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An Image Based Activity Recognition

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ABSTRACT

As the age profile of many societies continues to grow, supporting health, both mental and physical, is of growing vitalness if self-regulating living is to be maintained. Recently, the term of Internet of Things (IOT) has emerged, which highlights the interconnection of all physical and virtually accessible resources with the purpose of collecting and exchanging data. Activity recognition is one of the concepts in ambient assisted living which has been rigorously explored in recent years. The researchers have mainly focused to use sensors to check elderly people. In this paper, we discuss an optical sensor-based monitoring system, for elder people geriatric care and fall detection. In particular, we establish centralized model which works as a decision maker of active recognition. We analyze the photo frame to improve the scalability of our proposed geriatric care system and propose fall detection algorithm to identify the activity of the person.

Key words: Ambient Assisted Living (AAL), Decision Support System (DSS), Fall detection, Gait recognition.

1. INTRODUCTION

In recent years, the advances in medical science and standard of living have given rise to an increase in the global population of elderly persons. Today 8.5 percent of people world-wide (617 million) are aged over 65. According to [1], this jump is projected to become nearly 17 percent of the population by 2050(1.6 billion). This involves regular monitoring and assistance to this growing elderly population. This is where ambient assisted living (AAL) is being useful by providing the necessary support. AAL is destined to help in geriatric care for elderly people staying alone in their homes. The main aim of Ambient Assisted living (AAL) is to inspect the self-care of aging people and to help them if the need arises. AAL emphasizes to improve their lifestyles, from the perspective of security, health care and energy control.

Most of the research works involving AAL focus on reporting an emergency situation by placing sensors in strategic locations within the home of the person being monitored. We have studied several works in this field and observed that the percentage of accuracy of detection of emergency situation has a fair scope of improvement. In order to have an accurate decision support system to analyse a system at real time so as to reduce false alarms, we need to identify all important metrics involved.

Rest of the paper is organized as follows: Section 2 discusses the existing literature review, section 3 defines the proposed architecture, section 4 presents a case study and section 5 includes future direction and concludes the work.

2. STATE OF THE ART

We have studied several research-works by pioneering researchers trying to provide solutions for assisted living of elderly people. At the beginning many papers are related to wearable sensor where they collect the data through the wearable sensor networking, then using some clustering method provide the monitoring system [2]. In some paper they want to use mobile devices to locating elderly people [3]. By this approach they developed Geriatric Ambient Intelligence, an intelligent environment that integrates multi-agent systems, mobile devices, RFID, and Wi-Fi technologies to facilitate management and control of geriatric residences. We have observed that most of these applications result in generating enormous amount of data. In a real-world situation, it becomes quite challenging to process and analysis such amount of data efficiently. The use of mobile devices to track the position of elderly per-sons has to the problem of memory and processing restrictions. There have been various segmentation methods also for medical imaging [4].

Last few years some works have been done on Activity recognition [5]. An activity recognition system using finite state machines which can distinguish insignificant instances of actions to learn a general model has been discussed in [6]. The use of active learning for activity recognition systems has been introduced by very few re-searchers. Human activity recognition and posture estimation has become popular not only because of their wide area of applications in video surveillance, but also because they are still challenging tasks. Posture estimation and action recognition are usually considered as distinct problems [7], sometimes, the later one is used as a previous for the first [8] [9]. Despite the fact that posture of any individual is of extreme significance for action recognition, to the best of our knowledge, there is no method in the existing works that solves both problems in a joint way to the benefit of action recognition. In that direction, this work proposes unique end-to-end trainable multitask framework to handle 2D and 3D human pose estimation and action recognition.

Fall detection is one of the popular choices for detecting abnormality in the person being monitored. Therefore, a new solution was introduced that is video-based monitoring system [10] which has been used for provide the geriatric care more efficiently. Even though, in this solution privacy is totally ignored by today's systems that fully rely on accessibility to raw video feeds. Both data on the way to the operator and the operator itself impose potential risk points of misuse. Furthermore, some re-searchers thought many others way to detect the fall occurrence. In [11], they tried to identify fall detection by using wearable device. In comparison with other solution it provides better result, still it is not good enough for Alzheimer disease yet.

