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Developing A Sensor Based Alerting System For Stroke Patients' Safety

Mritha Ramalingam, R. Puviarasi, Elanchezhian Chinnavan, Nur Sofea Iznie Binti Johan

Abstract*: With the expanding number in the elderly populace, as well as the changes in lifestyle emergence that causes several chronic diseases. Stroke is one of the main chronic disease that leads to disability and death. So, it is necessary to monitor the health status of the patients to prevent from fatal disorders. If affected by stroke, in order to improve the function and gain as much independent as possible, the stroke patients have to do some rehabilitation. The selection of medicinal services innovation is promising to improve the personal satisfaction for endless illness patients and the elderly and an individual. This paper proposes a promising innovation by discussing some of the existing, related works. This paper is aimed to develop a system that can measure stroke patients' vital sign during their rehabilitation using microcontroller and sensor technology. As a result, the system will prevent the patients to suffer from further stroke or fatal. Also, the system will produce alarm as an alert to the assisting person of the patient.

Keywords: alarm, rehabilitation, sensor, stroke.

I. INTRODUCTION

It is well established actuality that when a nation's economy enhances the social insurance of its residents likewise makes strides. Social insurance is a noteworthy issue confronted in many real nations, according to a Pew Research Center "A median of 85% of respondents believe it was a problem in their country [1]." Hence, health care of a country should be given more attention.

The primary issue is when patients who exaggerating high intensity exercise may get the risk of death from a heart attack or stroke [2]. The over sightedness of medicinal services delegates may lead reason of death. All these deaths have been caused due to the negligence of the physiotherapists, person in charges etc. As one side of the brain controls the opposite side of the body, stroke patient have problems in communication [3]. Lastly, assistant/ physiotherapist have to focus on the patients even though they are doing the repeated exercises.

In the most recent decade, the outline of wearable physiological estimation frameworks has been a developing exploration enthusiasm because of the potential application in pharmaceutical, medicine, etc. Besides, it offers the possibility to modify the present medicinal services framework by empowering out-patient care and forestalling pointless hospitalization.

Stroke is considered to be the most common cause of severe disability in most of the developing countries. Anyone can suffer with stroke, including children, but the majority of cases is found among adults [4]. A stroke or paralyzed condition is a brain attack and occurs when the blood supply to the brain is disrupted. The brain is the nerve center of the body, controlling the automatic functions of a human body. Medically, the stroke is referred as hemiplegia. Generally, the brain is divided into two hemispheres, separated by a bundle of fibers called the corpus callosum. The right side of the brain control muscles and other functions on the left side of the body, while the left side of the brain controls much of the right side of the body. Thus hemiplegia and hemiparesis almost always indicate a problem with one side of the brain [5]. Mostly the patient with this condition are the adults that are caused by a blood clot, trauma, bleeding, brain infections and cancer. The symptoms vary depending on which part of the brain is affected and on the size of the damaged area such as weakness of an arm, leg or both. This may range from total paralysis of one side of the body to mild clumsiness of one hand. Other symptoms are weakness and twisting of one side of the face and numbness in a part of the body.

To improve the function and gain as much independent as possible, the patients have to do some rehabilitation by using physiotherapy, occupational therapy, speech therapy and also counseling. During the physiotherapy session, the treatments are concentrating primarily on controlled and balanced movement, increased strength and stamina for greater mobility for example basic level standing and balance exercise. For this exercise, patient has to hold on to a stable surface, standing and tall while the patient transfers his/her weight to one side. The patient has to swing the other leg to the side. They have to use his balance to hold this position for 10 seconds. Then slowly lower his leg back down. The patient has to repeat for a few times, as long as he has the strength and then switch legs.

Sometimes, patients who enduring stroke could not comprehend and clarify what they feel, for example, they effectively sufficiently drained to do the activities, however the physiotherapist still requesting them to proceed. Recurrent strokes often have a higher rate of death and disability because parts of the brain already injured by the original stroke mat not be as resilient [6].

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***** Correspondence Author

Mritha Ramalingam*, Faculty of Computing, Universiti Malaysia Pahang, Kuantan, Malaysia.

Puviarasi, Department of Electronics and Communication Engineering, Saveetha School of Engineering, SIMATS, Chennai, India.

