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IoT Based Health Monitoring & Fall Detection System

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Abstract— The term IoT encompasses everything connected to the internet, however it is progressively getting used to outline objects that discuss with one another. Health monitoring and fall detection using IoT advantages can improve the daily lifestyle of elderly people. In this paper, we present an IoT based health monitoring and fall detection system for elderly people [1]. The proposed architecture presents both health monitoring and fall detecting on together. For health monitoring, the health parameters are transferred using RFID signal [12]. Both the data for health monitoring and fall detection are then classified and analyzed. After that, the results are sent via Bluetooth, Server and GSM to the receiving device.

Index Terms— Health monitoring , Fall detection, Internet of things (IoT), Smart Device , Radio Frequency Identifier, Household paper skin.

1 Introduction

Today's generation is a generation which is pressed for time and that, arguably, has a lack of compassion. As a consequence of this negligence, the old and important are unfortunately forgotten. The establishments of aided care environments mushroomed as a results of this sinister trend. Beside a rapid growth in aging population there is conjointly a decrease within the population of caretakers [12]. The main purpose of our work is to reduce the death rate of the elderly people due to fall or lack of care. We propose a device to monitor health as well as to detect fall of elderly people. Our device will have household paper skin, which is made of household items such as aluminum foil, scotch tapes, sticky-notes, napkins and sponges. It contains humidity array, pressure array and temperature array to integrate body temperature, blood pressure, heart rate and skin hydration. Besides, our device will have Arduino Uno R3 microcontroller which will detect fall of a person [11]. Our device will work on the basis of a threshold value. If the value is within the range, it will not generate any kind of signal but if it crosses the limit it will definitely generate a danger signal as soon as possible and send it to the caretaker or the person who is in charge of the ill person so that immediate help can be given to him [4].

2 Methodology

In this system, we combine pressure, temperature and humidity sensors with flexible silicon integrated circuits on one singular Smart Watch type device [8]. Smart Watch can sense the body vitals of the carrier (body temperature, blood pressure, heart rate, and fall detection simultaneously and in real-time wise [5] [8].
A smart watch that contains a transmitter which includes thin household paper, accelerometer sensor, gyroscope sensor, IR sensor, RFID which path goes from Arduino Uno R3 microcontroller ADXL Accelerometer wireless Bluetooth module to receiver that's send data to Bluetooth module server but in emergency case SMS and email will be send to mobile phone by GSM module [9].

Our vision towards an autonomous wearable device is to replace the flexible printed circuit board with printed stretchable metal-interconnects on a low-cost paper platform, where careful integration and alignment of flexible processing units are performed through flip-chip technique [2] [7].

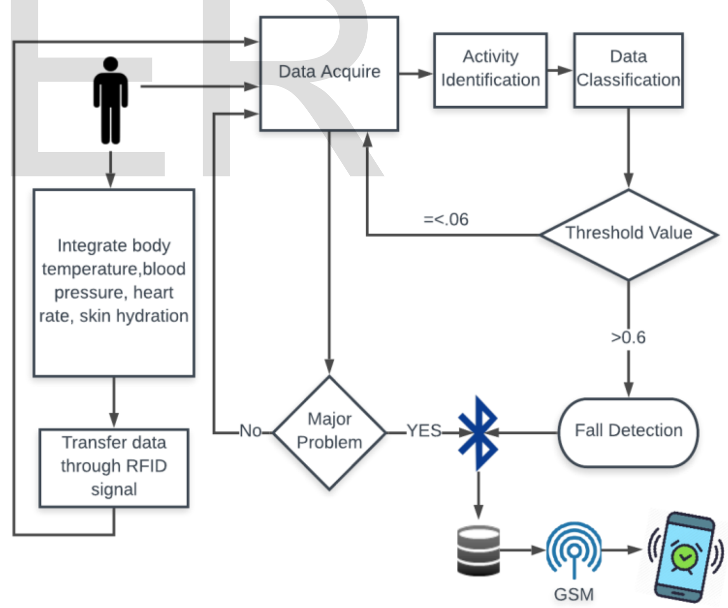

Figure 1: System Architecure for health monitoring and fall detection system.

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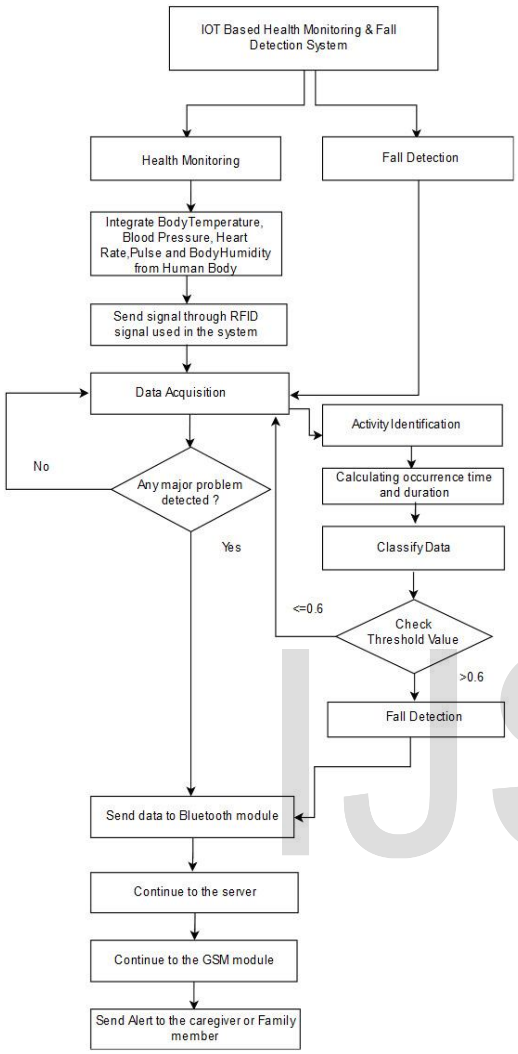
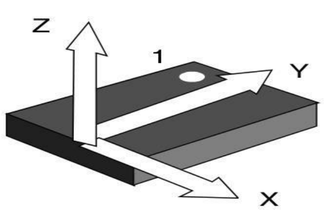
3 Flowchart for Fall Detection and Health Monitoring System



