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AN IOT-BASED EFFICIENT WEARABLE FALL DETECTION SYSTEM USING RASPBERRY-PI

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ABSTRACT: Falling is the most hazardous occasions that frequently occur among senior individuals, patients which requires medicinal consideration in time. Fall discovery frameworks could support senior individuals and patients to live autonomously. A programmed continuous fall discovery framework may discover fall occasions among old individuals in time that lessen the general setback rate. Fall detection (FD) and fall prevention (FP) are research areas that have been active for over a decade, and they both strive for improving people's lives through the use of pervasive computing. This paper surveys the state of the art in FD and FP systems, including qualitative comparisons among various studies. Proposed system used to find patient fall prediction and used to monitor patient body parameter conditions like pressure, temperature.

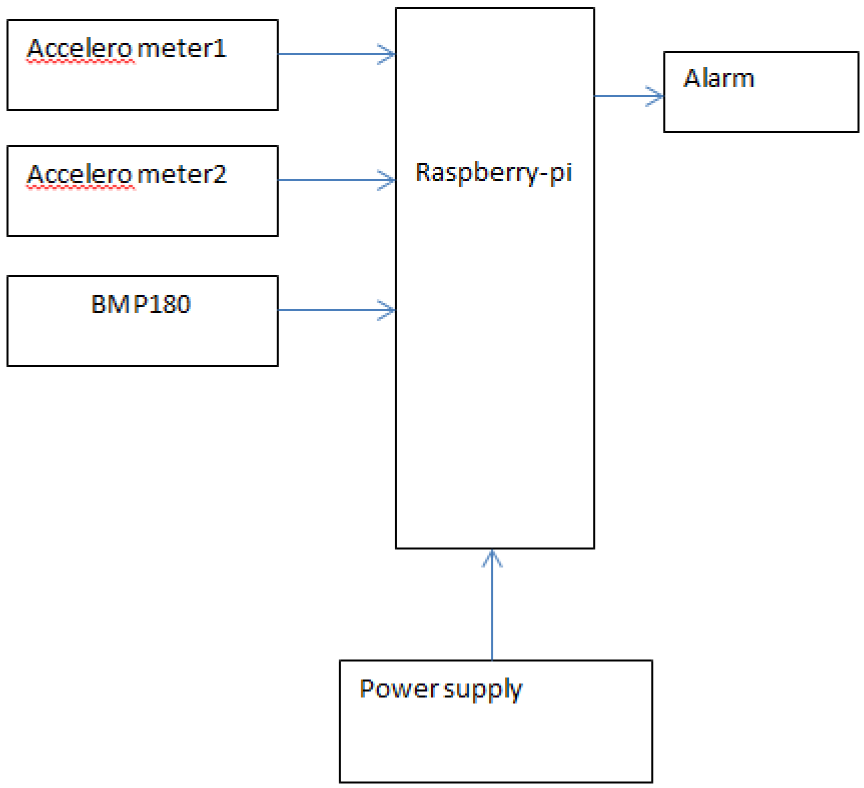
KEYWORDS: *Fall detection (FD), Fall prevention (FP), Raspberry-Pi, Internet of Things, Accelerometer*