Keeping in mind the above problems, we have proposed the 2-layer architecture for assisted living with an aim towards reduced rate of false alarms [12 – 16]. The following section includes a detail description of the proposed 2-layer architecture. In this proposed solution we especially concentrate to get centroid (threshold) value through gait analysis and measure the injury severity [17 - 19]. As well as, detecting fall occurrence using this concept. Thus, we pledge security, increase the level of life style of elderly people.

3. DESCRIPTION OF PROPOSED ARCHITECTURE

On studying the state of art in the domain of activity recognition, we understand that the precision of detection is of utmost importance for timely assistance to the elderly person [20]. This is achievable by means of an efficient decision support system.

The bottom layer (Layer 1) of the proposed system consists of a network of optical sensors involved in monitoring an elderly person. The set of image data is processed (noise reduction and feature detection) at this layer. Layer 2 takes the reduced image data set from layer 1 as input and feeds it to the DSS for analysis.

We propose to use an anomaly-based detection technique to detect the occurrence of an emergency situation. The feedback loop is used to enrich the anomaly database in the cloud server.

Through monitoring data, we can analysis user regular walking pattern with help of gait technology. Figure 1 depicts the modular architecture of the proposed scheme.

We propose a system for geriatric care in home. Our proposed two-layer architecture aims to achieve safety for our elders at home. The methodology focuses on using face and gait active recognition highly. Existing face recognition algorithms helps to identify user and identify facial features changes by extracting features from an image of the user. These features are then used to search for other images with matching features and identify changes. Gait analysis is used to assess and treat individuals with conditions affecting their ability to walk. It is also commonly used in our proposed work help user more efficiently and to identify posture-related or movement-related problems in user with injuries. We have used optical lens (optical sensor) for capturing photo for further monitoring an elderly person.

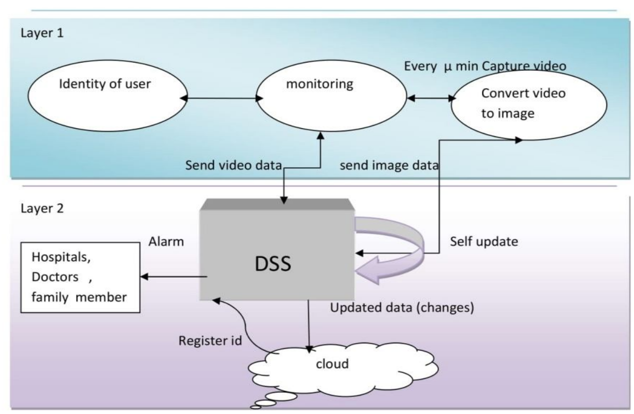

Figure 1: Overview of the Architecture

A centralized Decision support system is used for analyzing the findings of module one and generating an alarm in case of need. The outputs from module two are used to update the pattern database stored in the cloud server. In our proposal at least one optical sensor remains ON at all times, so as to allow round-the-clock monitoring besides maintaining regular sleep schedules of optical sensors.

3.1 Centralized DSS

It is basically an analyzing device which works as a decision support system. DSS is connected with optical sensor devices, which sends every movement of user. DSS updates data every 5 days into master data base and posture data base. It helps to analysis for decision making. DSS takes different decision on the basis of input video data and photos. Helps of data, DSS analysis user walking changes, facial changes and detects injury. Centralized DSS is connected with other devices look like a star network topology. DSS does several types of analysis, so it makes a huge amount data. It's impossible to store this vast amount of data in master data-base [21] [22]. Therefore, processing time will be increased for which this is not beneficially for active recognition. If DSS cannot take decision promptly then it does not profitable for user. However, for minimize the processing time we add posture data-base, where huge data as a summary will be stored. This posture storage is a cloud-based data base. It is accessed by user relatives and user doctor. This helps to get user medical reference, by which doctor can specifically note the user health changes with the time.

This proposed work is focalized in gait recognition and fall detection. Fall injury detection which helps to identify user injuries. Through centroid measurement we find out two types of injury in the first type system will wait for seconds to observe the movement of user if user unable to stand-up then DSS will take the decision .In the second type if DSS identify any kind of color change surrounding user then generated message to user family and doctor. And through regular monitoring video data with previous recordings data, DSS can be used to measure joint angles and velocities changes with help of gait analysis.

