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Alert System for Fall Detection

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Abstract: Healthcare is one of the most important industries, yet new ideas must travel a long way before being fully adopted due to its complexity, scope of duty, and stringent laws. The Internet of Things (IoT) may be the key to resolving healthcare challenges. The Internet of Things (IoT) has a lot of potential in healthcare, but it's still in its early stages. With the advancement of medical IoT, new possibilities for telemedicine, remote monitoring of a patient's status, and much more will emerge. Falling is a significant health danger for the elderly. If the problem is not detected in a timely manner, it can result in the death or impairment of the elderly, lowering their quality of life. Falls are a major public health concern for the elderly around the world. When it comes to old age, we must keep an eye on our loved ones to ensure their health and safety. It is therefore critical to determine if an elderly person has fallen so that help can be provided promptly. Proposing a person fall detection system based on a wearable device for detecting the falls of people in every situation, which takes advantage of low-power wireless sensor networks, smart devices, and analyses human body motions. The system detects movement using an accelerometer and a gyro sensor. The sensor is wired to a microprocessor, which transmits the acceleration data continuously. Fall detection and sudden movement changes in the person would be monitored by the system. The sensors are getting values from a quick movement shift with shock in the system. When a person falls and becomes unconscious, the system determines whether the person has indeed fallen. If the person has truly fallen, the system will send an alert to the caregivers and sound an alarm to alert anyone nearby. When the system detects that a person has fallen, it immediately sends an alert to the individual's care takers. It is an IoT-based fall detection system that assists people by telling their caregivers about their fall so that quick attention may be drawn to the situation and essential actions can be taken to save the person who has fallen.
Keywords: Threshold Based Fall Detection, Arduino, Bi-Axial, Accelerometer, Gyroscope,

I. INTRODUCTION

Elderly falls almost invariably result in major health problems, as well as a loss of physical fitness. The most common damage in an elderly person's fall is a fracture, but there's also a chance of coma, paralysis. It is currently important to determine whether an adult has fallen in order for medical assistance to be delivered in a timely manner. Medical attention must be offered immediately in order to limit the danger of older persons being injured as a result of a fall. Making a system to warn when a fall occurs is advantageous since it provides peace of mind to the user and their loved ones. A gyroscope and an accelerometer are commonly used in fall detection systems. An accelerometer offers information on the angular parameter as two-axis data, while a gyroscope is utilized to detect orientation. However, we must set a threshold for the system to distinguish between a fall and normal activity. This internet-connected IoT gadget can communicate with four modules: an accelerometer, a gyro sensor, a buzzer, and a Node mcu. The user holds the produced device in his or her hand. The accelerometer data from the surrounding environment is continuously collected by the client device. The sensor is wired to a microprocessor, which transmits the acceleration data continuously. Fall detection and sudden movement changes in the person would be monitored by the system. The sensors are getting values from a quick movement shift with shock in the system. When a person falls and is knocked out, the system determines if the person has truly fallen or not. If the person has indeed fallen, the system will send an alert to the caretakers and sound an alarm to alert nearby people.

II. LITERATURE SERVEY

Inadvertent falls to the ground or a lower level as a result of a sustained blow, loss of consciousness, or health-related concerns, according to the Kellogg International Working Group. Unintentional posture changes cause patients to fall to the ground, floor, or other lower surface, according to Moylan and Binder. According to Liu and Cheng, a fall is defined as an event in which a body's center of gravity rapidly decreases. A fall's impact and consequences can vary greatly based on a variety of factors. Falling when walking, standing, sleeping, or sitting in a chair, for example, has certain qualities in common but also has substantial distinctions. The varieties of can be divided into three categories: forward, lateral, and backward. Split is a term that encompasses a wide range of concepts. forward, backward, left-side, right-side, blinded-forward, and blinded-backward, and falls are divided into more specific categories such as fall lateral left lie on the floor, fall lateral left and sit up from the floor, fall lateral right and lie on the floor, fall lateral and left sit up from the floor, fall forward and backward and lie on the floor, and fall forward and backward and sit up from the floor.

