applications are seen from last decade. Some of the research is describe below with respect to monitoring fall detection in elderly people. In 2018, Thiago B. Rodriguesa et.al has proposed the smart system using inertial sensors. These sensors collect data about the acceleration and angular velocity of the elder person. Using Machine learning algorithms, extracted data from sensors was trained and classified into four classes of different fall states. Comparison with various other models proved the good performance of the system.

Wann-Yun Shieh et.al worked on multi-camera video surveillance system for implementing automatic falling-detection system for elderly patient. All cameras are used for monitoring and fetching the data from it. The falling pattern recognition algorithm is used for automatic classification of fall incidence. As soon as fall is detected via algorithm alert message is send to the concerned person. The authors have claimed 90% accuracy of this system. Diana Yacchiremaa et.al proposed IoT based wearable device which can collect data from movements of Elderly people. It proved to be good combination of smart IoT, cloud computing, machine learning and big data. The researchers tried to design a system which can detect the fall of elderly patient. On detection of fall alert messages are sent to group of registered people. Record of all the falls is maintained on cloud of each patient so that it can be useful for analysis and treatment by health professionals.

Lei Yanga et.al worked with Kinect cameras for image acquisition which can generate 3D depth images. Analysis of these images initiated with disparity map created by horizontal and vertical projection histogram statistics. Fall incident was detected by calculating centroid and angle of human body with respect to floor plane In 2010, Eric Campo et.al has proposed the behavior monitoring system for the elderly people using Trajectory analysis through multisensors installed in home environment. They tried to give solution via both supervised learning and unsupervised learning and found in their research supervised learning gives better results in specific time. The repetitive patterns of elderly patient in their trajectories were analysed for the study of the patients locomotor profile.

METHODOLOGY

The following figure shows the basic flow of our system. The proposed system is divided into following steps:

- Dividing input video into segments of 10 seconds
- Foreground Segmentation
- Image Enhancement
- Feature Extraction
- Classification and Alert Generation

Figure 1: Workflow of Proposed System

Dataset: This system takes input as surveillance video of Home environment at present in future live real time video can be given as input. The video dataset is taken from UR Fall Detection Dataset by Michal Kepski from Interdisciplinary Centre for Computational Modelling University of Rzeszow. It contained 70 videos from which 30 are fall videos and 40 are daily activities video. From this 30 Videos were used for testing the system.

Video Segments: The input video is divided into segments of 10 seconds for the proper analysis and processing. All the further processes are performed on each segment and the fall is detected based on complete analysis.

Foreground Segmentation: Since the video surveillance system is applied for home environment. The background will remain same for maximum times. So to segment the human being in the video we use motion in video. Gaussian Mixture-based Background/Foreground Segmentation Algorithm is used for background subtraction.

Image Enhancement: The video frames are separated and for high contrast all the frames are converted to gray scale. Since background is subtracted in first step, the human being will be visible in the form of white dots in gray scale image.

Feature Extraction: In this phase region of interest is selected from the complete frame via contours and features are extracted through bounding box.

Contours: Contours form the structural outline of any object with some similarity and different from background which can be used to identify the shape of object. The contours in image processing are generally used for shape analysis and object detection and recognition. After background subtraction, the human being in gray scale frame is found to be white dots which are connected via contours and this is considered as area of interest from the frame.

Figure 2: NO FALL Result

Figure 3: Fall detected Result

Bounding Box creation: After getting contours for human being in the video, Bounding Box is created on the contours of each frame. The bounding box is used to highlight the region of interest from the frame. The properties of bounding box consist of width and height of the box which is used for classification in successive frames.

Classification and Alert Generation: Using the property of bounding box, the system will compare the height (h) and width (w) of the contour area. If $h < w$ the counter will be incremented by 1 for each frame and if the counter value reaches greater than 100 then it will send the alert message to the group of concerned people. Otherwise if the $h > w$ then it will reset the counter to zero and the system classifies as NO Fall.

RESULTS AND DISCUSSION

The screenshot of result is shown in figure 2 and figure 3. When the system classifies as NO Fall the bounding box of green color is generated around the human being in the video frames to highlight there is no fall so no danger. When the system classifies as Fall detected the bounding box of Red color is generated to highlight the danger and alert is generated. This system is tested on 30 videos and has achieved the accuracy of 90%.

CONCLUSION AND FUTURE SCOPE

Aging problem faced worldwide has grown the industry of Smart healthcare. Smart healthcare started with e-health, m-health and now to smart wearable devices and smart health applications. The good monitoring will have less risk to severe injuries to the elderly people and proper action taken at proper time will increase their quality of life. With this motive we proposed an affordable system which will monitor the elder people and if fall is detected it will generate the alert and send message to concerned group of people. In future scope, this can be further extended to android application which will be connecting to health professional also. The alert will be generated to personal healthcare professionals so that fast treatment can be provided to the patient. Daily monitoring of the person can also be provided via application.

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