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Fall Detection Alert System Using Android

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Abstract: ***With the advancement in technology and development of smart cities, the reliance on smart phones has increased more than ever. Right from home automation to online payments, every person needs his smart phone in most activities he performs throughout the day. Needless to say, every person has his mobile phone with him almost always, thus if his phone falls down it may be inferred that the person has fallen down. We propose a system by which it is possible to detect this fall, alert the emergency contacts and keep logs. Every android phone has an accelerometer sensor embedded, which can be used to detect a fall. Using REST API calls and Java Mail API, emails can be sent to the emergency contacts and logs can be maintained whenever a fall is detected. It may also happen that the phone falls and the person doesn't fall, that case is also taken care of by maintaining a time out, and if the person doesn't open his phone within that time out, only then the alert mails are sent.***
Keywords: ***Fall detection, Accelerometer, REST API, Java Mail API, Twilio SMS API, Spring Boot***

I. INTRODUCTION

Due to wet bathroom floors or slippery footpaths, it is very common for people to slip while walking and fall down. If this happens to senior citizens, often it can cause them serious injuries and getting help from someone immediately is very crucial in such situations. This is commonly termed as fall detection. We have proposed a system for fall detection where we make use of the current trends in technology to make sure such accidents get notified to the emergency contacts immediately. This is more useful because nowadays, as, when the working class is away from home, the senior citizens are many a times alone, so there is often no one present when such people fall down accidentally. With this system, we attempt to reduce the severity of the injuries caused through such accidents by providing immediate help to them. We make use of accelerometer sensor in the mobile phones to detect a fall, and email and text messages for the communication. This is however not the most effective solution, as it cannot detect a fall unless the person falling down has his mobile phone with him.

But this is a very easy to implement solution, as people don't have to buy any additional hardware devices for this, or wear anything extra. Everyone nowadays has a cell phone and we make use of that, making it very easy for the senior citizens to use. But such falls don't take place every day, months may pass between two falls, so the system has to be alert always. False alarms may seem to be a drawback as a user's mobile phone may fall down without the user falling down, but we take care of this situation by waiting for 30 seconds before sending an alert. If the user picks up his phone before this time, no alert will be sent.

II. RELATED WORK

In [1] and [4], fall is detected by implanting a device in the floor which monitors sound and other vibrations and differentiates between a human fall and other objects falling down. In [2], [3], [5], users are required to wear external sensors and if a specific threshold is broken, the device sends an alert to emergency contacts. In [6], a system similar to ours is proposed where the fall is detected through a mobile application. But, in this they make use of a stand-alone mobile application which provides all the functionalities. This may not be effective when the number of users increases, there is no central control over the applications, and no logs can be recorded. If the user's family members want to change their contact details in the mobile application, they would have to have access to the mobile application. This may not be possible all the time. We propose a system where the mobile applications would be connected to a framework, where all the business logic would be stored, all the user data would be stored and also data storage and analysis would be possible. The users would be able to edit these business logics as they need. It won't be static.

III. GENERAL FLOW

A. First time users register to the application where they enter the emergency contact details, (email-id and phone numbers)
B. After they register, this data is stored on the framework side. We make use of Mongo DB as the database.
C. They can sign in using their user-id.

D. Logs are maintained on the framework side every day, and when a fall is detected, the logs are updated. In case there is no fall, the log says no fall detected.

E. When the fall is detected, an email as well as a text message is sent to the emergency contact as entered while registering.

F. Users can also view the logs and analysis on the framework side as required later.

IV. PROPOSED ALGORITHM

The main aim is to discern whether the phone itself has fallen off or the person carrying the phone has suffered a fall. In order to ascertain which scenario has occurred, a buffer period of 30 seconds is taken into account. If the phone is picked up within this period, then it is assumed that it was the phone which had fallen off.

However, upon completion of the buffer period, if the phone remains in the same position, then the latter scenario is decided to have taken place and an email or message is sent accordingly. As accelerometer is a popular sensor type it is equipped on most of the smart phones nowadays.

Therefore, using acceleration as the data source to detect fall can make our solution reach a large number of users. A simple android application is created to analyse and read the values that are provided by the accelerometer. The values are in accordance with the X, Y and Z axis i.e. (x, y, and z). So for each of them there is a value associated with it. We need to use the formula to calculate the vector Sum of these three values:

$$\text{Sum} = \sqrt{x2+y2+z2}$$

After calculating the vector sum it is checked with one of the following cases 1. Stationary: Here, the value is stable or we can say it is almost equal to 9.8 which is the earth's gravity. So this case is considered to be stationary. 2.