Elanchezhian Chinnavan, Faculty of Allied Health Professions, AIMST University, Malaysia.

II. RELATED WORKS

Vital signs are the evidence of the current physical functioning of the human body. They provide critical information that is 'vital' for life, so they are called as vital signs. They are also measurements of the body's such as body temperature, pulse rate, respiration rate and also blood pressure. These four main vital signs routinely monitored by medical professionals and health care providers. The technological innovation has brought the changes of vital signs monitoring devices. Despite the fact that this framework could be practically same as the other framework that as of now exist, however this have been redesign more progressed. The stroke patients are the individual who has the issue on accomplishing something that created by various restorative condition. The proposed system help them to monitor their body temperature, respiratory rate, pulse rate and blood pressure during their rehabilitation.The physiotherapist can set the limit depending on the level of disability of the patient in doing the activities. This system could avoid them from second stroke by producing alarm once it reaches the value limit set for the patients. As this device is used to monitor the patient, it will display the reading of vital signs in the screen. There are some related vital sign monitoring system available such as vital sign monitor with emergency control, wireless sensor network for rehabilitation application and mobile wearable device for long term monitoring of vital signs.

A. Vital Sign Monitor with Emergency Control

The Vital Sign Monitor with Emergency Control is a wellbeing observing gadget which is utilized by most of the specialists to measure the heart rate, blood pressure and body temperature of the patients. The block diagram of vital sign monitor with emergency control is shown in Figure 1.

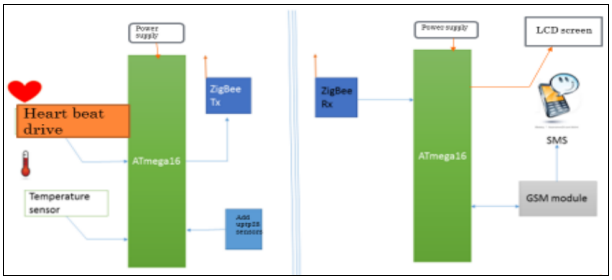

Figure 1. Block diagram of vital sign monitor with emergency control

This is an elementary, cost efficient health monitoring system which is based on a simple controller. The thumb finger will help in finding the normal heart rate. It is measured using the IC LM-358 that uses the photoplethysmography (PPG) technique. The PPG is a straightforward and minimal effort method that is utilized to distinguish blood volume changes in the smaller scale vascular bed of tissue. The framework utilizes a sensor called LM 35 which is aides in the estimation of the body temperature. The blood pressure on the other hand is taken manually from the conventional blood pressure device and connected to a microcontroller. The result is displayed on a text based LCD screen.

After the vital signs are measured, it transmits them remotely to a monitoring room using ZigBee. In emergency situations, abnormal vital signs measurements are sent to the doctor and the emergency contact using a Global System for Mobile communication (GSM) module [7]. The vital sign monitor with emergency control system is used to measure vital signs such as heart rate, blood pressure and body temperature; to transmit data wirelessly to a monitoring room; to send the measurement to the doctor when the reading is abnormal and to help in reducing human errors.

B. Wireless Sensor Networks for Rehabilitation Application

The wireless sensor networks (WSN) for Rehabilitation Application is a gadget that is used for patients' recovery. The fundamental objective of WSN is to catch developments and stances of patients for observing his engine exercises amid recovery treatment. Possible clinical applications include cognitive rehabilitation, for example, cognitive impairment or brain injury treatments, as well as motor rehabilitation, post-surgery rehabilitation, post-accident rehabilitation or post-disease rehabilitation [8]. The Figure 2 shows the prototype of WSN for rehabilitation application.

