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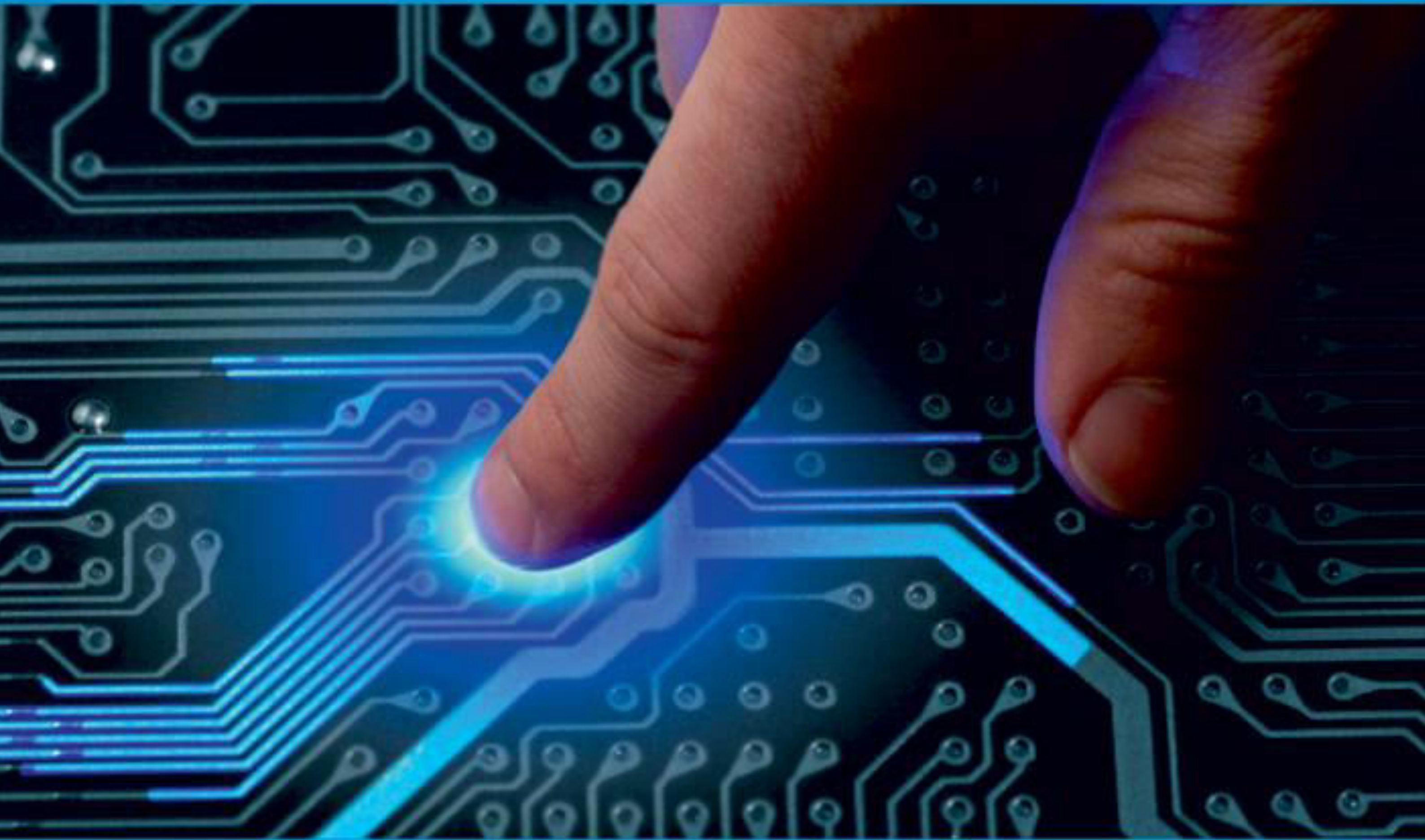

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Posture Recognition and Fall Detection System

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ABSTRACT: In current societies are struggling with the increase of aged populace whilst at the equal time social security and fitness charges should be reduced. to be able to avoid the need for unique care facilities, the real fashion is to inspire the elderly to live dwelling autonomously in their very own homes for as long as possible. The project presented in this paper contributes to this objective since it provides user localization, automatic fall detection, and activity monitoring both for indoors and outdoor activities, associated with a complete call center for medical monitoring of the patient as well as to provide support and manage emergency situations.

