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Fall Detection System: A Wearable Sensor Device

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A B S T R A C T

A fall shows significant damage to the body especially for people 65 and older, who are more prone to injury due to weight loss and this can lead to death. With the rapid increase in population it is necessary to build a fall detector as reliable and timely monitoring is essential to reduce the negative effects of a sudden fall.

This paper provides literature research on the nervous system of the elderly and is a wearable tool. This device is worn on the wrist of a patient who monitors body movements and detects falls from normal activities with an algorithm, and sends a request for help to caregivers and a physician. In some lands, studies have shown that the risk of death from failure is greater than that of men. So the consequences of this fall often lead to tragic circumstances or even death. A fall is a major source of damage or injury due to the high impact. And according to the WHO, about 700k fatal crashes occur each year in the world, most of them over 65 years of age. Gender plays a vital role according to the WHO.

Keywords: Fall detector, Accelerometer, Bolt IoT, Wearable sensor device, Elderly people.

Introduction

Falls always lead to serious injuries or damage to the body due to decline in their physical fitness. Fall is the main source of damage or injury due to the high impact. Also according to the WHO, around 700k fatal falls occur each year in the world, most of them are above 65years of age. Gender also plays an important role according to the WHO.

In some countries, studies have shown that the risk of death from failing is much higher in men than women. Thus consequences of these falls often lead to serious conditions or even death. MEMS sensors have made the design and implementation much easier and also mobile computing makes health monitoring much easier to perform. Location based service makes it more easy to locate the elderly in health monitoring.

Several methods have been proposed by many researchers using machine learning, support vector machines (SVM), artificial neural networks and deep learning.

In this paper, we have proposed a wearable fall detector device which is worn on the wrist. This device consists of an accelerometer ADXL345 which measures the static acceleration of gravity, bolt IoT which consists of a Wi-Fi chip to connect the sensors to the internet.

Bolt IOT device is connected to a bolt IOT mobile application which can be logged through mobile, which tracks the patient's movements and alerts the caretakers and doctors if any help is needed.

Materials

The components utilized to design a fall detector are accelerometer ADXL345, Bolt IoT device, Bolt IoT platform. The accelerometer is the sensor to analyzetheconditionofthepatienti.e.,isthepersonsitting,standing,walkingandfallen.Theaimofthisprototypeistoalerttheclosedonesofthepatient if the patient hasfallen. The accelerometer ADXL345 is utilized as a sensor to acquire the acceleration of a person in all the three directions i.e., x-, y- and z-directions. This measures the static acceleration of gravity. This is a digital accelerometer which has inbuilt ADC converter.

Fig. 1 ADXL345 accelerometer

The Bolt IoT device is a Wi-Fi Module with ESP8266-12E. Its operating voltage is 3.3V. Power supply to the device is 5V/1A via Micro USB port or 5V and GND pins. The device connects to Wi-Fi when it is switched ON. The module works on the Wi-Fi. The communication through UART protocol

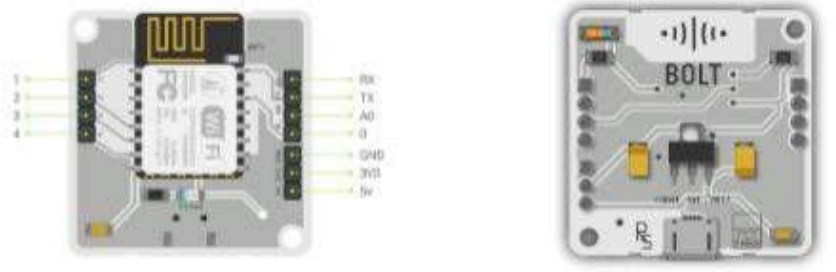

Fig. 2 Bolt IoT device

can be utilized for further analysis of the data. The GPIO is another mode of the device to visualize the data in the Bolt IoT platform. The weight of the components, both ADXL345 and Bolt IoT is 6.5gms.

ProposedMethodology

The data is acquired from the ADXL345 accelerometer and the data is transferred to the cloud through the Bolt Wi-Fi module. The data from the cloud is analyzed and if the person has fallen then the notification is sent to the mobile. The Bolt module is connected to the Wi-Fi and the data from the bolt IoT device is registered in the Bolt IoT platform and then the product named fall detector is created in the products and the hardware is configured as the GPIO with analog output. The device is then registered in the mobile Bolt IoT App. Then it is connected to wifi in the mobile app.

Fig. 3 Proposed Methodology

Through the Wi-Fi the bolt IoT is connected to the internet and through the cloud the alert messages are sent to the mobile.

- The first step is to register to the bolt iotplatform.

