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A Smart Phone Based Accident Fall Detection, Positioning and Rescue System

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***Abstract:** This paper proposes the architecture of accident fall detection, positioning, and rescue system that uses 3G networks. To perceive the fall detection algorithm, the angles acquired by the electronic compass and the waveform sequence of the tri-axial accelerometer on the smartphone are used as the system inputs. The obtained signals are used to produce an ordered feature sequence and then tested in a consecutive way by the proposed cascade classifier for identification purpose. As soon as an equivalent characteristic is confirmed by the classifier at the current state, it can continue to the state; contrarily the system will come back to the initial state and halt for the emergence of another feature sequence. When a fall accident event is diagnosed the victim's position can be acquired by global positioning system (GPS) and forwarded to the rescue center via a 3G network so that immediate medical help can be provided.With the proposed cascaded classification architecture, the computational burden and power consumption issue on the smartphone system can be mollified. Moreover, known fall incident detection accuracy and reliability up to 92% on the sensitivity and 99. 75% on the specificity.*

***Keywords:** Tri-axial Accelerometer, Electronic Compass, GPS, 3G Networks, Cascade Classifier.*

I. INTRODUCTION

Fall is a common phenomenon which can occur at any time or place to a person of any age. A fall is well capable of causing either major or minor injuries and if the victim is not given immediate medical assistance, he/she might end up into a very serious condition. The constant increase in injuries due to accidents and deaths due to unattended victims generated the necessity to create a fall detection algorithm, which could instantly detect a fall and provide medical aid without any delay. These systems were of mainly two kinds: either space-bound systems or wearable-sensor based. Space bound system had both its pros and cons. At one place it could monitor all the people who needed attention but on the other hand, it had the limitation of space. Only a confined place could be monitored and hence popped out the need to overcome this limitation and upgrade the system by removing the distance restriction barrier. Step by step we shall briefly discuss all the previous systems and then move on to a detailed study of our proposed system.

II. RELATED WORKS

As customary, the weak is always the primary recipient of assistance, and hence the first system was developed for the diseased people with the help of Ambient Intelligence (AmI), which was a new model in IT. Originally this technology was developed by Eli Zelkha in the 1990s which created an electronic environment which realizes the presence of humans and is responsive for the same, leading to the evolution of smart environment and wearable medical gadgets [1]. Furthermore, it was extended for the elderly section of the society using the ambient assisted living (AAL) tools [2]. With time, a reliable surveillance became a requisite in order to alleviate the consequence of fall. Fall detection approaches were classified into three types: - wearable, ambiance and vision based [3-4]. The latter composed of visual systems that extracted features from video recordings and set apart fall from normal activities. Camera's coverage plays an important role in the determination of fall. But using a number of cameras would lead to a rise in the complexity of the device [5-6]. Later, background subtraction was used to focus on the human body, whose results were enhanced using post-processing and were then fed into a vector machine to be used for posture classification to detect a fall (if any)[7]. One of the greatest advances in this system came with the introduction of MEMS sensor. As we can see in the following picture, falls can occur in any configuration or angles. It is never pre-defined and hence a sensor which can identify falls in any angle can significantly change the approach towards this project.

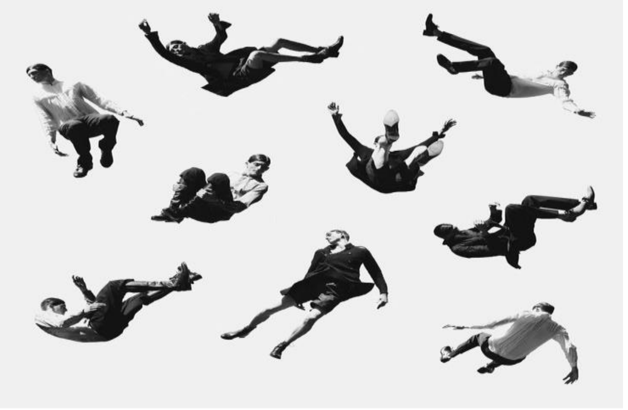

Fig.1 (a) Picturesque Representation of fall in Different Possible Angles

The next advancements were the inclusion of three-dimensional MEMS sensor or accelerometer. Along with it, it consisted of a micro-controller, gyroscope, a high-speed camera and a Bluetooth device. It documented the information of human motions and the gyroscope would identify lateral falls. It used the digital signal processing (DSP) technique along with the support vector machine (SVM) [14].