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Aside from the direction in which one falls, the duration of the fall is also essential, this can be determined by age, health, and physical condition, as well as any consequences of the individual’s activities. Elderly persons are more likely to fall for longer periods of time.as a result of low-speed motion in day-to-day activities an elderly person might, for example, try to rest against a wall before lying down on the floor if they are fainting or experiencing chest pain. A senior person may fall suddenly in different scenarios, such as injuries caused by impediments or harmful environments. The kinematics of falls are also influenced by the subject's age and gender. In most of the work on fall detection assessed, the features of different types of falls are not taken into account. Most of the publications published so far include data sets that only include falls simulated by young and healthy volunteers and do not include all of the types of falls discussed above. As a result, the models that emerge from such investigations do not generalize well enough in real-world situations.

Falls are a huge public health issue all around the world. Each year, an estimated 684 000 people die as a result of falls, making it the second highest cause of unintentional injury mortality behind traffic accidents. Over 80% of fall-related deaths occur in low- and middle-income nations, with 60 percent of these deaths occurring in the Western Pacific and Southeast Asia. Adults over the age of 60 have the highest death rates in every region of the world. Every year, roughly 37.3 million falls serious enough to require medical attention occur, despite the fact that they are not fatal. Each year, falls cause nearly 38 million DALYs (disability-adjusted life years) to be lost globally, resulting in more years of impairment than transportation injuries, drowning, burns, and poisoning combined. While minors account for over 40% of all DALYs lost due to falls worldwide, this figure may underestimate the burden of fall-related disabilities on elderly people who have less life years to lose. Furthermore, those who fall and become disabled, particularly the elderly, are at a high risk of needing long-term care and institutionalization. The financial expenses of injuries caused by falls are significant. In the Republic of Finland and Australia, the average health-care cost per fall injury for adults 65 and older is US$ 3611 and US$ 1049, respectively. According to evidence from Canada, implementing effective preventative techniques and resulting in a 20% reduction in the incidence of falls among children under the age of ten could result in a net savings of more than US$ 120 million per year.

III. PROPOSED SYSTEM

Proposing a system that uses a fall detection algorithm to reduce false alarms. This algorithm is used to determine whether a person has truly fallen and to avoid false alarms. And also send the alert message when person was fall.

IV. FLOW CHART OF FALL DETECTION

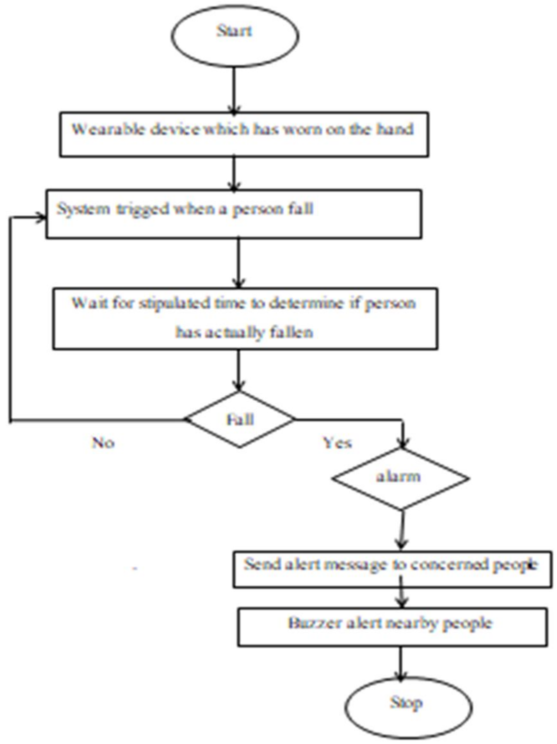

Figure 1. Flow chart of fall detection system

Figure 1 illustrates that when the system starts, The user wear device in his or her hand. The accelerometer data from the surrounding environment is continuously collected by the client device. The sensor is wired to a microprocessor, which transmits the acceleration data continuously. Fall detection and sudden movement changes in the person would be monitored by the system. The sensors are getting values from a quick movement shift with shock in the system. When a person falls and is knocked out, the system determines if the person has truly fallen or not. If the person has indeed fallen, the system will send an alert to the caretakers and sound an alarm to alert nearby people

V. DESIGN METHODOLOGY

Using hardware devices such as Arduino, Node MCU chips, Mpu6050 sensors. An intelligent system based on the Internet of Things is introduced to the person really fall or not in real time. Arduino is connected to all sensors. Figure 2 shows how the connection process.