INTRODUCTION: Normally it is difficult to keep track on abnormalities in heartbeat count for patient itself manually. The average heartbeat per minute for 25-year old ranges between 60- 80 beats per minute while for a 60-year old it is typically between 50-60 beats per minute and body temperature is 37degree Celsius or 98.6 Fahrenheit. Patients are not well versed with manual treatment which doctors normally use for tracking the count of heartbeat. So there must be some device which would help patient to keep track on their health by themselves. There are various instruments available in market to keep track on internal body changes. But there are many limitations regarding their maintenance due their heavy cost, size of instruments, and mobility of patients. To overcome these limitations a device use to keep track on heartbeat count of patient should be easy to use, portable, light weighted, small size etc so that it give freedom of mobility for patient. The devices which can be carried everywhere to keep track on patient's health. This device that is a heartbeat sensor would help them to keep track on heartbeat counts of a patient and check for any abnormalities. If any varied change takes place it is notified. This notification would help to take an appropriate action at an instance of a time. This would save patients from the future health problem which would arise. This would also help patient's concern doctor to take an appropriate action at proper time. The process of implementing a damage detection and characterization strategy for engineering structures is referred to as Structural Health Monitoring (SHM). Here damage is defined as changes to the material and/or geometric properties of a structural system, including changes to the boundary conditions and system connectivity, which adversely affect the system's performance. The SHM process involves the observation of a system over time using periodically sampled dynamic response measurements from an array of sensors, the extraction of damage-sensitive features from these measurements, and the statistical analysis of these features to determine the current state of system health. For long term SHM, the output of this process is periodically updated information regarding the ability of the structure to perform its intended function in light of the inevitable aging and degradation resulting from operational environments. As the demand for health care rises rapidly, traditional diagnosis services have become insufficient. With the rapid increasing of the elderly population coupled with a longer life span, e-health is targeted to provide low cost and everyday household usage [1]. In fact, the Remote Mobile Health Monitoring (RMHM) system has become a research hotspot in recent years. Using the wearable physiologic detection technology, it is possible to monitor the user's health condition in real-time. Furthermore, long-term and continuous detection is also achievable. Since it can help doctors to implement regular monitoring and remote diagnosis on time [2,3], RMHM will not only improve the patient's quality of life, but also reduce the burden of the medical system and the cost of public health [4,5]. For RMHM systems, a traditional approach is to adopt wearable textile, wireless monitoring, and patient tracking. In recent years, physiologic sensors and wireless communication have gained great progress [6,19]. Various RMHM systems have been proposed, but there are still limitations and challenges in improving their application. The main drawback of traditional health monitoring systems is that patients are "constrained" within smart rooms and beds fitted with monitoring devices [6,7]. To track a patient's position, GPS (Global Positioning System) is often used, but highenergy cost and indoor unavailability have been reported [28]. In contrast, the major attractive application for wireless-sensor-network (WSN) based systems is the indoor localization of both devices and patients. One disadvantage, however, is the deployment of WSN nodes beforehand. Patient comfort is another concern, as some may find wearing vests with several sensors physically uncomfortable, restrictive, and even irritating. Healthcare applications require lightweight devices with sensing, computation, and communication capability so that they can be comfortably worn on the body like a belt or wrist watch [8,9]. Other concerns around RMHM systems are complexity and the cost. Except for indispensable sensors, additional equipment, such as a Personal Digital Assistant (PDA) and a special electrical board, might bring higher cost and inconvenience to users, especially due to the confusion with manual instructions [10].

LITERATURE SURVEY:

Frequent monitoring enables proper dosing and reduces the risk of fainting and other complications [11]. Since professional equipment always requires operational skills and limits the patient's mobility, it is unsuitable for daily monitoring of sub-health or chronic disease patients. Such situations bring challenges for continuous monitoring and mobile health. Mobile health is an interdisciplinary field. Jovanov [12] proposed that the emerging short-distance Personal Area Network (PAN) and sensor technology could be used to establish a wearable health monitoring system. Then, Mamaghanian [13] introduced several new sensors such as MEMS-based accelerometers, gyroscopes, and integrated front-ends for electrocardiogram (ECG) acquisition. These sensors can reliably perceive the vital signs and detect physiologic activities. In recent years, a variety of health-monitoring systems have been proposed. Spinsante [4] presented a wireless and home-centered health monitoring system, which can efficiently manage medical devices in a blind manner. His key point is the Open Services Gateway initiative (OSGi) framework. Due to a significantly higher number of falls in the older adult population, tri-axial accelerometers and video cameras have been employed widely for fall detection [5]. However, there are still some limitations involving visibility because cameras can only work in a given view angle and with certain lighting conditions [6]. Wireless body area network is also adopted in the health-monitoring system. CodeBlue [7] is a wireless infrastructure intended to provide common protocol and software framework in a disaster response scenario, which allows wireless monitoring and tracking of patients and first responders. The MobiHealth project [8] aims to provide continuous monitoring of patients outside the hospital and improve their quality of life with new services such as disease diagnosis, remote assistance, physical state monitoring, and even clinical research. Most of the health monitoring systems mainly focus on data collection, while data process and information analysis can only be performed offline [1]. These systems are unsuitable to continuously monitor and implement initial medical diagnosis. Traditional RMHM systems often adopt PDA as the data receiver, while a webpage is used to display the data and chart [4]. Chen [1] presented a web-based remote human pulse monitoring system with intelligent data analysis. The system adopted physiological sensors, PDA, wireless communication, and World Wide Web for home health care in daily lives. Its friendly web-based interface is convenient for observing immediate pulse signals and heart rate to support remote treatment. Hande [2] used MICAz motes to design a robust mesh network that routes patient data to a remote base station within a hospital via router node. Dong-Her [3] proposed an embedded ECG monitoring system based on client-server architecture. RFID and WSN-based methods are used to keep track of the patient's position. The framework, ANGELAH [1], integrates the sensors and actuators required for monitoring and detecting potential acute situations. It also alerts medical professionals to respond to emergency cases. An RFID reader is used for entry/exit while a camera is used for vision-based emergency detection. Likewise, LAURA [2] performs localization, tracking and monitoring of indoor patients with WSN. For such systems, the main drawback is that the additional PDA is indispensable and the MICAz motes cannot support the patient's mobility. In recent years, mobile phones have become an increasingly important platform for the delivery of health interventions [1]. Chan [2] proposed a multi-agent architecture comprising of intelligent agents for cardio monitoring. It relies on the GSM network to collect patient data. Intelligent agents send diagnostic information and recommend medical interventions.

