A review of Elderly assistance mechanisms using the advance wearable sensors technologies

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Abstract- Sensor technology has improved significantly in the last decade. Third generation sensors are now available to use in various walks of life including healthcare, gaming, agriculture, vehicular industry etc. One of the major use of sensors now a days is continuing and real time monitoring of patient specifically elderlies. Many health issues face by elderlies these days including falling because of weakness of muscle and their overall strength. These sensors can be used to monitor vital sign in elderly people who live alone. Various third generation sensors have been developed by industries including monitoring physiological parameters, movements, ECG, EMG, blood pressure and another vital sign etc. In this paper we review related technologies, different mechanism proposed for assisting elderlies specifically for falling and vital sign monitoring. Finally, we present our analysis of the review of existing literature.

Keywords: Elderly assistance, sensor technologies, fall detection, vital sign monitoring.

I. INTRODUCTION

Wireless sensor is used in many areas especially for monitoring in healthcare and surveillance. Reason for using the sensor in healthcare is portability, real time monitoring, availability, ease of deployment and scalability. The need for healthcare at home is expected to increase drastically telemedicine and remote consultation. The sensors which are used in healthcare named as biosensor. Mostly wireless sensors are used all over the world mainly because of ease of use and controlling. They can reduce the work load of medical assistance, easy to wear and takeoff. This monitoring through sensor can allow suggestion of right treatment on right time. This can be very time saving and energy efficient process. In healthcare and fitness sensor can monitor temperatures, chemical, and biological levels of users and patients like blood sugar, core body temperature, blood oxygen, respiratory rate, EMG, ECG, and EEG are biosensors which are used in hospital to measure the brain and heart activity. As old age people become physically weak, the risk of fall is more likely happen to them anytime. According to the reference Error! Reference source not found., falling is one of the major causes of severe injuries in elderly and the second topmost cause of accidental deaths in worldwide. As people grow older their body gets weak and due to which their chances of falling also increases. There are number of reasons of fall in elderly including incorrect weight shifting, trip while walking forward etc. as shown in Figure 1. There are many reasons behind their falling such as low sugar,
heart problem etc. but our main focus is on issues of muscles because it is the common reason behind the falling in elder age. This problem is found more in elderly as compare to youngster. There are a number of health issues whose treatment benefits from continuous vital sign monitoring. This include heart patient monitoring, diabetic patients, rehabilitations after the surgery etc. Most of these sensors are helpful in these elderly assistance scenarios. The most commonly used are ECG and EMG. EMG devices record [1] the electrophysiological activity of motor units, EMG recordings can be performed by means of intramuscular (needle) or non-invasive (surface) electrodes. Surface EMG techniques are becoming more popular because they are noninvasive and inexpensive. EMG is also used to measure electrical activity generated by muscles cells either these cells are electrically or neurologically activated. Therefore, it is very helpful device to determine the muscle fatigue. This muscles problem name as “muscles fatigue”. Muscles fatigue normally starts at the age of 50, and then it increases per decade. It increases greater extent at the age of 60 years and above. In this paper we have discuss about different review paper and technologies which are used and also make a compression table of different review papers. Rest of paper is organized as follows: section II introduces the related advance sensors technologies. In section 3 we review the use of these technologies for assistance of elderlies from the literature. In section 4, we present comparison of technologies and their use. Finally, we summarize our work and highlight future work in section 5.

II. Sensor Technologies:

In this section, we present the sensors use these days for various walks of life however focus on healthcare technology. The sensor in Figure 2 measures the activity of the muscle where electrodes are placed. The resulted signal shows the filtered and rectified electrical activity of a muscle. Its output 0-Vs volts depending the amount of activity in the selected muscle, where Vs signifies the voltage of the power source.

Durable develop Xltek EMG [3] device which is very helpful to get most accurate neurophysiological data, print out reports and provide information to the patient. Most of the hospital used this device in Liquat hospital we see same device when we go there for collection of data as shown in Figure 3.

