IOT-Based Patient Fall-Detection System using Raspberry Pi

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Abstract

Fall needs to be attentively considered due to its highly frequent occurrence especially with old people - up to one third of 65 and above year-old people around the world are risk of being injured due to falling. Furthermore, fall is a direct or indirect factor causing severe traumas such as brain injuries or bone fractures. However, timely medical attention might help to avoid serious consequences from a fall. A viable solution to solve this is an IoT-based system which takes advantage of wireless sensor networks, wearable devices, Fog and Cloud computing. To deliver sufficient degree of reliability, wearable devices working at the core of a fall detection system, are required to work for prolonged period of time. In this paper we investigate energy consumption of sensor nodes in an IoT-based fall detection system and present a design of a customized sensor node. In addition, we compare the customized sensor node with other sensor nodes, built on general purpose development boards. The results show that sensor nodes based on delicate customized devices are more energy efficient than the others based on general purpose devices while considering identical specification of micro-controller and memory capacity. Furthermore, our customized sensor node with energy efficiency selections can operate continuously up to 35 hours.

Introduction

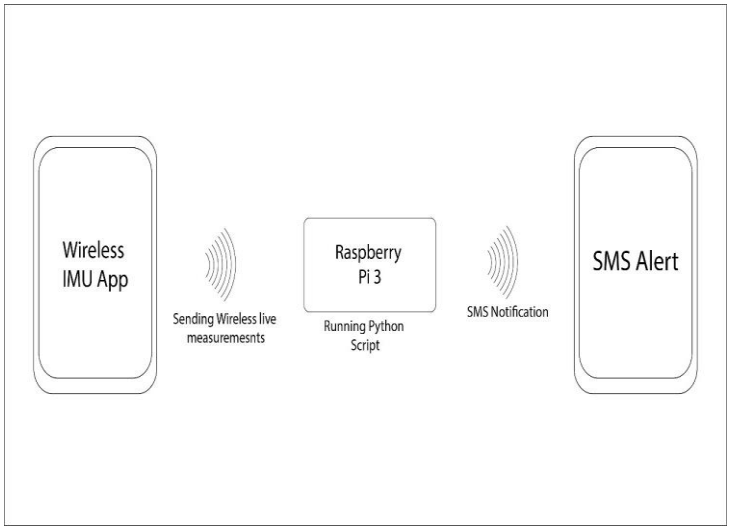
Internet-of-Things (IoT) is a concept that encompasses a number of technologies, with the aim to extend Internet to real-world objects With this approach, different quantities which represent physical world, such as temperature, humidity, acceleration, just to mention a few, will be digitized. Wireless Sensor Network (WSN), plays a key role in IoT, acting as a source of data, enabling digitalization. Collected data can be further processed and analyzed by the means of fog [2] and cloud computing. IoT application area is broadening, currently including a number of domains such as smart environments, personal and social fields, transportation, and logistics. The field of health-care is one of the most important areas covered. As predicted in, health-care will shift to home-centered fashion by 2030. Pervasive nature of IoT might significantly contribute in the change.

According to World Health Organization falls are one of the dominant health-related issues among elderly.more than one third of 65 (and above) year-old falls each year. Falls might lead to serious injuries such as head traumas or brain damages**.** Delay in a medical treatment in such cases threatens patient's life However, only a half of the patients reports about the incident. Unreported cases might lead to dangerous health related problems. A quick response on the incident might decrease the risk of serious medical conditions after a fall.

Fall detection systems in this regard play an important role. They can be categorized into wearable and context-aware systems [9]. Latter systems feature environmental sensors such as microphones and cameras, placed around a patient to be monitored. Wearable systems estimate patient's movements by exploiting sensors attached to the body. Popular wearable solutions employ accelerometers and gyroscopes attached to a patient**.**

I. SYSTEM DESIGN (E.G. SMART ROOM, SMART DUSTBIN..)

A. Block Diagram of the implemented System



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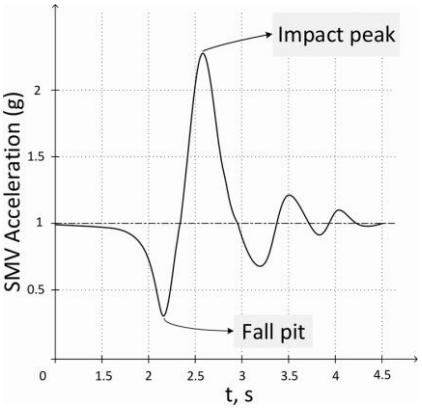

B. Hardware and Sensor

Raspberry pi 3 model B - The
Raspberry Pi is a single board computer with Microprocessor. The Raspberry Pi can run an OS (Linux Distribution). We might use Raspberry Pi for anything where we want a fully functional cheap computer. Raspberry Pi also becomes a good choice for building IOT (Internet of Things) Applications
.

1)**Rasberry Pi:** Raspberry Pi 3 uses Broadcom BCM2837 SOC 64-bit quad-core ARM Cortex A53 (ARMv8 CPU) with 512KB shared L2 cache.Memory: Provided with 1 GB of RAM

USB Ports: 4-USB ports which allow attaching four different USB devices like keyboard, mouse, etc.
Full HDMI Port: Support HDMI port (High-Definition Multimedia Interface) which can be used to quickly connect raspberry pi to HDMI Monitor. With HDMI Cable and Monitor we can add Screen to Raspberry Pi.