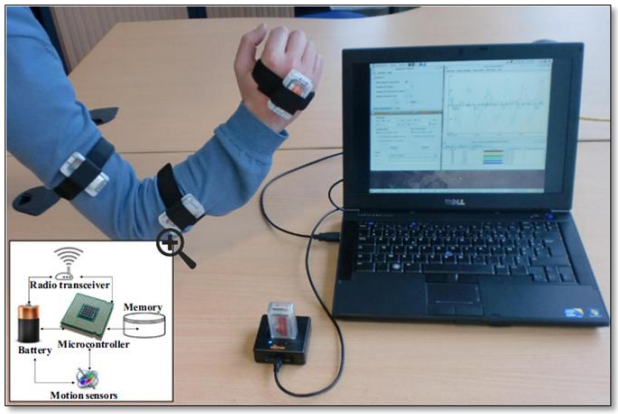

Figure 2. Prototype of WSN for Rehabilitation Application

The data is continuously collected and recorded in order to be analyzed by specialists. The recorded information can be raw sensors data such as acceleration and velocity or processed data such as limb joints, angles and positions. This WSN have also been used to monitor the movement of lower body parts such as knees, legs and hips. The wearable sensor module comprises of an optical linear encoder, an accelerometer sensor, a 16 bit microcontroller and a CC2420 radio-handset. The wearability of the human sensor module is finished with a mortar that clings to the human skin as represented in Figure 2. A movement sensor, Actis is incorporated into multi-level telemedicine design for PC supported physical restoration application. The iNode is a sensor hub containing two different types of sensors to measure the train and respiratory flags and break down the coordination between them keeping in mind the end goal to encourage the recovery for Parkinson patients. A HipGuard in WSN is used for recovery of patients with hip surgery. It consist of accelerometer, magnetic and capacitive insole sensor to measure hip or leg position and rotation and the force between foot and the shoes. The Creators are utilized systems administration innovation to gather information from sensors to the base station. Besides these, this gadget present many disadvantages, for example, constrained correspondence run and settled parcel estimate.

C. Mobile Wearable Device for Long Term Monitoring of Vital Signs

The Figure 3 shows the mobile wearable device for long term monitoring of vital signs.

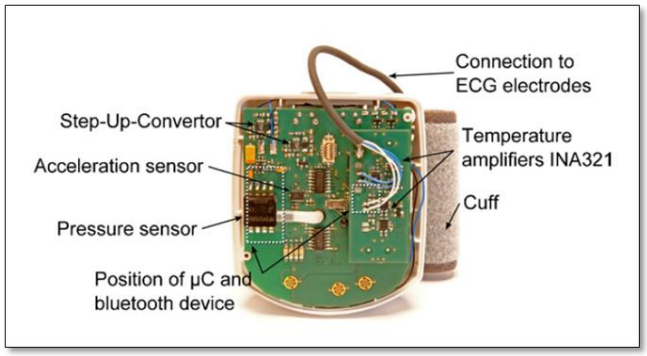

Figure 3. Mobile wearable device

The portable wearable gadget for long haul observing of indispensable signs is another venture that has an indistinguishable reason from the WSN extend which is utilized for recovery. Both are fundamentally the same as, the principle distinction is that the patients' information handled and dissected in the gadget that contains the sensors. This gadget will record the electrocardiogram (ECG), circulatory strain and skin temperature; and incorporate a 3D-accelaration sensor for the assurance of the developments during recording.

To deal with motion artifacts in all recorded properties, it uses data fusion to reject or correct distorted vital sign signals. This gadget is simple for patients to use as it is versatile wearable gadget and it likewise gives remote correspondence. The Figure 4 demonstrates the top view of vital sign prototype. This device include one-channel ECG for measuring blood pressure and body temperature. This gadget works under the main controller called, microcontroller. The ECG is attached to have contact with the skin [9]. A 10-bit AD-converter is used for digitizing. The converter is found in the microcontroller. The blood pressure is determined by recording the oscillations in an inflatable handcuff.

The user can program the microcontroller to control the software for recording the sensor values. The vital signs such as heart rate, breath frequency, blood pressure, body temperature are displayed. The users are instructed with the help of the display unit. For example, when a user is progressing with a sensitive measurement, the user should be in resting position. The major advantage of mobile wearable device can record ECG, skin temperature, blood pressure and provide wireless communication.

The advantages of vital sign monitoring devices consist of three outcomes which are clinical outcomes, organizational outcomes and social outcomes. For clinical outcomes, it include the improvements in the quality of the medical care, minimization of medical errors, and the other innovations in measurements in patients.

Next, organizational outcomes include financial and operational performance, and also the fulfilment of the patients and physicians that use the electronic health record. In social outcomes, should be able to conduct research to achieve improved health population [10].

These pros and cons of vital signs really help in the technology innovation. This will remain as the bench mark for developing a new vital sign monitoring device in future by maintaining the advantages and try to eliminate the disadvantages.