3.2 Register

/*Through these steps, we elaborate starting way of our proposed system. At the time of registration, the user details will be uploaded to the master database it presents in DSS, and posture data upload into cloud. Registration_Detail table (User_name, age, Bio data, sample walk, sample image, user relative details) are indexed here.

.

The hospital details will be stored in hospital_master table (user house doctor name and details, nearby hospital details).

The posture_master (Registration_Detail, Hospital_master table)*/

```
Begin
      call Registration_Detail()
      call hospital_master table()
      callposture_database()
      validate data()
    send user id (connected user relative and doctor with
    User ID)
End
```

3.3 Monitor

/* when registration is done, we can go for a next step, where we face recognition, identify user. Where we use motion Sensor it helps to monitor the user movement. User's movement sensation takes as input, and switch on the optical sensor. Where movement take as a gait input and it will send to DSS for analytical purpose. It helps to identify user regular gait changes. */

```
Monitor ()
Begin
      if sense any movement then,
      put on photo-lens
      detected user()
      check gait style()
      check face expression()
      send DSS( gait style, face expression)
      else
      sleep mode
      endif
End
```

3.4 Image Acquisition

/* this step we convert video data to static/ frame photo. We take video data as input. Through various step systems go through for a detected the edge, positioning, photo filtration and send DSS, for further works*/

```
Convert video to static picture( )
Begin
   call click()
   while (every µ minute)            /* µ = variable of time*/
   call monitor()
   convert video frame to static frame()
   if quality of video resolutions above 360p
   then
   convert video frame to static framework( )
   /* using pre-existing algorithm */
   else
   call click()
   end if
   filter image()
   /* using pre-existing algorithm */
   if quality of photo resolutions above 300dpi
   then
   filter image()
   detected edge()
   detected position ()
   else
   goto Convert video to static picture( )
   end if
   Send DSS(position, image_frame, edge)
End
```

3.5 DSS algorithm

/* This algorithm is master of our proposed work. DSS mainly takes every decision through analysis intelligences. It takes large number of various data input. From monitoring (gait style of user, facial identification) and other side from convert video to static picture (Image, position, edge detection). As an output we get different type alarm. After analyzing the data, DSS will summarize the report send to the cloud for further usage. It update every 5 days if there no big changes, but above threshold changes happened it will automatically updated DSS on database and posture data base.*/

```
DSS( )
Begin
monitor_DSS(gait style, face expression)
    if any change is there, find out
    then, /* user current gait style compare with previous stored gait style */
calculate changes percentage()
        if changes above 50 % then, /* percentage can be varied */
        alarm
        else
        update gait_masterdata()
        update posture_database()
    else
goto monitor()
end if
convert video data to static data (position, image frame, edge)
check quality of image
If below 50% dpi
then
    recapturing image and n = +1
       /* n is a variable which helps to identify optical sensor problem*/
    if (n>3) then
 generated message relative (error optical sensor);
  else
  go to next step
   end if
    compare image to DSS pervious data_image()
    if below 30% change image
    then
        if (image_ master data update within 5 days)
        then
        update image_ master data()
        update postuer_database()
        else
        goto monitor()
        end if
    Else if above 30% then,
            Detected fall_injury ()
            Update posture_database()
            Update image_masterdata()
    Else if above 70%
             Detected fall_injury( )
                send message hospital (user details, relative details, doctor details, type of injury, position of user)
            update posture_database()
            update image_masterdata()
    endif
End
```

3.6 Posture_database()

/* This algorithm describes that when a user will be registered then a random number will send to user's family members, doctor. If DSS send new data about user then this new data will be stored in cloud.*/

Initialization of user=c;
cloud=d; random number=r;
family members, doctor =k_i ;
Initially store the data of user c_i in the file z_i

Int r=random() this random number will be generated for c_i and send to the K_i to ensure authentication of client c_i if any changes are made of c_i

```
    Zi=update()
    Return zi to Ki
    else
    return zi to ki
    endif
    Stop
```

3.7 Fall_Injury detection

/*Specifically, this proposed methodology emphasis fall_injury detection, which helps to identify user injury severity also. Through centroid measurement, Fall_injury detection gets the attribute of user height and position both.