III. EXISTING SYSTEM

The existing system mainly focused on utilizing this system for elderly/diseased people, who were prone to falls and minor accidents at their homes. It used the MEMS accelerometer for determining the angle of the fall. Also, it utilized the GSM technology for sending of the alert messages.

Disadvantages of the existing system: a. it could not track the location of the fallen victim because of the absence of GPS technology.

b. The use of Bluetooth module limited the area of fall detection.

IV. PROPOSED SYSTEM

We are proposing a framework for accident fall detection, positioning, and rescue system that uses 3G technology. To perceive the fall detection algorithm, the angles acquired by the electronic compass and the waveform sequence of the tri-axial accelerometer on the smartphone are used as the system inputs. The obtained signals are used to produce an ordered feature sequence and then tested continuously by the proposed cascade classifier for identification purpose. Just as an equivalent characteristic is confirmed by the classifier at the current state, it continues to the state; contrarily the system comes back to the initial state and halts for the emergence of another feature sequence. When a fall accident event is diagnosed the victim's position can be acquired by global positioning system (GPS) and forwarded to the rescue center via a 3G network so that immediate medical help can be provided. The proposed system finds many applications, for example, it is useful not only for diseased and elderly but for people of all age group. Bike accidents which have been consistently highlighted in the newspapers can be identified using it. Not just this, small kids who might wander off somewhere suddenly and fall down and be identified and tracked with this device.

Advantages of proposed system: a. with the proposed cascaded classification architecture, the computational burden and power consumption issue on the smartphone system can be mollified.

b. Wireless sensor module called Zigbee is used which overcomes the limitations of the Bluetooth module.

c. GPS tracker is used to tracking the exact location of the fallen victim immediately.

V. FUNCTIONAL BLOCK DIAGRAM AND WORKING

Our entire model is divided into two parts: The transmitter and the receiver. The major components of the transmitter are Micro-controller unit (M.C.U), MEMS sensor, heartbeat sensor, Analog to digital converter (ADC) and a conscious switch. The receiver consists of the main station and the receiving devices (which are: a computer and cell phone). Universal Asynchronous Receiver Transmitter (UART) is a major transmitting and receiving component. The wireless sensor used by us is Zigbee. The block diagram depicting the various components is given:

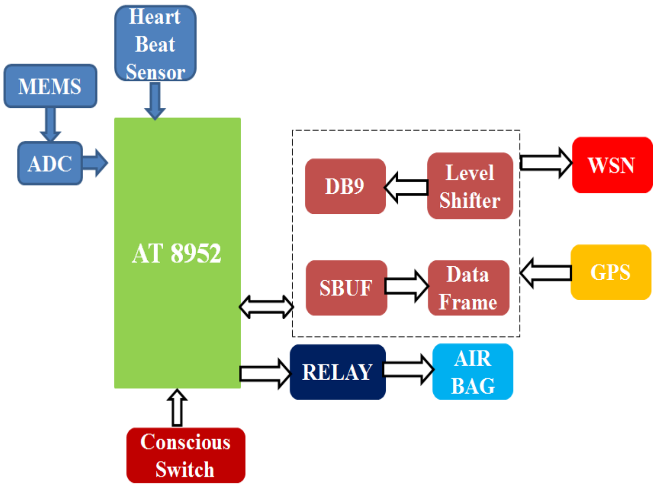

Fig.5 (a) Block Representation of the Transmitter Components

The MEMS sensor which stands for *Micro-electrical-mechanical-system* continuously records the angles at which the body is postured. As soon as a person falls, the angles change drastically. This change in the X, Y and Z axis is recorded and compared with the minimum and maximum values set by the developer. If the angles are below or above these threshold values, fall is confirmed and the signals are further sent to UART.