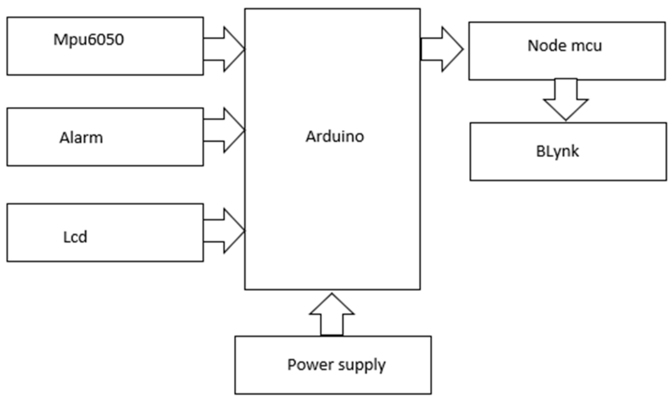

Figure 2: Block Diagram

VI. IMPLEMENTATION

A. Resource Components used for Implementation

1) Arduino
2) Mpu6050
3) Buzzer
4) Nodemcu
5) Lcd

B. Threshold Based Fall Detection

Threshold-based approaches function by extracting features from motion data and determining a threshold value that is only reached during falls. The method entails recording data during falls and determining the lowest threshold that captures all of them. Finding a feature that gives adequate performance is a vital component of building TBM fall detection. The acceleration's norm is one of the easiest features to extract. The gravitational pull is generally felt by the system's wearer. The gravitational pull is missing when a person falls, and the descent can be detected. A review of accelerometer-based TBM systems was conducted. In a supervised laboratory context, they discovered that the performance of these systems had a sensitivity of 90-100 percent and a specificity of 92-100 percent. On data from real-world falls, researchers evaluated the efficacy of thirteen published fall detection algorithms. Their conclusion is that fall detection systems based on laboratory-monitored falls perform poorly in real-world situations. As a result, the TBM system's threshold values do not correlate to real-world scenarios. The fundamental advantage of TBM is the speed and simplicity with which it may be evaluated. Simple mathematical processes can be utilized to detect the fall once the threshold has been set. Such systems can be implemented on hardware with modest computational capabilities and have the potential to be extremely energy efficient. One of these systems' significant drawbacks is that it's difficult to create an adequate threshold for all forms of falls that doesn't cause false alarms during ADL. Furthermore, individual motion dynamics differ, and the threshold cannot be generalized to match all types of people.

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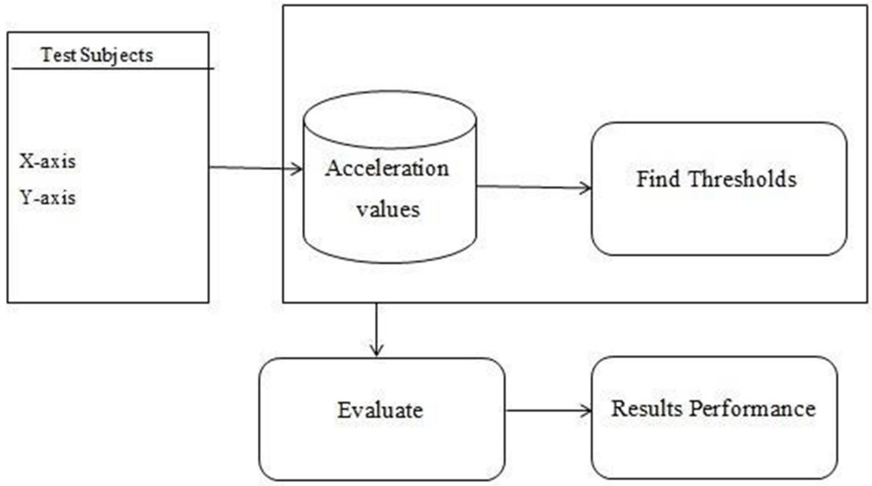

Figure 3: Workflow of creating a generalized threshold-based classifier.