KEYWORDS: Bluetooth, Arduino board, ATmega328P, ADXL 335.

I. INTRODUCTION

In recent years, many types of consumer electronics devices have been developed for home network applications. A consumer home network usually contains various types of electronic devices, e.g. sensors and actuators, so that home users can control them in an intelligent and automatic way to improve their quality of life [1]. a few consultant technologies to put into effect a home community encompass IEEE 802. eleven, ultra huge Band (UWB), Bluetooth and ZigBee, etc. ZigBee is appropriate for consumer domestic networks because numerous sensors can be deployed to collect home statistics facts in an allotted, self-organizing manner with highly low energy. a few common packages encompass home automation, domestic hobby detection (like fall detection), and domestic healthcare, etc. The population of sixty-five-and-over elderly human beings in the developed nations will technique 20% of the whole populace in the next 20 years and will manifestly turn out to be a critical healthcare difficulty in the close to destiny. In China alone, the population over the age of 60 years old is 133.9 Million [7]. Among the elderly, fall events can be an unpredictable and dangerous event. information display that one in 3 65-and-over-elderly individuals falls each year. Among these fall events, 55% occur at home and 23% occur near the home. In 2003, the global number of deaths caused by fall events was approximately 391,000, and specifically, 40% of the falls were from people over 70 years of age [7]. hence, dependable client-primarily based fall detection structures want to be designed, examined, and commercially deployed to international locations everywhere in the global. Furthermore, the cost of healthcare is highly related to the response and rescue time and can be greatly reduced by fast detection and delivery of signals to the specified operator for immediate consideration [2]. Thanks to the development of wireless sensors and low-power sensor nodes, many novel approaches have been proposed to solve the problem, as discussed in Section 2.

in this paper, a greater fall detection device for the elderly individual tracking via a wearable is proposed based totally on smart sensors that are worn on the body. The proposed system has been deployed in a prototype system and tested within different situations of falls, it is found that the system can achieve very high accuracy of 97.5%, and the sensitivity and specificity are 96.8% and 98.1% respectively.

II. LITERATURE REVIEW

Many preceding and cutting-edge research initiatives use clinical sensor networks to identify and tune human sports in day-by-day existence. The reason to effectively discover falls, there are often 3 forms of fall detection methods for aged humans, particularly wearable device primarily based methods, vision primarily based methods, and ambient based totally strategies.

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A. Wearable Based Methods

Wearable-based methods often rely on smart sensors with embedded processing. They can be attached to the human body or worn in their garments, clothing, or jewelry. Zhang, Ren, and Shi [3] proposed HONEY (Home healthcare sentinel system), a three-step detection scheme that consisted of an accelerometer, audio, image, and video clips. Its innovation was to detect falls by leveraging a tri-axial accelerometer, speech recognition, and on-demand video. In HONEY, once the autumn event became detected, an alert email become without delay despatched and the autumn video changed into uploaded to the network garage for further research.

Bagalà et al. [4] gave an evaluation of accelerometer-based fall detection algorithms on real-world falls. They found that the sensitivity and specificity of real falls are much lower than that in an experiment environment. This conjures up researchers to take extra real-global situations into consideration.

Abbate et al. [5] proposed a smartphone-based fall detection system with consideration of the acceleration signal produced by fall-like activities.