Moving: Here, the value is rising above 20 (the value of vector sum considering the coordinate axes as (9.8, 9.8, 9.8) we get 20 as the value) and falling below 0. To evaluate the performance we have developed a working prototype on Android platform and Android is chosen solely because of its popularity.

This prototype first retrieves the data from the accelerometer then these values are used to calculate the vector sum and after that comes the part where it checks for the scenario where the phone has fallen off or any fall is detected. A time series is also maintained to keep a record of all the values to identify the scenario to come to a conclusion or to make any prediction about the fall that can happen.

V. SYSTEM OVERVIEW

In our proposed system, the user can configure the business logic on the server side without having the need to access the mobile application. This can be done remotely because it may happen that the Distributed with permission of author(s) by ISA 2018 Presented at ISA Technical Paper Presentation Contest; http://www.isa.org emergency contacts may be in different cities than the person who has to be monitored.

In certain situations like for example, in a meeting, when a person may not have access to his mobile phone he would not be able to view the SMS alert and help the person who has fallen down in time.

To avoid this scenario, we are sending both email and SMS alerts. This way, the person will get alerts on time, either by viewing the SMS or email. The main feature of this system is that the data is not stored in the application but in the server.

This way data logs can be viewed and analyzed without having memory issues. Users may not have mobile phones with high memory storage available, so using this application should not put any burden on the memory.

We take care of this by sending the data through REST API to the server side where it is stored in the Mongo DB database. Data from various users will be collectively stored with having the option of data prediction.