We'll start by gathering data from the accelerometer before calculating the magnitude of the acceleration. We require acceleration magnitude because acceleration informs us how quickly velocity varies, whereas velocity rate tells us how quickly velocity changes.

$Acc = \sqrt{(Ax)2 + (Ay)2}$

Where Ax, Ay are the acceleration in the x, y axes, respectively.

The bi-axial accelerometer's acceleration magnitude, Acc, is constant, and the angular velocity is 0°/s. When a person falls, the acceleration changes rapidly, and the angular velocity provides a multitude of signals throughout the fall path. Because the Fall Index (Acc) necessitates a high sampling frequency and rapid acceleration changes, it will miss slow falls. As a result, Acc is only employed if we want to compare our system's performance to that of earlier studies that used the same positions but different speeds and accelerations.

The lower and upper fall thresholds for the acceleration and angular velocity used to identify the fall are derived as follows:

1) *Lower fall threshold (LFT):* The signal lower peak values are the negative peaks for the consequence of each recorded action (LPVs). For acceleration signals, the LFT is set to the magnitude of the lowest lower fall peak (LFP) detected. If the readings are less than the fixed threshold value, no warning will be sent.
2) *Upper fall threshold (UFT):* The signal upper peak values are the positive peaks for the recorded signals for each recorded activity (UPVs). The UFT was set at the level of the least magnitude UPV obtained for each of the acceleration and angular velocity data. The highest impact force experienced by the body segment during the impact phase of the fall is connected to the UFT. If I get the values higher than fixed threshold value then alert will be sent. Fall detection methods that use thresholds are typically separated into two groups: one that uses LFT comparisons and the other that uses UFT comparisons of acceleration data. Although previous research has yielded some substantial outcomes, accuracy is still lacking. Adjusting the UFT and LFT in this study, the performance was determined to be 83.33 present and 67.08 present, respectively. The flowchart of our algorithm, which was implemented in an Arduino UNO software written in C, which was designed to read an analogue variable from its port as an additional adjustment to fix the upper and lower ACC.

C. Fall Detection Algorithms Were Used To Design And Build A Wireless Human Fall Detection System

The most difficult aspect of creating a human fall detection technology is eliminating errors and just detecting actual falls. To accurately detect a fall, a large amount of sensor reading data from numerous circumstances of human falls must be collected. When these algorithms are applied to acquired data, they produce threshold values where a fall is possible. The upper fall threshold (UFT) and lower fall threshold (LFT) are the two threshold values. If the UFT and LFT readings are higher than the fixed threshold value, then an alarm will be sent; otherwise, no alert will be sent.

D. Fall Detection Algorithm

if the parameter > threshold value of the parameter

then

if > threshold value of

(Among 150 samples after satisfying the condition in Line 1)

then

return fall detection

return no fall detection

The code follows seven steps and is based on the above-mentioned algorithm:

1) Collect information from module
2) Determine the magnitude of the acceleration.
3) Check to see if the magnitude value exceeds the lower limit. Return to Step 1 if false.
4) In 0.5 seconds, see if the magnitude crosses the higher threshold. Return to Step 1 if false.
5) Within 0.5 seconds, look for a shift in orientation. Return to Step 1 if false.
6) Check to see if the orientation stays the same for 10 seconds. Return to Step 1 if false.
7) When a fall is detected, set the output pin to HIGH (if all of the above steps are resulted as true).

E. Alert Generation

Using Blynk app, If the person is really fallen This app is used to send the alert to the family members else the app will not alert to the family members.