B. Vision-Based Methods

Vision-based methods are always related to spatiotemporal features, changes in shape, and posture. Yu et al. [8] proposed a vision-based fall detection method by applying background subtraction to extract the foreground human body and post- processing to improve the result. To discover a fall, information became fed into a directed acyclic graph aid vector machine for posture popularity. This device mentioned a high fall detection rate and occasional false detection charge.

Rougier et al. [10] analyzed human shape deformation during a video sequence that is used to track the person's silhouette.

C. Ambient Based Methods

Ambient-primarily based methods generally rely upon strain sensors, acoustic sensors, or even passive infrared motion sensors, which can be commonly applied around caretakers' houses. the autumn detection sensors are linear arrays of electret condensers positioned on a pre-amplifier board. in order to capture the records of the sound top, the sensor array becomes positioned inside the z-axis. The trouble with this method was that the best character became allowed in the vicinity.

Video-based totally methods are commonly extra correct than wearable based and ambient based totally methods. however, these systems frequently are afflicted by the high threat of privacy and the prohibitive cost of imposing the cameras. as a consequence, wearable sensor-based strategies are considered in this study.

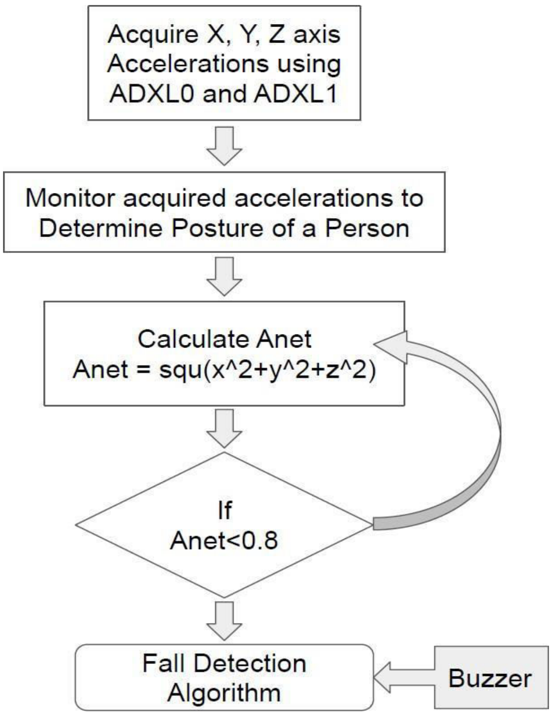

FIGURE1: Flow Chart of Proposed System

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III. PROPOSED SYSTEM

In this project conditions related to falls are detected and analyzed in order to substantiate falls. For this purpose acceleration variations and orientation, changes occur after the fall also the vital signs variations are also detected. The temperature and heartbeats of an individual vary according to different situations which are faced by the body. When a fall occurs then after the temperature of a person's body may increase due to a shocking state or may decrease due to a severe injury so does the heartbeat. Also, the posture of the person is detected in order to determine the response of the elderly person. The proposed system is well explained in figure 1.

IV. METHODOLOGY

The system takes the decision regarding sending the alert based on the following factors:

A. Posture Recognition:

a. Posture Estimation:

Here a posture of a person is estimated by using two ADXL335 which are mounted at one on the thigh and one exactly beneath the knee. Using these accelerometers the gravity felt by a person is being monitored. In this for different postures gravity felt is different in different axises.