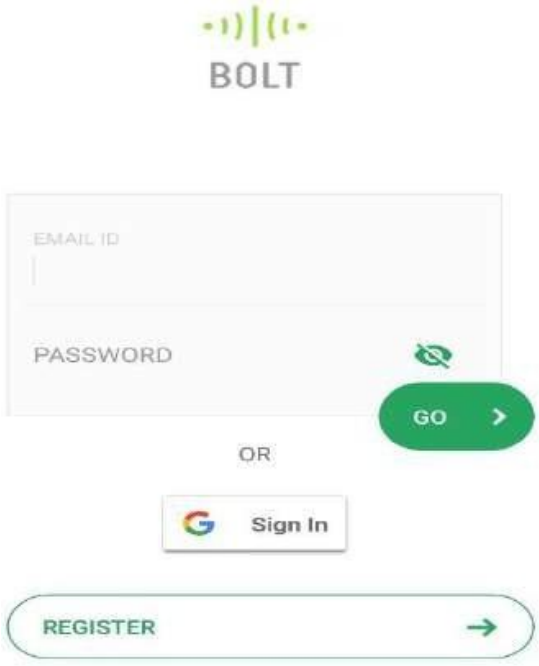

Fig. 4 Registering in the Bolt IoT platform

- The second step is to register the bolt device in the platform and then connect to theWi-Fi.

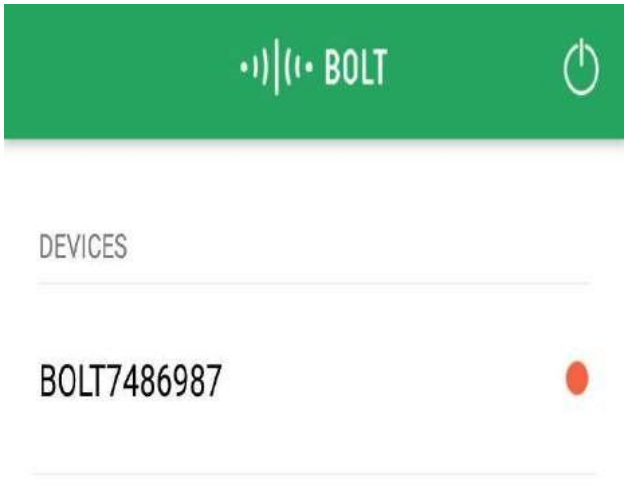

Fig. 5 Registering the bolt IoT Device in the platform

- The red light indicates that the device is offline and if it turns to green then the device is online. After registering the device, the product has to be created andconfigured.

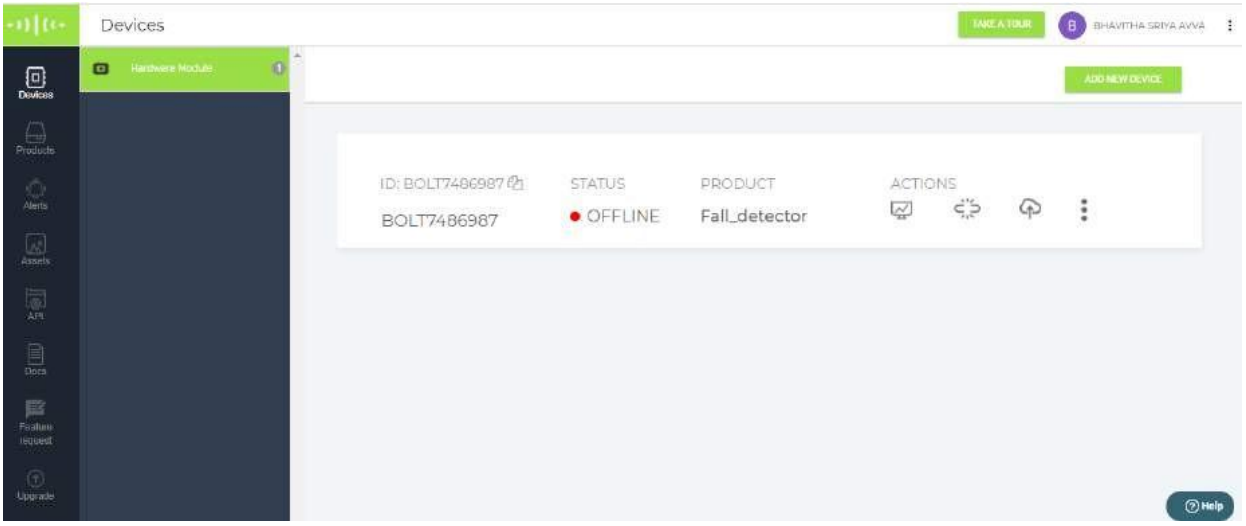

Fig. 6 Product creation and configuration

- Configuration should be done as both hardware and software. The software used for the configuration isjavascript.