VII. RESULTS AND DISCUSSIONS

By Using hardware devices such as Arduino, Node MCU chips, Mpu6050 sensors. An intelligent system based on the Internet of Things is introduced to the person really fall or not in real time. Arduino is connected to all sensors. Below figure shows how the sensors are connected to the Arduino board.

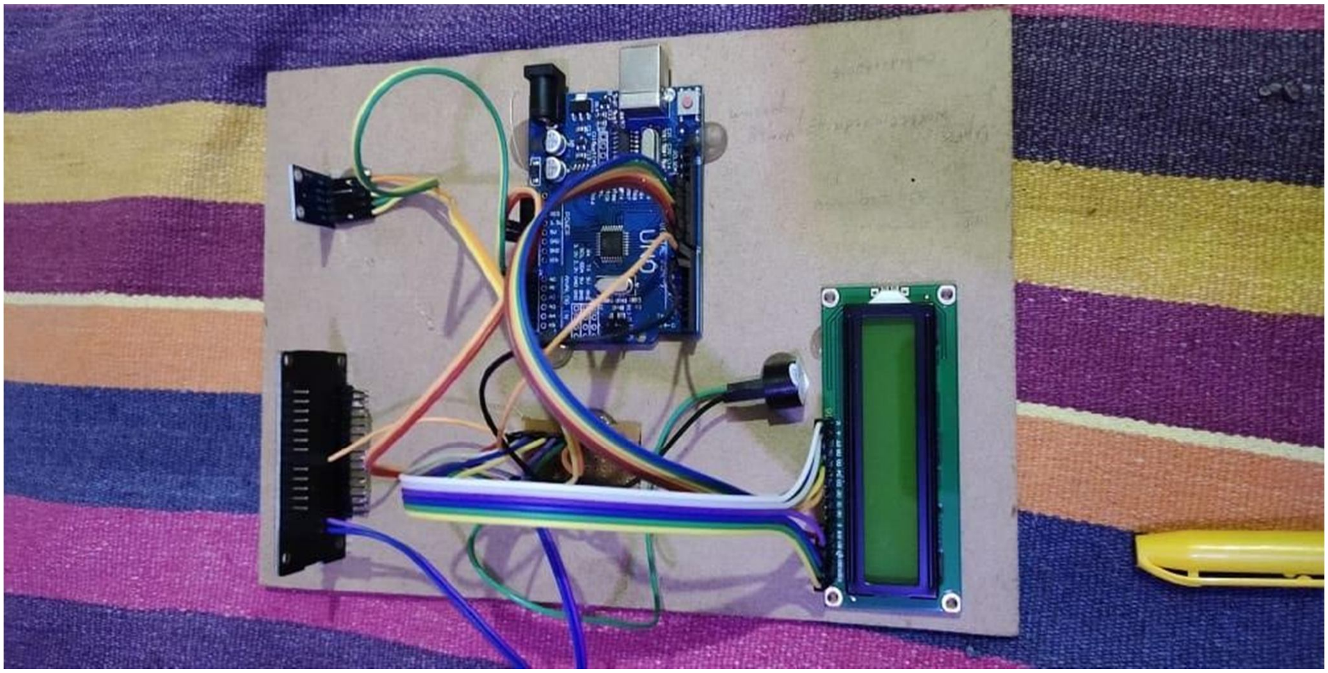

Figure 3: Fall detection board

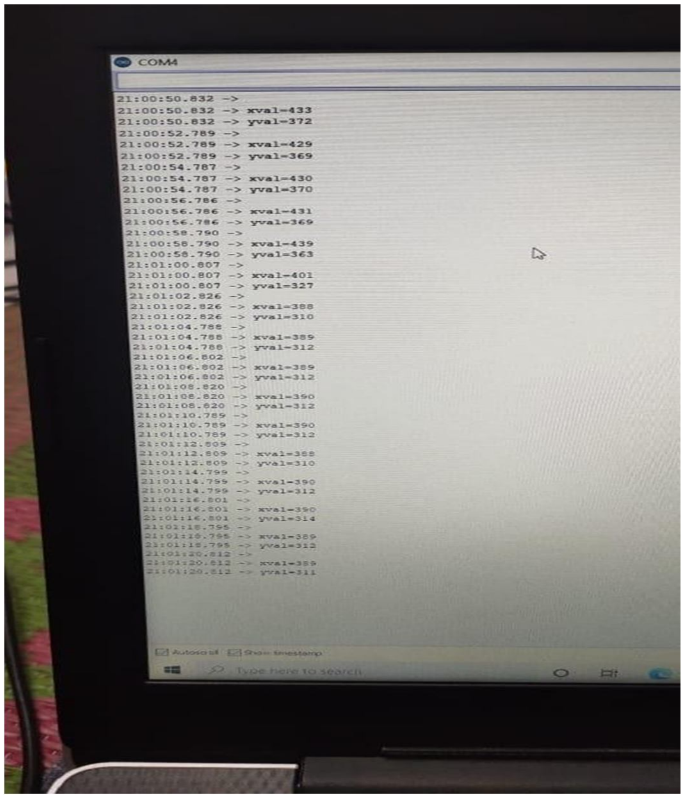

Figure 4. values of the sensors

Here the values of X and Y based on the movement of the person. Those values are being recorded by using the serial monitor in Arduino software.

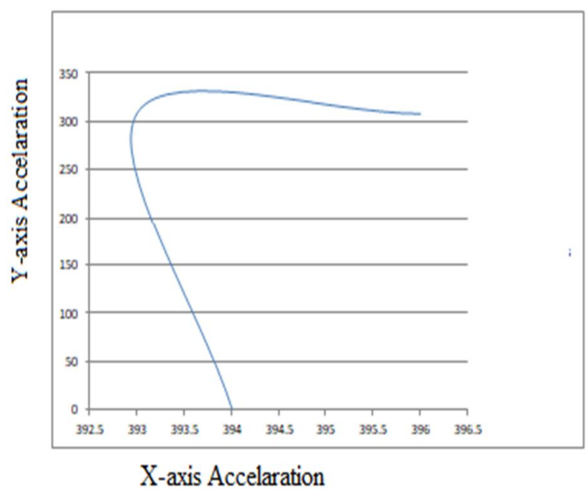

Figure 5: Graph of person sitting