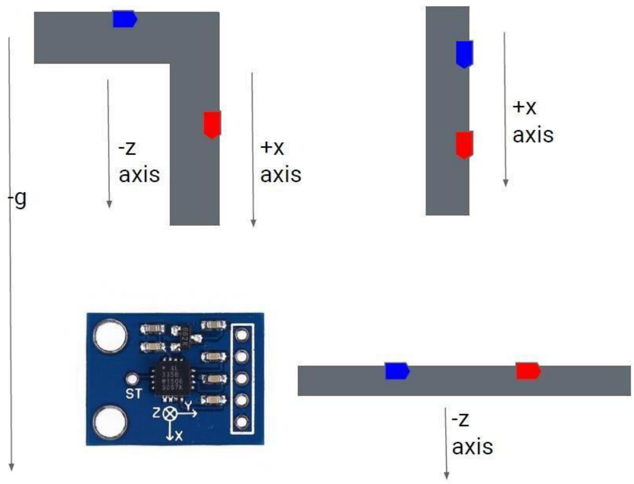

FIGURE 2: Sensor Configuration

The ADXL335 was first to be calibrated in order to obtain a configuration of (0, 0, 1) in (x, y, z) axis respectively. Figure 2 shows how the configuration varies according to different postures. When a person is sitting only then gravity felt by both the ADXls is in the positive X-axis, while when a person is sitting the gravity felt by the below ADXL is in in positive X-axis only but gravity felt by the ADXL just above it is in negative Z-axis. Also from the figure, one can figure out the gravity felt when a person is sleeping.

In this way by taking the assistance of gravity one can figure out the posture. This posture plays an important role in order to describe the physical condition of an elderly person at a point. It also helps to describe if an elderly person was performing daily activities in normal ways or not.

b. Health Abnormality Detection:

A fall may or may not cause harm to an elderly person, it is estimated by monitoring moments of a person after the fall which is derived from a posture of a person, if a person has been harmed by a fall then the movements of a person will reduce drastically otherwise they will tend to be regular.

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B. Fall Detection:

Accelerometers degree the acceleration, maximum probably due to the motion of a body. however, whilst the accelerometer is fixed, best the gravity knocking down on it is sensed. The tool detects linear acceleration alongside three perpendicular axes. If one changed the pattern of the x, y, and z axes information, they would get a correct idea regarding the orientation of the object. The analog values that the microcontroller gets are the acceleration quantities along each axis. however, one has to first calibrate their device to make sure accuracy maintains the device in a position such as the only proven inside the determine. We understand that each X and Y- axis reading must be 0 as it is parallel to the floor even as the Z- axis studying needs to be the most. adjust the correcting element to gain this. In the above orientation, the values in g's must be

– (0g, 0g, 1g). simple mathematical manipulation tells us to divide the corrected analog value by the maximum price. accordingly, we've correctly converted the voltage values into g's values. The internet acceleration is the foundation of the sum of the squares of all 3 values.

$$Anet = \sqrt{Ax^2 + Ay^2 + Az^2}$$

net acceleration is a really valuable amount for fall detection. whilst a frame undergoes loose-fall, the phenomenon of weightlessness will arise. This implies that during a fall, the Anet will tend towards 0g. it's miles proper and regular fall isn't like free-fall, but Anet will nonetheless be drastically lesser than 1g. The very last portions of interest we obtain are the ones of orientation – pitch and roll.

Checkpoint 2: Following the fall, the user makes an impact on the ground or surface. a pointy spike inside the Anet readings characterizes this. For our purposes, we consider this as greater than 1g. The time lag between the checkpoints must be no greater than2 seconds.

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

Checkpoint 4: there may be now a great threat that the user has fallen. We now check for a period of 3 seconds whether the user gets up, by setting a threshold on inclination. If 3 seconds have elapsed, we will expect a fall has been sensed.

Checkpoint 5: We now wait for a period of 20 seconds for the user to disable the alert, in case of a false alarm. If 20 seconds have elapsed, we affirm the autumn, and required action is taken.

c. Data Acquisition:

$/\sqrt{Ay^2 + Az^2}$ $/ Ax^2 + Az^2$

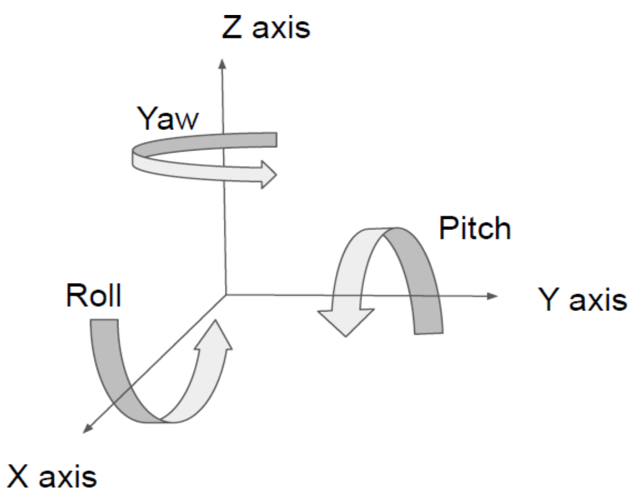

FIGURE3: Orientation of Object

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Accelerometer ADXL335 senses the acceleration in all the 3 axes. To determine, the thresholds user walks for a while and falls for a while to collect different samples of the accelerometer. And these samples are future analyzed to determine the characteristics to determine whether the data collected is classified as a fall or as a normal movement data.

b. Algorithm:

To safely conclude that a given action is a fall, you must eliminate the other activities of daily life. These include mendacity down, sitting, jumping, running, squatting, hopping, and so forth. Therein lies a major difficulty, because many of these actions give similar analog readings as that of falling. hence assigning easy thresholds will in no way do the job. What I have done is create a series of checkpoints that must all be satisfied to conclude that a certain event is a fall.

c.Data Acquisition:

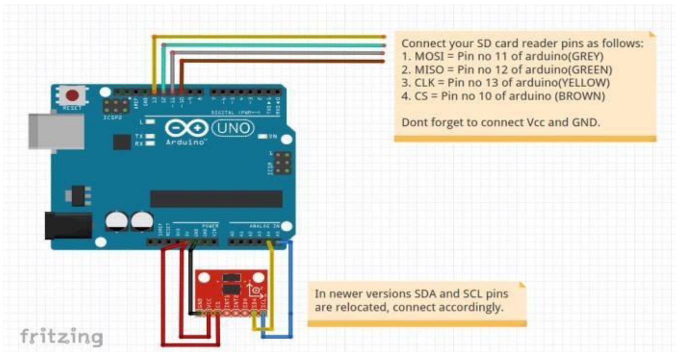

FIGURE4: Acquisition System

<u>Checkpoint 1:</u> As elucidated in the previous section, there will be a fall in the Anet value when the fall commences. Thus if the value goes below a specific threshold (in this case, 0.8g) it passes the first checkpoint.

There is no net force on the person in a balanced position, and the person would remain at rest indefinitely. If the fall happens, then the Normal force exerted by the floor on a person no longer acts on the object; the person is subjected to a single force, the gravitational attraction of the earth. Since there is no initial air resistance, the person begins to free fall and accelerates. But as the person's velocity increases, it encounters air resistance, or drag, which opposes the motion. The value of the drag relies upon the rectangular velocity. The drag increases till it is equal to the weight. At that point, there is again no net external force on the person, the acceleration goes to zero, and the person falls at a constant terminal velocity. The magnitude of the terminal pace relies upon the relative magnitude of the load, the drag coefficient, the air density, and the dimensions of the item. So due to all of this net acceleration acting on a person during a fall is less

and is given by:

$$A_{net} = g_{gravity} - A_{drag}$$

; $where\ A_{drag}$ a V^2

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E. Visualization System:

To give a wireless functionality Bluetooth is used in a prototype. When a fall happens an alarm is triggered which tones the buzzer at the same time. But to visualize the posture of a person an Android App is used in order to synchronize it with Bluetooth used in the prototype to see the messages which are coming from the device constantly in order to recognize the posture of a person.

FIGURE 5: Overall System

Further development plans of this android application include support of a cloud platform so as to share the data of an elderly person's movements with a responsible person like relatives or a doctor so that the elderly person would get appropriate assistance after the fall.