This system for walking functional evaluation providing objective and quantitative data related to muscles activity and kinematic parameters. It integrates the latest technologies available today. Based on wireless devices, this solution includes a set of miniaturized probes and an inertial sensor. Biometrics Ltd Surface EMG Sensors are used to measure the muscular activity, it has been extensively researched and developed over a number of years. its results are versatile, state of the art range of Surface EMG equipment which is reliable, accurate and easy to use.
Shimmer sensing technology, United Kingdom produce ECG and EMG kit (shown in Figure 6) using smart sensing technology. The shimmer sensor can connect with the shimmer software using Bluetooth and can be wireless to record both ECG and EMG data. The given electrode can be placed to record the specific muscle acidity where it is placed. SHIMMER mote is very tiny, slim and most robust wearable Bluetooth based wireless sensor engendered to date. It uses MSP430 microcontroller for core computation and ChipCon CC2420 radio for communication. This EMG sensor can be used to analyze and measure muscle fatigue in elderly persons.

III. Review of exacting literature

In this section we review the literature related to the Roldán-Jiménez et.al in [7] reported that they have performed EMG test on 18 men and 12 women. muscle fatigue was measured using surface electrodes placed on their biceps femoris, vastus medialis of the quadriceps, the abdominal rectus, erector spinae and the tibialis anterior. In first step each subject were performed 5 repetition sit to stand, in 2nd step 10 repetition and then they perform 30 repetition sit to stand in 30 sec. In first step they observe muscles readings were high as compare to 2nd and 3rd step. medial gastrocnemius, biceps femoris, erector spinae and rectus femoris muscles showed differences in muscle activation. This can indicate the muscle fatigue.

In another example cho et.al. in [8] reported that they use EMG to determine muscle activity in the lower extremities from sitting to standing movements with 52 subjects (26 males, 26 females). there work is also same as above mention paper but some muscles are different. They experiment on muscle activities of various muscles using the EMG sensors They used statistical method for analyzing muscle fatigue. A paired t-test was performed for the verification of a difference between the standing and sitting groups. The statistical significance level α was set at 0.05 The goals of this review were to decide the mental exhaustion and examine muscle action of creation laborers who are performing forms occupations while remaining for delayed eras. The mental weakness experienced by the specialists was gotten through poll reviews.
In the meantime, muscle movement has been breaking down utilizing surface electromyography (sEMG) estimation. Bring down limit’s muscles include: erector spinae, tibialis front, and gastrocnemius were simultaneously measured for over five hours of standing. Twenty male generation laborers in a metal stamping organization took an interest as subjects in this review. The subjects were required to experience poll reviews and sEMG estimation. Results of the survey studies found that all subjects experienced mental exhaustion because of delayed standing occupations. Also, muscle weakness has been distinguished through sEMG estimation. In light of the non-parametric factual test utilizing the Spearman's rank request relationship, the left erector spinae acquired a direct positive connection and measurably huge (rs = 0.552, p < 0.05) between the consequences of poll reviews and sEMG estimation. In view of this review, the creators reasoned that delayed standing was added to mental weariness and to muscle weakness among the generation laborers. Prolonged standing, Muscle fatigue, Questionnaire survey, Surface electromyography, Metal stamping industry [9].

Authors in [10] observe changes in enactment of the rectus femoris, biceps femoris, tibialis front, and gastrocnemius muscles using EMG sensors. The aftereffects of this review can fill in as reference for building up proper strategies and measures of practice for patients with orthopedic and neurological issue or other development issues on the grounds that the discoveries illustrate changes in the initiation of lower furthest point muscles.

Rahnama et. al. in [11] reported that Surface electromyography is helpful to think about the different games developments and muscle movement is an important Muscle actuation, coordination and method to survey exhaustion. Since these key factors has been researched.

In football, the present review plans to explore the substantial muscle action of the lower furthest point amid a soccer simulation fatiguing convention. They experiment with ten amateur soccer players age from 21 to 25 and observe their various muscles. The results indicated in a reproduction of the lower appendage muscle practice power were lower than EMG action before play football. This lessening the fact of the matter was supported long discontinuous practice work rate not withstanding when the influenced muscle movement [12].