PROPOSED METHOD:



Unlike sensors of wearable systems, those used in ambient systems are dramatically different from each other. Overall, these ambient systems have the advantage of operating in a low-light region and not being restricted by privacy issues compared to vision-based systems. These systems provide a more comprehensive analysis of user's posture by taking environmental factor into consideration compared to inertial sensor-based wearable systems. Most importantly, though the sensors used are cheap, the installation of such a system requires major home renovation as most of the sensors will be embedded underneath the floor or in the wall, which can be an expensive setup.

Two accelerometer sensors are used here to calibrate human body falling conditions with more accuracy conditions. BMP180 sensor is used to calculate both pressure and temperature of the present attached human body.

RASPBERRY PI 3

The Raspberry Pi 3 Model B is the latest version of the Raspberry Pi computer. The Pi isn't like your typical machine, in its cheapest form it doesn't have a case, and is simply a credit-card sized electronic board -- of the type you might find inside a PC or laptop but much smaller.

One thing to bear in mind is that the Pi by itself is just a bare board. You'll also need a power supply, a monitor or TV, leads to connect to the monitor--typically HDMI, and a mouse and keyboard.

Raspberry Pi GPIOs Pinout

The following figure shows the Raspberry Pi 3 GPIOs pinout that you can use for a future reference.

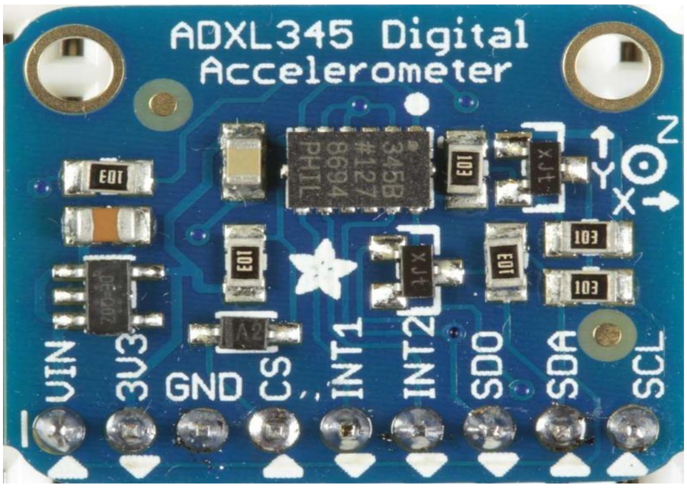
		Pin no.			
DC Power	3.3V	1	2	5V	DC Power
SDA1, I^2C	GPIO 2	3	4	5V	DC Power
SCL1, I^2C	GPIO 3	5	6	GND	
GPIO_GCLK	GPIO 4	7	8	GPIO 14	TXD0
	GND	9	10	GPIO 15	RXD0
GPIO_GEN0	GPIO 17	11	12	GPIO 18	GPIO_GEN1
GPIO_GEN2	GPIO 27	13	14	GND	
GPIO_GEN3	GPIO 22	15	16	GPIO 23	GPIO_GEN4
DC Power	3.3V	17	18	GPIO 24	GPIO_GEN5
SPI_MOSI	GPIO 10	19	20	GND	
SPI_MISO	GPIO 9	21	22	GPIO 25	GPIO_GEN6
SPI_CLK	GPIO 11	23	24	GPIO 8	SPI_CE0_N
	GND	25	26	GPIO 7	SPI_CE1_N
I^2C ID EEPROM	DNC	27	28	DNC	I^2C ID EEPROM
	GPIO 5	29	30	GND	
	GPIO 6	31	32	GPIO 12	
	GPIO 13	33	34	GND	
	GPIO 19	35	36	GPIO 16	
	GPIO 26	37	38	GPIO 20	
	GND	39	40	GPIO 21	

This pinout is the same for Raspberry Pi 2 Model B, Raspberry Pi 1 Model A+, Raspberry Pi Model B+, Raspberry Pi Zero, and Raspberry Pi Zero W.