III. PROPOSED METHOD

The proposed system is aimed to be developed for the safety of the stroke patients. The proposed system will be convenient for the patients in order to recover from stroke disease.

The block diagram of the proposed alerting system is shown in Figure 4. The proposed system is the vital sign monitor innovation that is specialized for the stroke patients. This system is also functioning as other vital sign monitor that measure body temperature, respiratory rate, pulse rate and blood pressure of the patients.

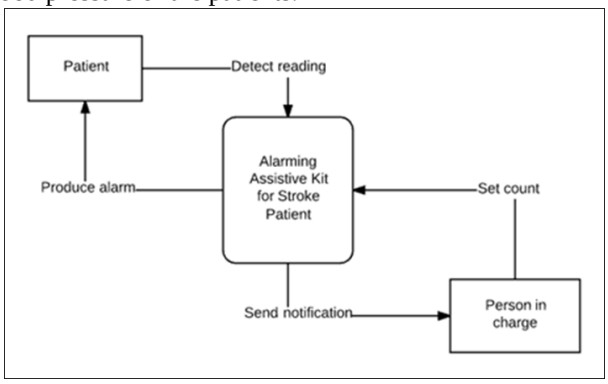

Figure 4. Block diagram of the proposed system

The proposed system is developed by utilizing microcontroller, buzzer and sensors. The microcontroller will act as the main controller of the system [11, 12]. All these technologies will be integrated with the patient's exercising machine. Normally for the rehabilitation of stroke patients, the pedal exerciser is used in the protocol.

There will be different sensors used to measure body temperature, respiration rate, pulse rate and blood pressure of the patient. All the measurements from the sensor are collected by the microcontroller and accordingly it will alert the physiotherapist or the patient assisting person.

This system could avoid the patients from second stroke which was caused by the changes of atrial fibrillation and high blood pressure. While doing the exercises, an alarm will be raised once it reached the set high risk limit of the patients. So, the assisting person will notice that the patients should have to stop from doing any exercises.

The overall flow of the proposed system is shown in Figure 5. The physiotherapist or the assisting person will set the count for the patient to do the exercise according to the ability of the patient on that day. If the patient is in the initial stage of the rehabilitation, then minimum count could be set. This value could be increased gradually based on evidencing the improvement of patient's rehabilitation activity.

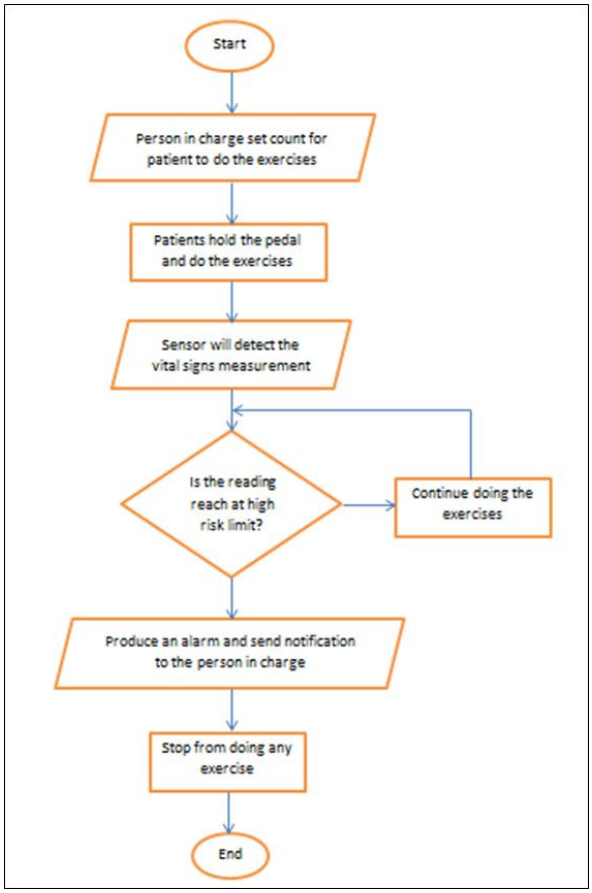

Figure 5. Overall flow of the proposed system

The proposed alerting system can be used by the patients who suffer with stroke conditions. This alarming assistive kit is proposed to monitor them on body temperature, pulse rate, blood pressure and heart rate while the patient is involved in the stroke rehabilitation. This system can avoid them from second stroke by producing alarm once it reached at high risk limit of the patients. As this device is used to monitor the patient, it will display the reading of vital signs in the LCD screen. The benefit to the physiotherapist is that they can do other works in the meantime because it will notify the physiotherapist that assists the patients by producing an alarm whenever the reading reached the risky limit.