Here The above graph shows the values of X and Y based on the movement of the person when person sitting. These values are taken from Arduino with the Mpu6050 sensors when the device is attached to the human body.

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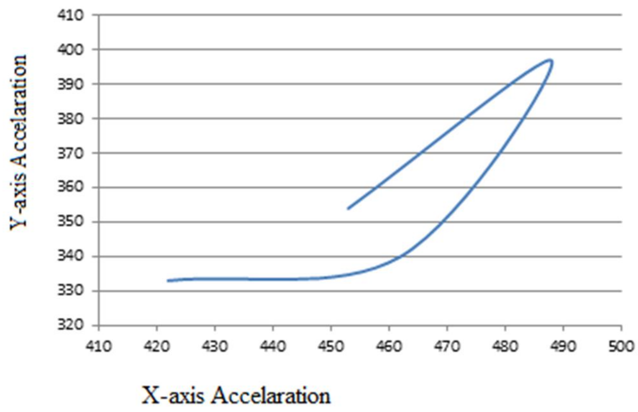

Figure 6: Graph of person standing

Here The above graph shows the values of X and Y based on the movement of the person when person standing. These values are taken from Arduino with the Mpu6050sensors when the device is attached to the human body.

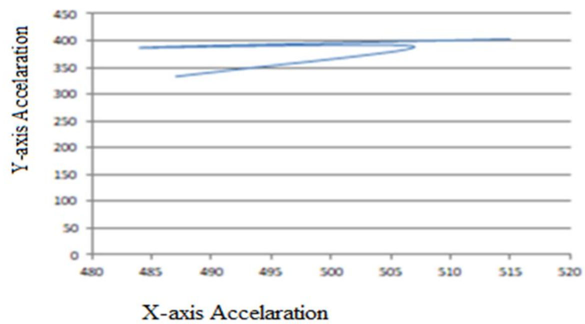

Figure 7: Graph of person walking

Here The above graph shows the values of X and Y based on the movement of the person when person walking. These values are taken from Arduino with the Mpu6050 sensors when the device is attached to the human body.