Thus we explored two types of injury in the first type system will wait for seconds to observe the movement of user if user unable to stand up then fall_injury will take the decision .In the second type if fall_injury identify any kind of color change surrounding user then generated message to user family and doctor.

```
fall_injury ( )
      Begin
     DSS()
     If Current picture above threshold value then,
            if check height higher than centroid value
            then, /* it helps minimize flase alarm*/
            goto monitor()
            else if after β  time then,  /*  let  β  = 1minutes */
            generate Alarm
            else
            goto monitor()
            end if
     else
     monitor()
     end if
    End
```

Above algorithms basically works as a different module of our methodology, among all these algorithms we precisely counter on fall injury detection methodology.

Through this way we made our methodology unique. It can identify user fall detection and injury then generated auto alarm. These alarms will be sent to the listed members as a message, these listed members details are already stored at the time of installing on DSS and cloud. It also notifies house physician.

Above 70% injury directly send the information to hospital. This way we make safe our elder, through this concept family members feel relax for elder.

4. CASE STUDY

We try to support geriatric care for elderly people. In this section, we generate a case study with the following assumptions:

a) the elderly patient resides in a 2BHK apartment
b) Each room is connected to the other room through doors.
c) Random walk mobility model is used for tracking the movement of the elderly patient System Requisites:

i) lens camera
ii) Micro controller-based decision-making support system
iii) Store posture data in to cloud
iv) Details of hospital, doctor, user relative
v) User bio data with user clear face picture
vi) Motion Sensor

We try to install our proposed work into user home. One or more optical sensor /photo-lens are installed in each room. In the middle of the room centralized decision support system (DSS) is present. Photo-lens captures video data then sends it to DSS. User will be identified by using face recognition technique among others.

Every decision is taken by centralized Decision support system. It helps to monitor every movement of elder person using gait analysis identify posture-related or movement-related problems in people with injuries where conclusions about the subject (health, age, size, weight, speed, etc.) and through face recognition we identify user. DSS will get current image of user by using lens then through analyzing the data it generates the decision. We use replica data base as a cloud. Cloud database is connected via Centralized DSS, summary of data in text form store every 5days.

Specifically, this proposed work is focalized in fall injury detection which helps to identify user injury through centroid measurement. We explored here two types of injury. Injury will be informed to user family and doctor.

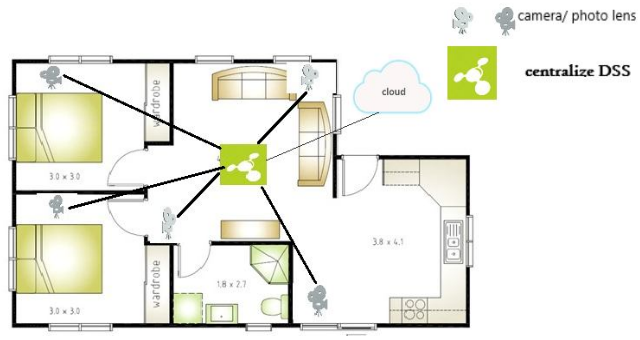

Figure 2: Overview of proposed methodology

The overview of our proposed methodology is shown in Figure 2, where each room has one optical sensor and connected with the centralize DSS. DSS is also connected to cloud, where we can store our previous and current data.

5. FUTURE DIRECTION AND CONCLUSION

This paper proposes photo frame-based activity recognition by introducing several algorithms. Using this proposed solution, we try to monitor elder person all the time by which system can fall detection as well as importance of injury. DSS plays a role of decision maker through analyzing the data. Finally, this data will be stored in cloud for further requirement. Now we just focused on gait changes, fall detection and injury severity also. In future we will try to enhance our domain on facial expression which provides more accurate user health condition and improvement of data access security. Thus, provide secure geriatric care. Through introducing this concept, we can provide more security to elderly people. We monitor all the movements of elder. Thus, the quality of live is increased of elderly people behavior can be detected using this idea. By moment, as a result we provide geriatric care to them.

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