V. SIMULATION AND RESULTS

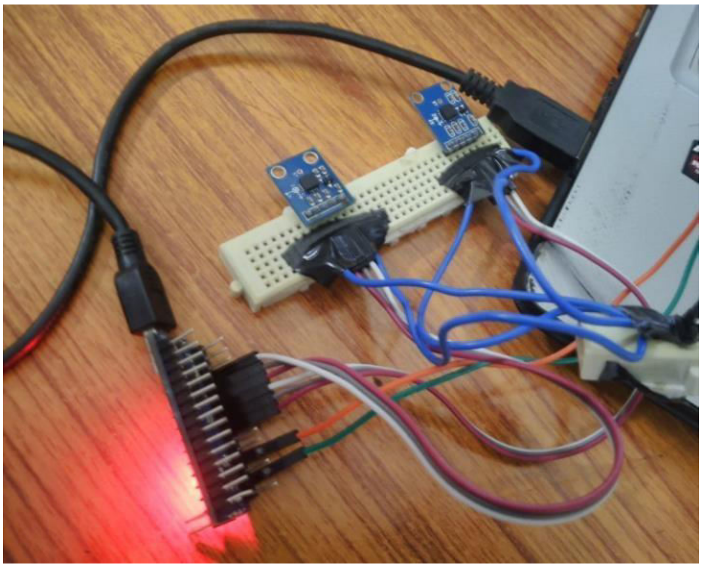

FIGURE 6: Calibrating Sensors

Activity	No of Tests	Fall Detected	Not Detected
Front Fall	5	5	0
Backward Fall	5	5	0
Side Right Fall	5	5	0
Side Left Fall	5	5	0
Sitting	5	0	5
Jumping	5	0	5

TABLE 1: Fall Detection Test Results

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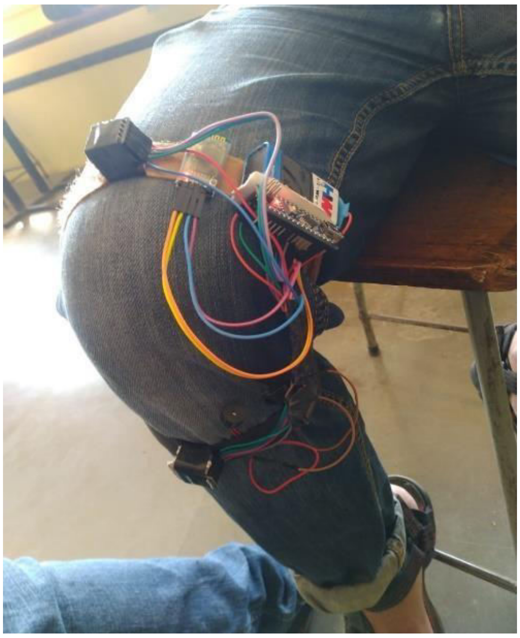