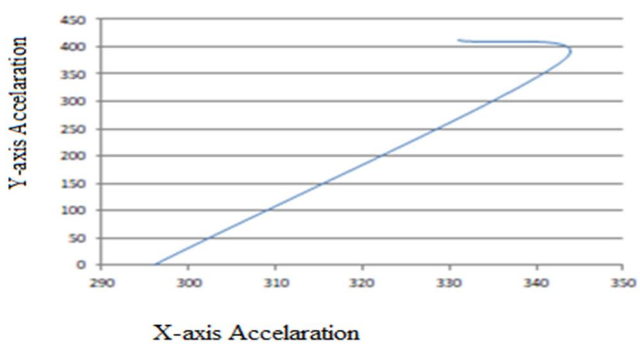

Figure 8: Graph of person fall

Here The above graph shows the values of X and Y based on the movement of the person when person fallen. These values are taken from Arduino with the Mpu6050 sensors when the device is attached to the human body.

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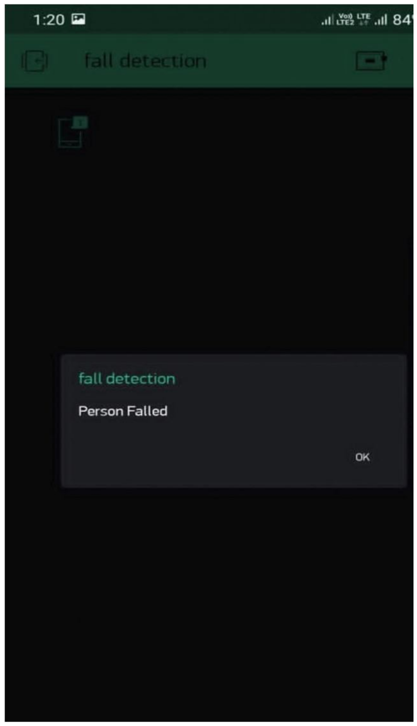

Figure 9: Blynk app with alert notification

In Blynk app, when the person falls the family members will get the notification.

VIII. CONCLUSION AND FUTURE SCOPE

Wearable sensors are useful for post-impact fall detection, according to the findings of this study. However, the classifier used is critical to the whole system's success. A generic classifier for detecting falls is rarely accurate, because it does not fit all people. The approach was used to introduce and apply many fall-feature parameters of the 2-axes acceleration. To overcome problems like departure of interpersonal falling behavioral patterns and comparable fall behaviors, possible falls were picked through the threshold. Aside from that, this project contained a notification system. When a fall is detected, the nodemcu module notifies the appropriate authorities. This demonstrates that the fall detection and alarm system is capable of detecting and alerting caregivers in the event of a fall. As a result, this device is a single unit.

A. Future Scope

The fall detection device has a wireless construction that allows for the addition of additional functionality by using different sensors such as a temperature sensor or a blood pressure sensor. The end result is a single, powerful portable gadget that can provide continuous healthcare monitoring of a patient's vital indicators. Human subject testing is recommended, which includes mounting the device on various parts of the body to determine an accurate threshold value that can be used to distinguish between falls and everyday activities, as well as determining the best location to attach the device, such as around the neck, waist, or other areas.

IX. ACKNOWLEDGEMENT

While bringing out this project to its final form, I came across a number of people whose contributions in various ways helped my field of research and they deserve special thanks. It is a pleasure to convey my gratitude to all of them. First and foremost, I would like to express my deep sense of gratitude and indebtedness to my supervisor Smt. N. Rama Devi and Smt. G. Vanitha for their valuable encouragement, suggestions and support from an early stage of this research and providing me extraordinary experiences throughout the work. I am also thankful to the Head of the Department Dr. Y. Rama Devi for providing excellent infrastructure and such a nice atmosphere for completing this project successfully. Finally, I would like to take this opportunity to thank my family and friends for their support throughout this work. I also sincerely acknowledge and thank all those who gave directly or indirectly their support in completion of this work.

