IP Based Fall Detection System Using The Concept of IOT

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Abstract- *In our society, yearly 33% of senior citizens fall down in their residential area. When our family members come to old age, it becomes essential to monitor them for their in-home health and safety. Although they dwell in home, because of illness and weedy joints they have a big threat of falling down in any corner of home premises. In such circumstances, it becomes significant to recognize if an elderly person has fallen so that he/she can get quick help on time. Physically handicapped people on wheelchairs also require to be monitored for fall detection. Currently CCTV Camera-based monitoring systems are in existence but these systems are very expensive. Common man cannot afford such a system. For these reasons we propose a novel, smart and cost-effective fall-detection system by merging the latest technology as Internet of Things and existing algorithms like Motion History Image and C-Motion. This system uses a low-cost Pi Camera mounted on Raspberry Pi to monitor and detect a person's fall-like movements. Pi Camera is a smart camera that can be easily fixed on windows and walls of living rooms. System will be watching keenly for fall detection and unexpected motion changes in the targeted person. An unexpected abrupt change with peak in the system is treated as a fall. In case the person did not fall and the alarm was false, then the system will have a provision to stop the alert within 5 seconds. If within stipulated time, the person does not press the stop button, the system will consider it as fall-activity and automatically sends an alert message via Wi-Fi to victim's take-givers for quick medical help.*

I. INTRODUCTION

As we know that the Internet of Things (IoT) is a network of smart devices other than computers that are linked to each other via the Internet and can exchange data among them. In our society, yearly 33% of senior citizens fall down in their residential area. When our family members come to old age, it becomes essential to monitor them for their in-home health and safety. Although they dwell in home, because of illness and weedy joints they have a big threat of falling down in any corner of home premises. In such circumstances, it becomes significant to recognize if an elderly person has fallen so that he/she can get quick help on time.Currently CCTV Camera-based monitoring systems are in existence but these systems are very expensive.For these reasons we propose a novel, smart and cost-effective fall-detection system by merging latest technology as Internet of Things.This system uses low-cost Pi Camera mounted on Raspberry Pi to monitor and detect person's fall-like movements.System watching keenly for fall detection and unexpected motion changes in targeted person. An unexpected abrupt change with peak in the system is treated as a fall. In case the person did not fall and the alarm was false, then the system will have a provision to stop the alert within 5 seconds. If within stipulated time, the person does not press the stop button, the system will consider it as fall-activity and automatically sends an alert message via Wi-Fi to victim's take-givers for quick medical help.

II. RELATED WORKS

Falls are responsible for 40% of all injury related deaths and need immediate medical attention. The reason for a fall may be heart problems, loss of consciousness, fatigue, exhaustion, diseases and loss of balance. Although falls occur through all age groups, the major chunks of incidents are those of senior citizens.An upsetting figure is that 40% of nursing home admissions are directly linked with incidents of falls.

This highlights two major points

i. Falls require immediate medical attention- and the only way one can establish that is by conceiving a sensing method.

ii. Falls greatly limit the independence of an individual. He or she will not have the confidence to venture or stay alone for extended periods of time. This is primarily due to the fear of medical complications surfacing.

Efficiency of the system is paramount, as the message must be delivered from point A to point B in a matter of seconds. An established mode of communication must be employed; in this case the Short Message Service (SMS) can reach people the quickest. False alarms can be both extremely annoying and wastes both time and money. So in order to

ensure accuracy, the fall-detection algorithm must be perfected and the device must be made interactive. Communication can be made possible via wireless means to a central database. This database is to be located at the doctor's end, giving a constant stream of information related to the patient. In case of any issues detected, a suitable alert is issued both at the central display, as well as via SMS to the doctors and relatives. SMS is the most rudimentary, ever-accessible means of communication in the modern world and cannot be missed by any individual. One uses the Internet of things to communicate from machine-to-machine.The number of steps and distance travelled by an individual is an indicator of the health of the person. To identify a step taken, we use a series of thresholds, similar to that used in the fall detection. The first criterion is that the user must be in 'stable' state. This means that he must be upright and not in the process of falling. The second criteria it checks for is a spike in the net acceleration as a result of foot contact.Each time a step is taken, we detect this and increment the number of steps taken. Falling in the elderly is considered a major cause of death. In recent years, ambient and wireless sensor platforms have been extensively used in developed countries for the detection of falls in the elderly.However, we believe extra efforts are required to address this issue in developing countries, such as Pakistan, where most deaths due to falls are not even reported. A fall, according to [1] , is defined as "an event which results in a person coming to repose unintentionally on the ground or any other lower surface". This definition has been adopted by many fall aversion and fall-risk assessment studies, and it covers most types of falls targeted by fall detection research. The risks of fall-related problems increase with advancing age. As elderly people become physically weaker, the risk of falling anytime increases. A study by the World Health Organization [2] shows that 30%–50% of elderly people fall each year, and of these falls 10%–20% may lead to serious injury or even death [3].We can find several examples of research that has focused on understanding fall-related problems. For example, the problems of fall-related injuries among the elderly have been investigated to provide a systematic approach to fall prevention [4]. The investigation of prediction accuracy is important to predict falls in older people living in residential care facilities. Population-based interventions for reducing injuries related to falls among older people is necessary. Fall prevention strategies for assisted living residents as well as the importance of evidence-based fall assessment and interventions to reduce the risk of falling were discussed in [7]. Detailed study of the application of wireless sensor networks to real-world habitat monitoring is essential to improve the identification of falls using wireless networks [8].