4 Algorithm for Fall Detection

In this system, accelerometers measure the acceleration, most likely due to motion of a body. If the accelerometer is fixed, only the gravity pulling down on it is sensed. The system detects linear acceleration along three perpendicular axes. In this situation if one was to sample the x, y and z axes data, they would get an accurate idea regarding the orientation of the object [4] [6].



The microcontroller receives analog values that are the acceleration quantities along each axis. In the above orientation X and Y-axis readings must be 0 as it is parallel to the ground while the Z-axis reading must be the maximum. In the above situation, the values in g's must be – **(0g, 0g, 1g)**. By using simple mathematical manipulation, it is to divide the corrected analog value by the maximum value [14].

We know, the net acceleration is the root of the sum of the squares of all 3 values.

$$\mathbf{A_{net}} = \sqrt{Ax2 + Ay2 + Az2}$$

In this way, net acceleration is an incredibly valuable quantity for fall detection. If a body undergoes free-fall, the phenomenon of weightlessness will occur.
In these parameters the final quantities of interest we obtain are those of orientation – **pitch and roll**.
Which is vital when it comes to detecting falls; these values give us an understanding of orientation of the user.

Finding out the pitch and roll angles, the acceleration along each axis can be used, along with a bit of trigonometry.

The equation,

$$\text{Pitch is } tan^{-1}\left(\frac{Ax}{\sqrt{Ay^2 + Az^2}}\right). \text{ Roll is } tan^{-1}\left(\frac{Ay}{\sqrt{Ax^2 + Az^2}}\right)$$

In this system, it is an extremely difficult process to generalize falls based on only two parameters. It is noted that including lying down, sitting, jumping, running, squatting etc. there in lies a major difficultly, because many of these actions give similar analog readings as that of falling case. In these phenomena, assigning simple thresholds will never do the job. For this reason, we have tried to create a series of checkpoints that must all be satisfied to conclude that a certain event is a fall.

Checkpoint 1: As there will be a fall in the A_{net} value when the fall commences. However, if the value goes below a specific threshold (in this case, 0.6g) it passes the first checkpoint.

Checkpoint 2: Happening the fall, the user makes impact with the ground or surface. As a result, A_{net} readings characterize this. In our purposes, we consider this issue as greater than 1g. And the checkpoints between time lag must be no greater than 2 seconds.

Checkpoint 3: We proposed that the pitch and roll of the user is checked and compared with a predefined threshold (In this case, greater than 60 degrees). In this time lag between checkpoint 2 and 3 must be very small – in the order of milliseconds.

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Checkpoint 4: Still now there is a good chance that the user has fallen. So, in that case, we check for a period of 4 seconds whether the user gets up, by setting a threshold on slant. If 4 seconds have elapsed, we can assume a fall has been sensed.

Checkpoint 5: Now we wait for a period of 30 seconds for the user to disable the alert, in case of false alarm. In this case, if 30 seconds have elapsed, we confirm the fall and required action is taken.

5 CONCLUSION AND FUTURE WORK

In this paper, we have provided a methodology, procedure and algorithms regarding smart device that works health monitoring and fall detection. In future we will differentiate and find out the more accurate and efficient algorithms technique which will help us to build a device. We will also reduce error rate and try to make this device very efficiency. Here, is our future device model that we will try to build.

Health of the patients are monitored using internet o things (IoT) and enables the doctor to monitor their patients outside the clinic and also apart their consulting hours. Connected health care devices utilize resources to provide an improved quality of care, leading to better clinical outcomes. Measureable benefits of connected medical devices include reduces clinic visits, including reduction in bed days of care and length of stays in hospitals. Using Internet of Things (IoT), patient conditions are obtained and stored for further analysis. In this project the heart rate and blood pressure patients are monitored [1] [7].

Due to the lengthening of life expectancy, society is aging, and more and more people live to an older age. Therefore, it is highly important to assure life quality and safety. Existing and emerging technologies can provide tools that can support elderly people in their everyday life, making it easy and safe. This paper concerns the design methodology of such tools especially for indoor and outdoor localization, health monitoring and fall detection.

From our work it is expected to monitor the whole body of the patient from remote location and improve the technology to world widely for patient monitoring by providing personalized and optimized services, it will promote a better standard of living. Nations across the world to improve patient care and IoT provides a timely and cost-effective response to those critical situations. Healthy and active people can also benefit from IoT-driven monitoring of their well-being, it also enables features for the aged persons who want only a monitoring device that can detect a fall or other interruption in every day activity and report it to emergency responders or family members.

In this paper, we have proposed such a model that will to replace the flexible printed circuit board with printed stretchable metal-interconnects on a low-cost paper platform. Our device will be more budget friendly and also user friendly at the same time than the previous devices.

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