IV. CONCLUSION

This paper has discussed some of the existing system that are relevant to the sensor based alerting system. This paper presented the importance of developing the alerting system for stroke patients. Also, the paper proposed an alerting system by using sensors for measuring the vital signs of stroke patients. The next part of the proposed system will be developed as an assistive kit for the stroke patients by utilizing sensors and microcontroller. The sensors will be used to record the vital parameters of the patients during stroke rehabilitation.

REFERENCES

1. M-C Chambrin, P Ravaux, D.Calvelo-Aros, A Jaborska, C Chopin, B Boniface (2013), Multicentric study of monitoring alarms in the adult intensive care unit (ICU); a descriptive analysis. *Intensive Care Med* 1999;25:1360-6.
2. Emma Innes (May 2014). Too much exercise can be FATAL: Overdoing it increases risk of a heart attack or a stroke. Available: https://www.dailymail.co.uk/health/article-2628314/Too-exercise-bad-heart.html
3. S. Parr, C. Pound, S. Byng and B. Long (2012). Communication problems after stroke, Produced by the Stroke Association's Information Service. Available: stroke.org.uk
4. How stroke is diagnosed. 2017, Available: http://www.nasam.org/english/prevention-what_is_a_stroke.php.
5. Hemiplagia SpinalChord.com. 2017, Available: http://www.spinalcord.com/hemiplegia.
6. Preventing Another Stroke. 2017, Available: http://www.stroke.org/we-can-help/survivors/stroke-recovery/first-steps-recovery/preventing-another-stroke.
7. S.K. Kavuru (2015). Vital sign monitor with emergency control, California State University, Long Beach.
8. A.Hadjidj, M. Souil, A.Bouabdallah, Y.Challal & H.Owen. (2013). Wireless sensor networks for rehabilitation applications: Challenges and opportunities. *Journal of Network and Computer Applications*, 36(1), 1-15.
9. T.Klingeberg, & M.Schilling (2012). Mobile wearable device for long term monitoring of vital signs. *Computer methods and programs in biomedicine*, 106(2), 89-96.
10. N. Menachemi and T. H Collum (2011). Benefits and drawbacks of electronic health record systems, *Risk Manag Healthc Policy*. (4), 47–55.
11. R.Puviarasi, M.Ramalingam, and E.Chinnavan. Low cost self-assistive voice controlled technology for disabled people. *Int. Jour. Modern Engineering Research* 3.4: 2133-2138.
12. Dryvendra, D., Ramalingam, M., Chinnavan, E., & Puviarasi, P. (2015). A better engineering design: low cost assistance kit for manual wheelchair users with enhanced obstacle detection. *Journal of Engineering and Technological Sciences*, 47(4), 389-405.

AUTHORS PROFILE

Mritha Ramalingam has received her B. Eng. and M. Eng. degrees in Computer Science and Engineering. She has received her Ph.D. in Computer Engineering. She is the Chartered Engineer in Engineering Council, UK. Her research interests include embedded systems, biomedical sensor systems, steganography, cryptography, network security and computer networks.

R. Puviarasi received her PhD in Saveetha Institute of Medical and Technical Sciences in 2018 and completed M. E (Electrical Drives and Embedded Control) from Anna University Coimbatore in 201. Her research area includes Power Electronics, Renewable Energy systems and Robotics. She has published 70 papers in various indexed journals and 15 papers are presented in National/International conferences. She has received Inspiring Young Teacher Award 2017-18-IET CLN International Awards - IET on 29th Sep 2018 and Excellent Researcher award of RULA International Awards on 15th Aug 2018.

Elanchezhian Chinnavan has received his Master Degree in Physiotherapy specialized in Neurology. His research interests include Neurological, Musculoskeletal and Sports rehabilitation. He has passion towards design and modification of health care devices.

Nur Sofea Iznie Binti Johan is graduated in Bachelor of Computer Science from University Malaysia Pahang.