Raspberry Pi 1 Model A and the Raspberry Pi 1 Model B Rev.2 only have the first 26 pins.

ACCELEROMETER

The ADXL345 is a low-power, 3-axis MEMS accelerometer modules with both I2C and SPI interfaces. The Adafruit Breakout boards for these modules feature on-board 3.3v voltage regulation and level shifting which makes them simple to interface with 5v microcontrollers such as the Raspberry-pi. The sensor consists of a micro-machined structure on a silicon wafer. The structure is suspended by polysilicon springs which allow it to deflect smoothly in any direction when subject to acceleration in the X, Y and/or Z axis. Deflection causes a change in capacitance between fixed plates and plates attached to the suspended structure. This change in capacitance on each axis is converted to an output voltage proportional to the acceleration on that axis.



BUZZER:

The piezo buzzer produces sound based on reverse of the piezoelectric effect. The generation of pressure variation or strain by the application of electric potential across a piezoelectric material is the underlying principle. These buzzers can be used alert a user of an event corresponding to a switching action, counter signal or sensor input. They are also used in alarm circuits. The buzzer produces a same noisy sound irrespective of the voltage variation applied to it. It consists of piezo crystals between two conductors.

INTERNET OF THINGS

IoT (Internet of Things) is an advanced automation and analytics system which exploits networking, sensing, big data, and artificial intelligence technology to deliver complete systems for a product or service. These systems allow greater transparency, control, and performance when applied to any industry or system.

IoT systems have applications across industries through their unique flexibility and ability to be suitable in any environment. They enhance data collection, automation, operations, and much more through smart devices and powerful enabling technology.

Let me start this IoT tutorial by introducing the person who coined the term “***Internet of Things***“. The term “The Internet of Things” (IoT) was coined by **Kevin Ashton** in a presentation to Proctor & Gamble in 1999. He is a co-founder of MIT’s Auto-ID Lab. He pioneered RFID (used in bar code detector) for the supply-chain management domain. He also started Zensi, a company that makes energy sensing and monitoring technology.

BLYNK APP:

Blynk is a Platform with iOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets. It's really simple to set everything up and you'll start tinkering in less than 5 mins. Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choice. Whether your Arduino or Raspberry Pi is linked to the Internet over Wi-Fi, Ethernet or this new ESP8266 chip, Blynk will get you online and ready for the **Internet Of Your Things**.

RESULTS:

Above shown pic represents the proposed kit prototype. Raspberrypi3 is used as main heart of this concept. Accelerometer sensor 1 is connected to 2nd Digital pi of raspberry-pi. Similarly, another accelerometer is connected to 3rd digital pin of raspberry-pi. BMP 180 sensor is connected to 8th pin of raspberry-pi to measure continuous blood pressure. Whole equipment is supplied with 5v DC power supply.

CONCLUSION AND FUTURE SCOPE:

The proposed framework is made to be convenient, wearable gadget set on the midriff of client, having sensors comprising of accelerometer, BMP180 and a basic calculation utilizing posture recognition fall detection. In this paper, the energy utilization of remote sensor nodes in fall identification was discussed. IoT-based framework for identifying an energy effectiveness technique for planning those sensor nodes was defined. Also, elaborated a straightforward modified sensor hub for accomplishing a significant level of energy consumption. Contrasted with essential energy utilization of a few sensor hubs dependent on this along with different plans presumed that sensor hub is energy efficient. In addition to the system can also provide more than one numbers so that more than one user can receive emergency message. According to availability of sensors or development in biomedical trend more parameter can be sense and monitor which will drastically improve the efficiency of the wireless monitoring system in biomedical field. Another aim of the future research is to enable controlled information sharing among the doctors, the patient, and the family of the patient, by taking advantage of the social networking paradigm.

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