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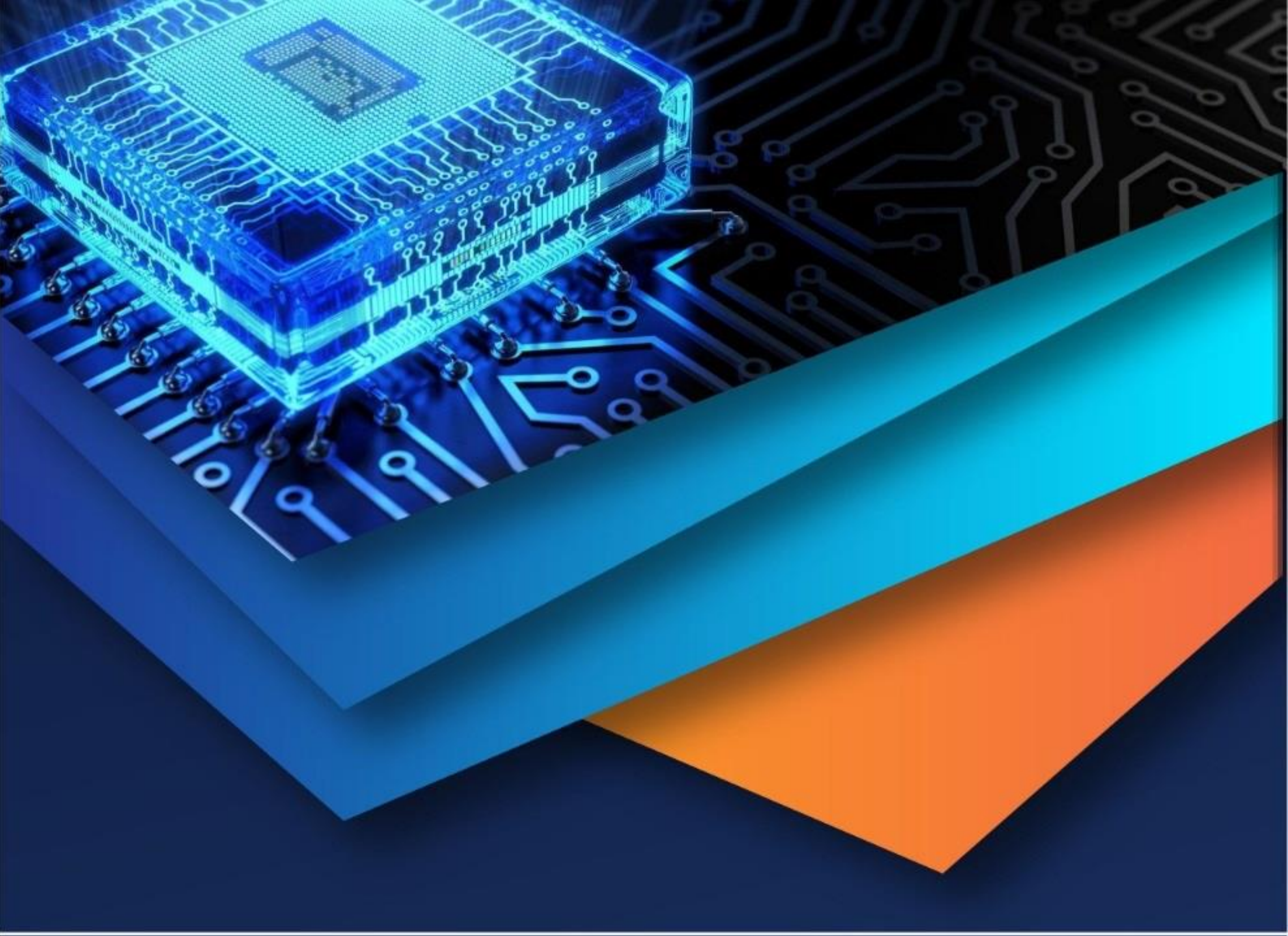

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