Fig. 1. Splash screen

Fig. 2. Valid data entered

Fig. 3. Unregistered ID entered

Fig.4. Application running

Fig. 5. Application running in the background

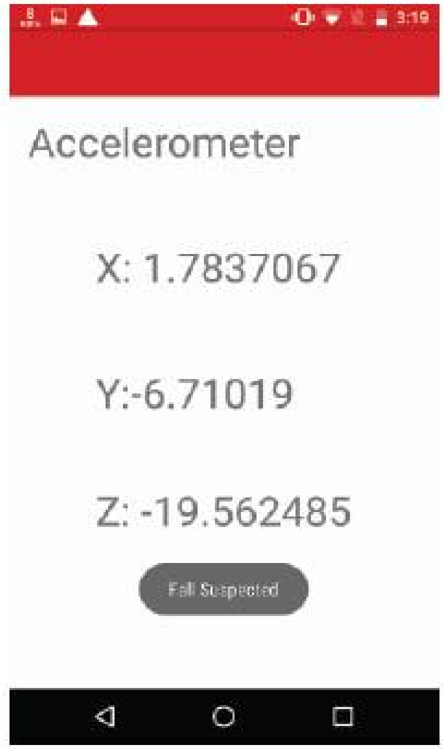

Fig. 6. Fall suspected

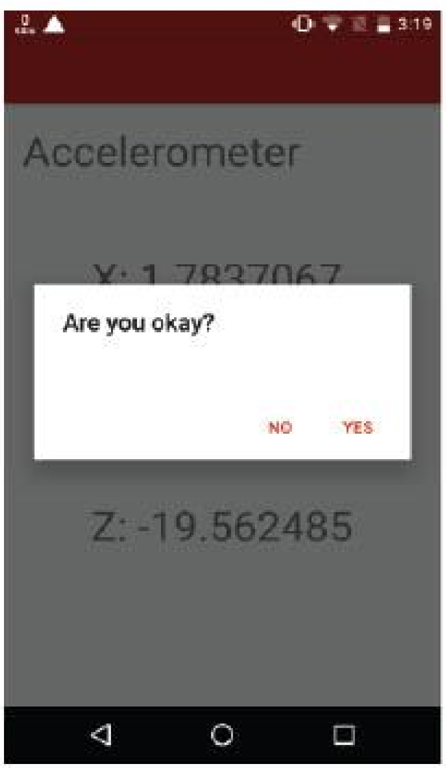

Fig. 7. Fal detected and waiting for user response

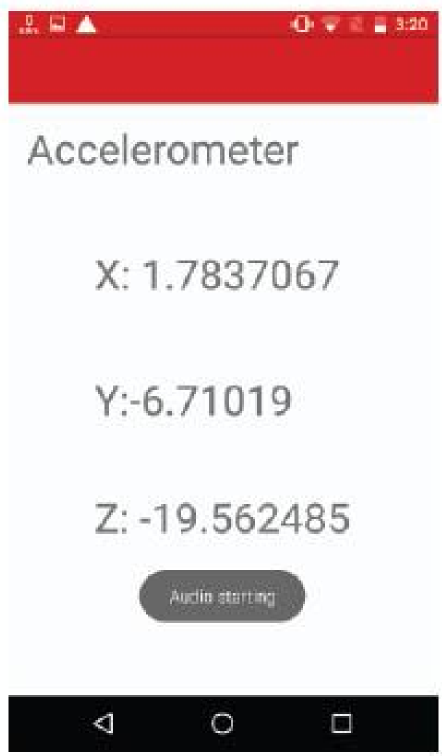

Fig. 8. Alerting user with audio message

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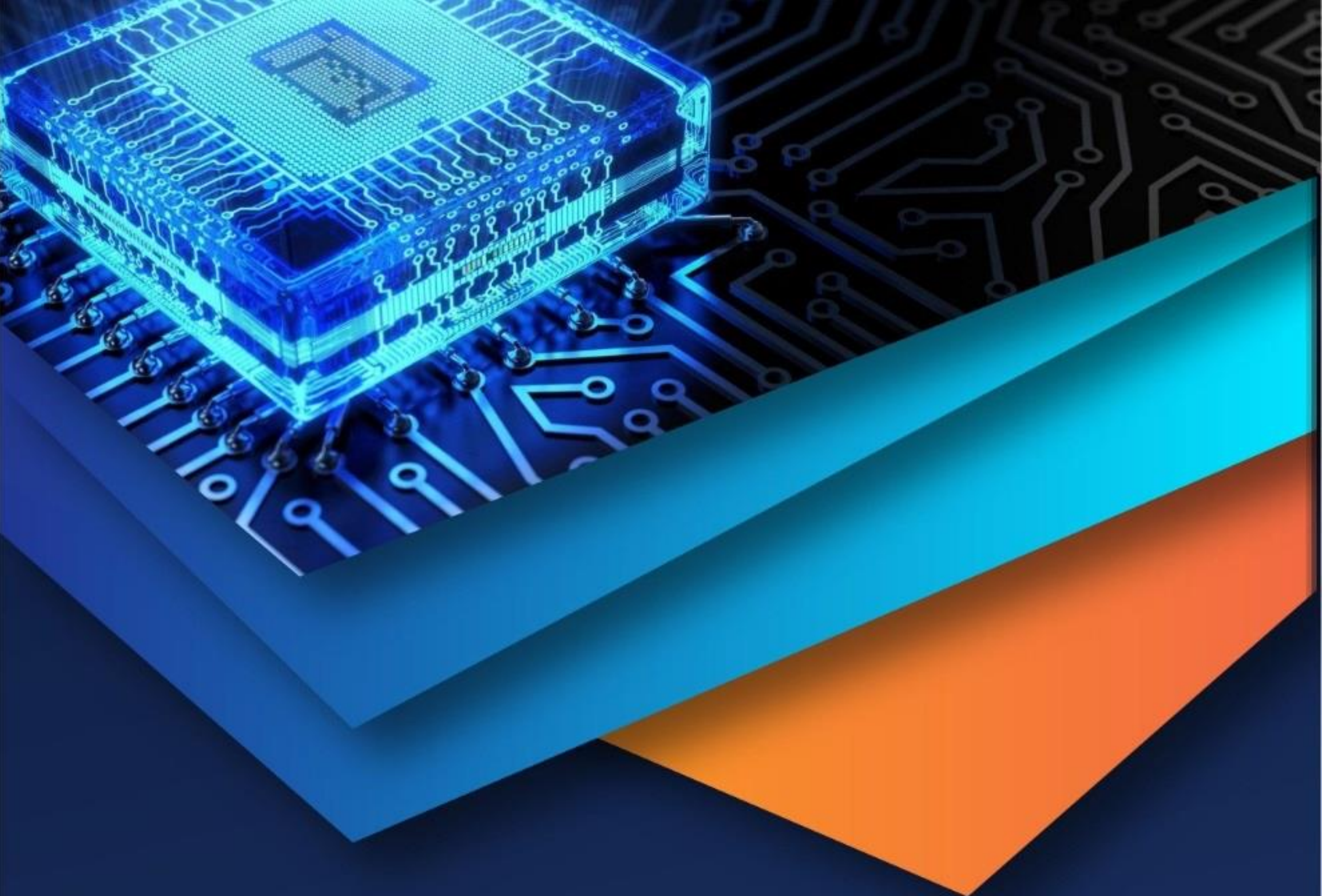

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