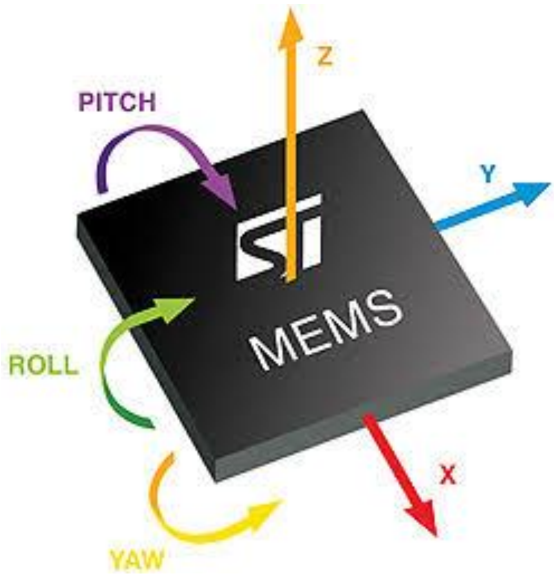

Fig.5 (b) Image Depicting the Angle Measurement by MEMS

The signals sent from the MEMS are analog and hence an analog to digital converter is used to transform those signals into digital values so that the M.C.U can accept and read them. The heartbeat rate is considered to lie between 60-100 bpm (bits per minute) for a normal human being. This rate is recorded by the heartbeat sensor which produces digital values that can be directly fed into the M.C.U. The heartbeat sensor makes use of the technique of light modulation of the flow of the blood through one's fingers. It constitutes the combined working of LED (light emitting diode) and LDR (light detecting resistor). The relay and a motor are used to make available the airbag in case of emergency situations. The DB9 and RS232 cables function as connectors in the entire system. The data is sent serially, one after another and this function is performed by the Serial Buffer (SBUF). The M.C.U is fed with programs written in embedded C language to define the proper working of all the components used in the system. The block diagram for the further process of reception is given as follows:

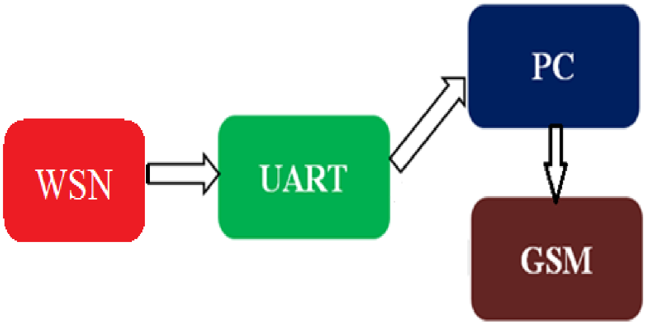

Fig.5 (c) Block Representation of the Receiver Components

The WSN, UART, PC and the GSM make the receiver side. A wireless sensor network (abbreviated as WSN) is made up of vastly scattered autonomous devices, providing wireless connectivity of them to each other. A universal asynchronous receiver/transmitter (abbreviated as UART) is specifically used for asynchronous serial transmission. UART is chosen when the transmission speed and the data format are to set manually according to the developer's needs.

Fig.5 (d) Integrated circuit of Zigbee data transfer pair for transmission and reception

As the signal arrives at the Zigbee receiver informing that a fall has taken place, the GSM circuit instantly sends an alert message to the numbers fed into the system memory. We are using Tracker software which is installed on our computer. The software depicts the perfect location on a map using the GPS technique and displays the latitude and longitude values of the place where the victim has fallen down. Along with it, it also displays the heartbeat rate and the X, Y and Z angle values of the fall. GPS stands for Global Positioning System and is a radio-navigation technique which is capable of providing a geographical location to any GPS receiver. A user does not need to send any data. The only problem with GPS is that its function demands a continuous L.O.S (line of sight) connection to any 4 GPS satellites. At last, the whole is process is terminated after sending the location of the fall incident to the concerned people.

RESULT

In our proposed system, we have obtained results for three devices, which are: LCD display screen, Tracker software on the computer/main station and cell phone. The following photo represents the LCD display at the time of No-Fall. It displays the X-Y and X axis values.