FIGURE 7: Prototype Model

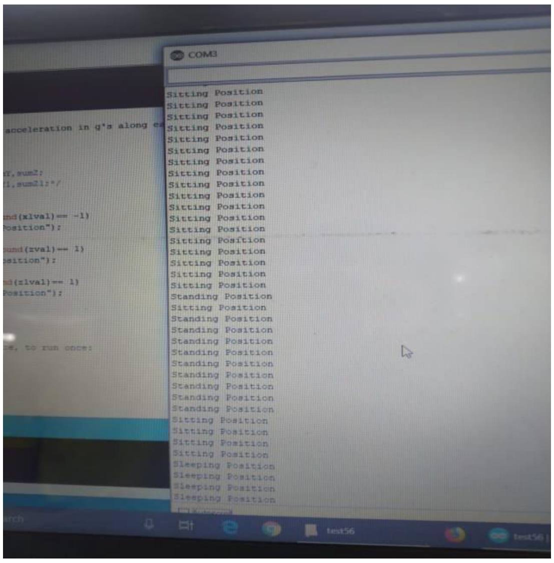

FIGURE 8: Results on Serial Monitor

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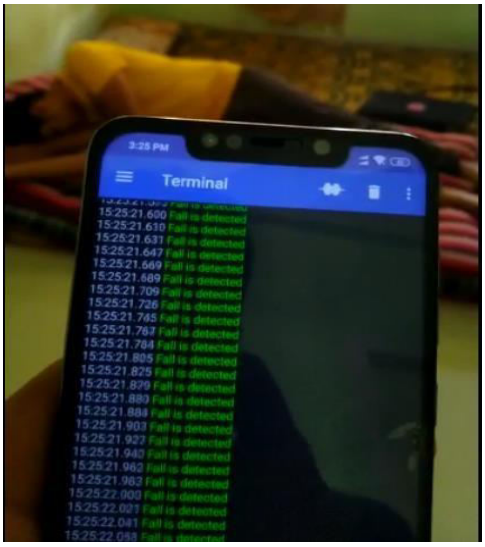

FIGURE 9: Fall detection

VI. CONCLUSION

An Accelerometer which is used to get acceleration values in X, Y, and Z directions was used.

The key objective of developing this project with the help of Sensors is to immediately alert Medical Emergency about the health condition of the patient in case of an unnoticed fall. We are developing a prototype of this system using the continuous monitoring of parameters to detect and predict the accident and generate an alarm. The buzzer will turn ON when a fall is detected. This objective is met by measuring the accelerometer output it's miles helpful in which non-stop tracking is needed below crucial circumstances. In addition, it is a very usable device due to its portability and ease of wearing.

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REFERENCES

1. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless sensor networks: a survey,"Journal of Computer Networks, vol. 38, no. 4, pp. 393- 422, March 2002.
2. M. Mubashir, L. Shao, and L. Seed, "A survey on fall detection: Principles and approaches,"Neurocomputing, vol. 100, no. 16, pp. 144-152, Jan.2013.
3. Q. Zhang, L. Ren, and W. Shi, "HONEY a multimodality fall detection and telecare system,"Telemedicine and e-Health, vol. 19, no. 5, pp. 415-429, Apr. 2013.
4. Bagalà, C. Becker, A. Cappello, L. Chiari, and K. Aminian, "Evaluation of accelerometer-based fall detection algorithm in real-world falls," PLoS ONE, vol. 7, no. 5, pp. 1-8, May 2012.

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| DOI: 10.15680/IJIRCCE.2023.1102032 |

5. S. Abbate, M. Avvenuti, G. Cola, P. Corsini, J.V. Light, and A. Vecchio, “Recognition of false alarms in fall detection systems,” in Proc. 2011 IEEE Consumer Communications and Networking Conference, Las Vegas, USA, pp. 23-28, Jan. 2011.
6. Y.W Bai, S.C. Wu, and C.L. Tsai, “Design and implementation of a fall monitor system by using a 3-axis accelerometer in a smart phone,” IEEE Trans. Consumer Electron., vol. 58, no. 4, pp. 1269-1275, Nov. 2012.
7. WHO, “The injury chart-book: a graphical overview of the global burden of injury,” Geneva: WHO, pp. 43-50, 2012.
8. M. Yu, A. Rhuma, S. Naqvi, L. Wang, and J. Chambers, “A posture recognition-based fall detection system for monitoring an elderly person in a smart home environment,” IEEE Trans. Infor. Tech.Biom., vol. 16, no. 6, pp. 1274-1286, Aug. 2012.
9. M. Popescu, Y. Li, M. Skubic, M. Rantz, “An Acoustic Fall Detector System that Uses Sound Height Information to Reduce the False Alarm Rate”, in Proc. 30th Int. IEEE Eng. in Medicine and Rougier, J. Meunier, A.S. Arnaud, and J. Rousseau, “Robust video surveillance for fall detection based on human shape deformation,” IEEE Trans. Circ. Syst. for Video Tech., vol. 21, no. 5, pp. 611-622, May 2011.

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