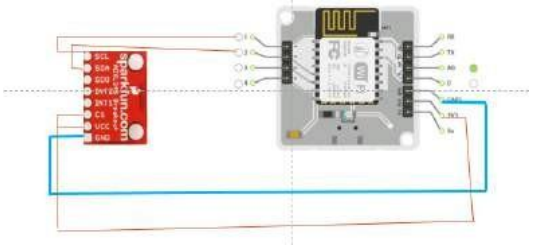

Fig. 5 Hardware Circuit

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Fig. 8 HardwareConfiguration

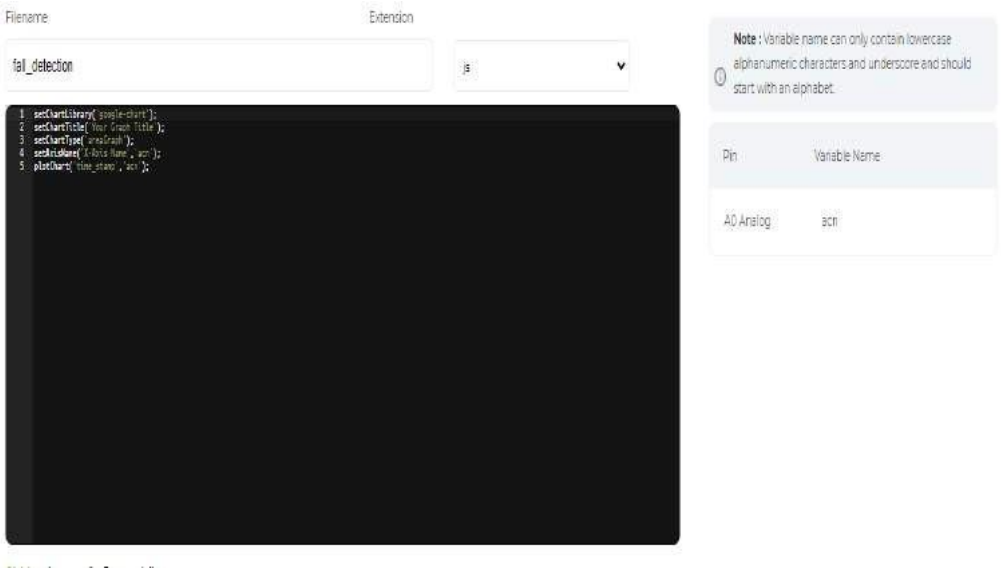

Fig. 6 SoftwareConfiguration

- The next step is to create alerts to send notifications to the mobile and link the alerts with thedevice.

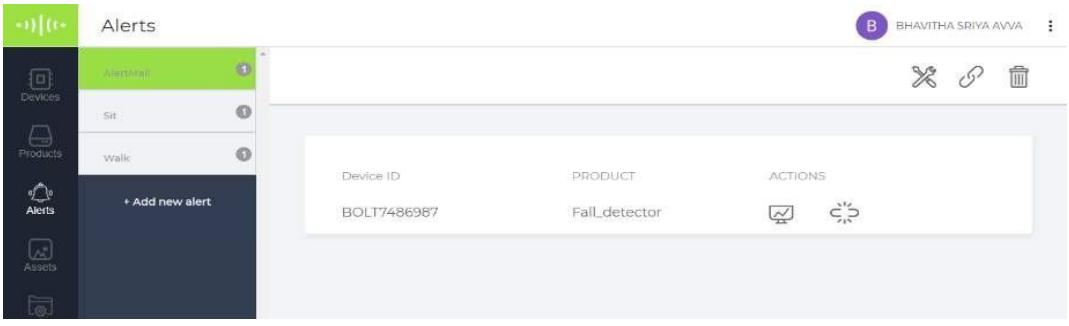

Fig. 10 Creating

Results and Discussion

The data from the accelerometer can be visualized by clicking on the device in the bolt IoT app in mobile and on the actions in the computer after login through the registered e-mail in the website. The acceleration increasing on the left side indicates that the person is standing and the constant accelereation indicates that person is standing without moving and the decreasing acceleration indicates that the person is sitting.

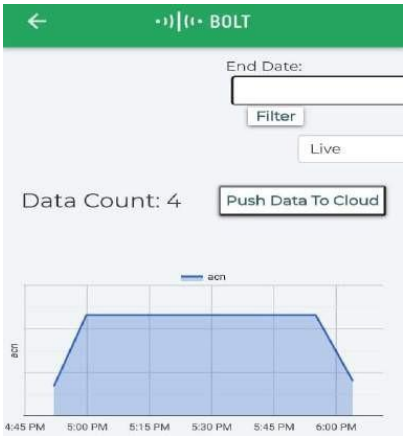

Fig. 7 Acceleration monitored through the device.

The status of person is analyzed and the status is sent to the mobile. The messages are sent to the mobile

Fig. 8 Messages to mobile

The cost of the components is about Rs.2750/-.

Table 1 – Cost of the components

Component	Cost
ADXL345	250
Bolt IoT	2500
Total Cost	2750

Conclusion

The advantages of this method are light weight, low cost and low complexity of the circuit as there are less number of components and circuit connection is also easy. The disadvantages of this model are any other programming language other JavaScript and html makes the model complex and costly. The model takes 5 minutes to transfer the data from the accelerometer to the computer. Even though there are disadvantages, the model is very useful to analyze the condition of the elder patients and heart patients where there is necessity for quick treatment. The research can be extended by incorporating RFID technology to the model and thus further research can be carried.

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