Fig.7 (a) Image showing the LCD display before fall

Fig.7 (b) Image showing the LCD display after fall has taken place

The following image captures the LCD display at the time of fall. Along with the values of X, Y and Z axis, the heartbeat rate if also recorded and displayed. The below image is a screen shot of the Tracker software on the computer screen at the time of No-Fall event.

The below image captures the display of the tracker software's screen after the fall event has taken place.

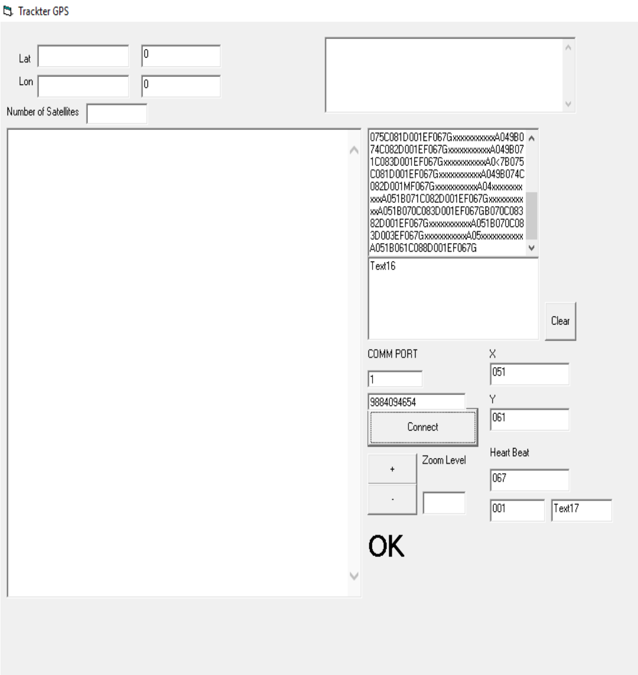

Fig.7 (c) The display screen on the tracker before fall

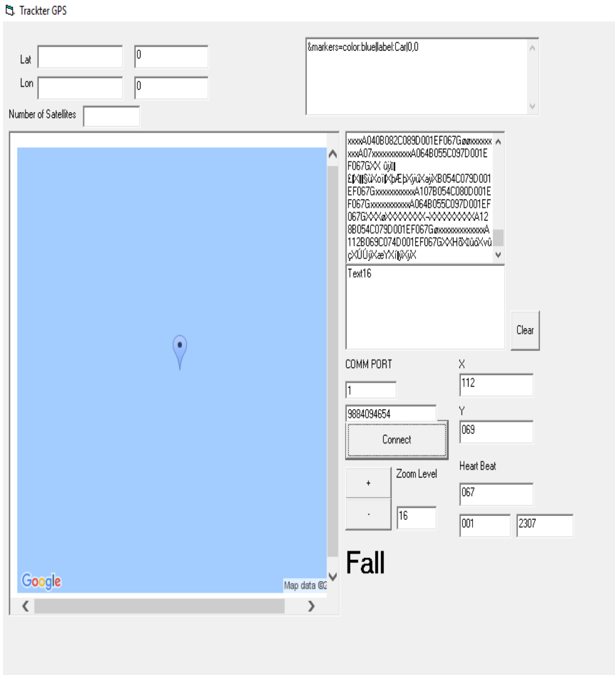

Fig.7 (d) The display screen on the tracker after fall

The following image is a screenshot depicting the successful reception of the alert message on the registered phone number.

Fig.7 (e) Screenshot depicting the reception of a text message on the cell phone upon the fall detection.

VI. FUTURE SCOPE

This project is highly versatile in a number of fields where it can be used to perform varied functions. For instance, this system can be used in old age homes, in offices, on roads while riding or traveling, etc. In the coming days, the project can be altered in varies ways to suit its applications. To make it completely wearable, Nano-sized components can be used which would make it very easy to carry this device across the globe. We have used 3-G technology in proposed system but in future 4-G and 5-G networks can be used to make it all the more efficient.

CONCLUSION

This concludes that the present work was a success and it will provide an efficient method for fall detection, positioning, and rescue system and help people all over the world who are prone to accidents. In a country like India where accidents are very common due to the violation of traffic rules, a product like this can serve in immediate rescue to the fall victims by sending instant rescue alert to the nearby hospital and concerned relatives.