Micro SD card slot: The Micro SD Card will hold the operating system which will boot while we power on Raspberry Pi 3. In next tutorial, we will learn how to setup and prepare SD card with Raspbian OS
.
Audio/Video: Combined 3.5mm audio jack and composite video Display interface (DSI): enable us to interface Display Module
.

2)Wireless IMU App: An android app which can measures the accelerometer readings ,gyroscope readings and magnitometer readings and can be connective to raspberrypi via wireless access.
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II. EXPERIMENTAL PROTOTYPE

1) Set up a server remotely in the mobile device, which can host the recorded measures to Raspberry Pi

2) The R-Pi can then access server housed remotely in the mobile device and feed the data to the algorithm.

3) The Algorithm decides, based on set parameters, if the patient's sudden change in acceleration or free fall.

4) If the threshold crosses, the system send the notification via SMS to patient's representative.

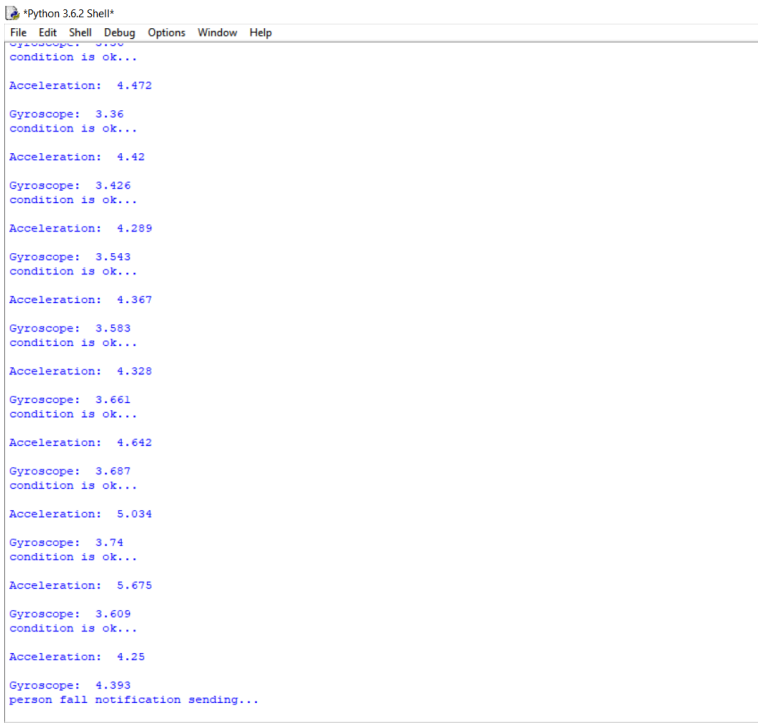
I. Following dependencies are used in the python program:-

1) **time module** -This module provides various tim-related functions.

2) Socket module:- This module helps the python script to trace all the measures of wireless IMU app to RPi.

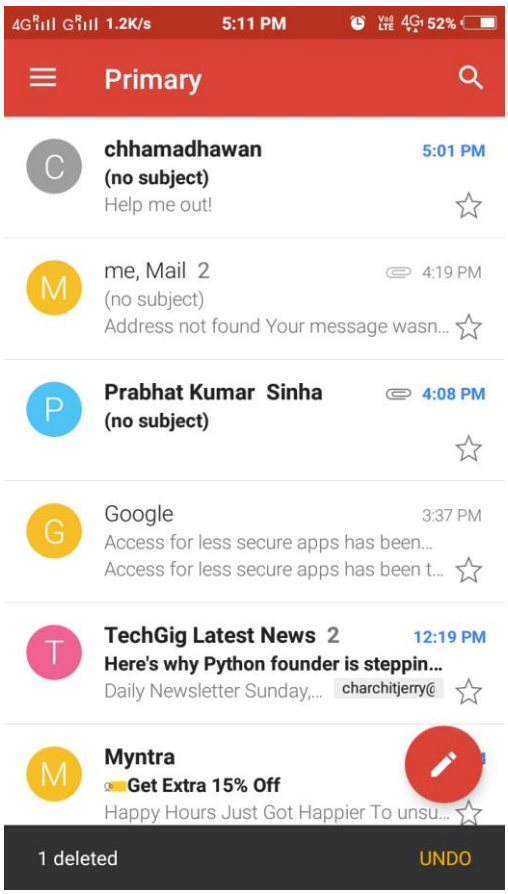
3) SMTP module:- This is an API module helps the python script to send Email- notification.

Result:



Wireless IMU : Live measures.

Email-Notification received:-



Conclusion

In this paper, we evaluated energy consumption of wireless sensor nodes in a fall detection IoT-based system for extracting an energy efficiency method of designing those sensor nodes. We implemented a simple customized sensor node for achieving a high level of energy efficiency. We compared primary energy consumption sources of several sensor nodes based on our and other designs. Based on experiments, we concluded that our sensor node is energy efficient. When using an 2600 mAh battery, the sensor node can operate up to 35 hours. In addition, our push notification service can improve quality of healthcare services via a mechanism of notification together with acknowledgement.

ACKNOWLEDGMENT

I would like to acknowledge the ECE lab and IIIT-NR for providing the necessary resources and facilities toimplement the project successfully.
Also great acknowledgement to Dr. Debanjan Das to give his innovation for implementing smartphone for efficiency.

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