Another fall detection system by using wearable sensors, is proposed in Error! Reference source not found.. the well-known SHIMMER platform-based sensors have been used for data acquisition. These motes are equipped with a tri-axial accelerometer, tri-axial gyroscope and use Bluetooth for wireless communication. In this study, two SHIMMER motes were placed on subject’s chest and right thigh. The vector magnitudes of acceleration and angular velocity with raw data are selected as input features for a decision tree C4.5 classifier. Four types of fall (FF, BF, RF, LF) were aimed to be distinguished from ADLs. Eight healthy subjects performed these four types of falls and ADLs. Authors claimed that they have achieved 99.45% accuracy for training with 7 subjects, but it decreases up to 98.91% when training with 3 subjects.

IV. Compression and Discussion

The aim of this report to review of analyzing muscles fatigue in elderly using different EMG technologies in lower limb. Regarding muscles activation, significant difference was found between different activities in QM, TA, RF, GM and ES in which activation increased when increasing repetitions. Table 1 shows our comparisons and analysis of proposed mechanism in the literature we review in this paper. The table compares based on various parameters such as sensor placement, activity, experimental setup, sensors used and their energy consumption. We also categorize the energy consumption in the proposed mechanism to be low normal and high and can see from the table most of mechanism has high consumption. Because of some limitations like some researchers have number of samples too small so their result was not generalized and subject was used with different parameters. Therefore, their result has significant difference. Researchers has different views like author in [14] reported that dynamic stability of quadricep, medial gastrocnemius and soleus are important for sit to stand movement as they play critical role in controlling motion speed. Authors in [15] reported that quadricep, medial gastrocnemius and soleus are important for standing movement and these are the
Table 1: Comparison of proposed sensor technology-based mechanism using EMG ECG sensors.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Experiment Environment</th>
<th>Sensors used</th>
<th>Sensor’s Placement</th>
<th>Technique</th>
<th>Activity</th>
<th>Software</th>
<th>Energy Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roldán-Jiménez et al [7]</td>
<td>Lecture Room</td>
<td>WEMG8</td>
<td>Lower limb</td>
<td>Statics analyzing</td>
<td>Sit to Stand</td>
<td>SPSS 18.0 Version</td>
<td>normal</td>
</tr>
<tr>
<td>Rahim et al. [9]</td>
<td>Metal Stamping Company</td>
<td>sEMG(Mega Electronic)</td>
<td>Lower extremities &amp; hip resign</td>
<td>Statics analyzing</td>
<td>Prolong Standing &amp; Questioner technique</td>
<td>Megawin</td>
<td>normal</td>
</tr>
<tr>
<td>Rahnama et al. [11]</td>
<td>Laboratory</td>
<td>sEMG</td>
<td>Lower limb</td>
<td>Statics analyzing</td>
<td>Running</td>
<td>Customer Software (RMS)</td>
<td>high</td>
</tr>
<tr>
<td>Cho et al. [8]</td>
<td>Laboratory</td>
<td>surface electromyography WEMG</td>
<td>Leg</td>
<td>Statics analyzing</td>
<td>Sit to Stand</td>
<td>SPSS 15.0 Version</td>
<td>Normal</td>
</tr>
<tr>
<td>Bae et al. [10]</td>
<td>Laboratory</td>
<td>EMG(BTS)</td>
<td>Lower limb</td>
<td>Statics analyzing</td>
<td>Flexion and extension of leg</td>
<td>SPSS 20.0 Version</td>
<td>High</td>
</tr>
</tbody>
</table>

main cause to muscle gets fatigued suggested by authors in [9].
We mainly review muscle fatigue because we believe this is the main reason in elderly for fall which has severe consequences including death.

V. Conclusion:

In this paper we have focus on elderly assistance considering the need of further enhancement in the existing technology and research. We have presented the existing sensing technology and wearable sensors specifically ECG, EMG sensors for monitoring of elderly muscle activity. These real time data can help us detect or even prevent falling of elderly. We observe that most researcher analysis muscle fatigue because statistical analyzing method produce more reliable and valid results. We are also aiming to use the advance wearable sensing technology to assist elderly person by developing a prototype.

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REFERENCES