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III. TECHNICAL DETAILS

The Raspberry Pi is a low-cost packet-size micro-computer that can be plugged into Monitor, TV, Keyboard and Mouse. The Pi Camera is a IP-based Smart-Camera that works with Raspberry Pi board as shown in fig that has capabilities to capture photos as well as full HD video at 1920×1080[10]. Video capturing is possible via command line raspivid tool. The Pi camera module is a portable lightweight camera that supports Raspberry Pi. It communicates with Pi using the MIPI camera serial interface protocol. It is normally used in image processing, machine learning or in surveillance projects. The Pi Camera board is connected to Raspberry Pi through 15-way ribbon wire.[9] It requires only two connections, one end of ribbon-cable is connected with Camera PCB and other end of ribbon cable gets attached with Raspberry Pi itself. SimpleCV is an open source software suite that supports Python.It is a pool of libraries and software components and provides a platform to work with the video streams and images which captured through web cameras, Fire-wire and IP based smart cameras like Pi Camera, or smartphones that help us to build useful software to craft our different technologies witness the world as well to understand it.

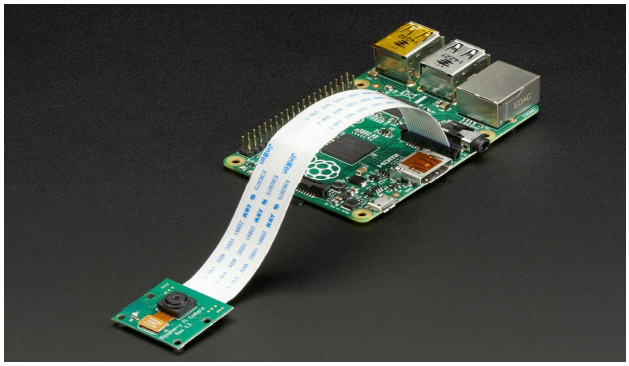

Fig 1: Raspberry pi with pi camera

IV. IOT BASED FALL DETECTION SYSTEM DESIGN

A. Fore-ground Splitting Technique

This technique is applied to find a movement-detection of a particular object that splits fore-ground layer from background layer. We can apply an Adaptive Gaussian Mixture.

B. Motion History Image (MHI)

A motion is a very important aspect of any daily life activity because it depicts vital information regarding fall and collapse of a person. The large movement indicates there is a

critical fall occurred. That's why we thought to mine some crucial motion information from the sequence of recorded video through Pi Camera. There are two popular techniques to extract motion information from video namely Optical-flow and MHI. The optical-flow is usually used to identify motion from sequences of captured video. But the first technique is incompatible for live applications, and it can produce bugs during detection of large movements as it occurs while a fall. To mine motion from large movements MHI is well suitable; it was first introduced by Bobick and his companion Davis. Basically, MHI is one kind of image. The MHI algorithm speaks regarding magnitude of motion and route of movement that's why it is generally used for detection of activity.

Fig 2: MHI of C Motion Walk and Fall

C. Approximated Ellipse

Then person' shape has to be approximated using an ellipse called "Approximated Ellipse" technique to observe the varying outlines of person's movements. This technique provides us crucial information regarding the orientation and shape of the individual in the motion history image. Fig. 4shows the sample of approximated Ellipses for the activities like (a) falling and (b) normal activity [11]. We can compute the orientation standard-deviation of the ellipse, using following formula, There are two popular techniques to extract motion information from video namely Optical-flow and MHI. The optical-flow is usually used to identify motion from sequences of captured video. But first technique is incompatible for live applications, and it can produce bugs during detection of large movements as it occurs while a fall. To mine motion from large movements MHI is well suitable; it was first introduced by Bobick and his companion Davis. Basically, MHI is one kind of image. The MHI algorithm speaks regarding magnitude of motion and route of movement that's why it is generally used for detection of activity.

Fig 3: Approximated Ellipse for human shapes

D. Motion Quantification

This technique is used to measure motion of the person's body. Actually, it is a ratio of the current MHI blob to no. of pixels in the person blob. the mean value within the specified number of frames and the Motion quantification which is estimated starting from the jth frame respectively and where n is no of frames inside a particular slide time frame. The obtained value of the term, Cmotion shows the varying rate of motion of a human body, and it is used to separate abnormal actions from regular actions. In motion like real fall, values of Cmotion and Cmotion will be lofty whereas the other abnormal activities such as fast walking and running, the value of Cmotion will be lofty but value of will have a small varying rate.

V. CONCLUSION

To replace existing expensive CCTV Camera-based commercial surveillance system, this paper discovers and proposes a novel, smart and cost-effective Pi Camera-based in-home elderly monitoring system by making use of low-cow packet-size computer system as Raspberry Pi. The system will detect real falls and will discriminate other fall-like actions from real fall as well. User can also send an alert message to his/her take-givers for assistance whenever a real fall occurs. Our approach is technically so simple and vigorous that will make this approach very realistic for implementation in future.

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