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REFERENCES

[1] G. Acampora, D. J. Cook, P. Rashidi, A. V. Vasilakos, "A Survey on Ambient Intelligence in Healthcare", Proceedings of the IEEE, pp. 2470-2494, Vol. 101, No. 12, Dec. 2013.

[2] P. Rashidi, A. Mihailidis, "A Survey on Ambient-Assisted Living Tools for Older Adults", IEEE Journal of Biomedical and Health Informatics, pp. 579-590, Vol. 17, No. 3, May 2013.

[3] M. Mubashir, L. Shao, and L. Seed "A survey on fall detection: Principles and approaches", Neurocomputing, Vol. 100, No. 16, pp. 144-152, 2013.

[4] T. Shany, S. J. Redmond, M. R. Narayanan, N. H. Lovell, "Sensors-Based Wearable Systems for Monitoring of Human Movement and Falls", IEEE Sensors Journal, pp. 658-670, Vol. 12, No. 3, March 2012.

[5] B. Mirmahboub, S. Samavi, N. Karimi, S. Shirani, "Automatic Monocular System for Human Fall Detection Based on Variations in Silhouette Area", IEEE Trans. Biomedical.

[6] Miao Yu, Yuanzhang Yu, A. Rhuma, S. M. R. Naqvi, Liang Wang; J. A. Chambers, "An Online One Class Support Vector Machine-Based Person-Specific Fall Detection System for Monitoring an Elderly Individual in a Room Environment", IEEE Journal of Biomedical and Health Informatics, pp. 1002-1014, Vol. 17, No. 6, Nov. 2013.

[7] Miao Yu, A. Rhuma, S. M. Naqvi, Liang Wang, J. Chambers, "A Posture Recognition-Based Fall Detection System for Monitoring an Elderly Person in a Smart Home Environment," IEEE Trans. Information Technology in Biomedicine, pp. 1274-1286, Vol. 16, No. 6, Nov. 2012.

[8] E. Auvinet, F. Multon, A. Saint-Arnaud, J. Rousseau,
   a. J. Meunier, "Fall Detection With Multiple Cameras: An
   b. Occlusion-Resistant Method Based on 3-D Silhouette Vertical Distribution", IEEE Trans. Information Technology in Biomedicine, pp. 290-300, Vol. 15, No. 2, March 2011.

[9] C. Rougier, J. Meunier, A. St-Arnaud, J. Rousseau, "Robust Video Surveillance for Fall Detection Based on Human Shape Deformation", IEEE Trans. Circuits and Systems for Video Technology, pp. 611-622, Vol. 21, No. 5, May 2011.

[10] Li, K. C. Ho, M. Popescu, "A Microphone Array System for Automatic Fall Detection", IEEE Trans. Biomedical Engineering, pp. 1291-1301, Vol. 59, No. 5, May 2012.

[11] A. Ariani, S. J. Redmond, D. Chang, N. H. Lovell, Simulated Unobtrusive Falls Detection With Multiple Persons", IEEE Trans. Biomedical Engineering, pp. 3185- 3196, Vol. 59, No. 11, Nov. 2012.

[12] M. Mercuri, P. J. Soh, G. Pandey, P. Karsmakers, G. A. E. Vandenbosch, P. Leroux, D. Schreurs, "Analysis of an Indoor Biomedical Radar-Based System for Health Monitoring", IEEE Trans. Microwave Theory and Techniques, pp. 2061-2068, Vol. 61, No. 5, May 2013.

[13] H. Rimminen, J. Lindstr¨om, M. Linnavuo, R. Sepponen, "Detection of Falls Among the Elderly by a Floor Sensor Using the Electric Near Field", IEEE Trans. Information Technology in Biomedicine, pp. 1475-1476, Vol. 14, No. 6, Nov. 2010.

[14] Guangyi Shi, Cheung-Shing Chan, Wen-Jung Li, Kwok- Sui Leung, Yuexian Zou, Yufeng Jin, "Mobile Human Airbag System for Fall Protection Using MEMS Sensors and Embedded SVM Classifier", IEEE Sensors Journal, Vol. 9, No. 5, pp. 495-503, May 2009.

