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IOT BASED HUMAN FALL DETECTION SENSOR DEVICE USING RASPBERRY PI 3

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Abstract - *Now-a-day's person data monitoring is a leading issue for health and disease management. Wireless Body Area Network consists of light weight, ultra low power wearable sensors. Hence the latest trend in Healthcare communication method using IoT is adapted. Our system is designed to be used in hospitals for measuring and monitoring various health parameters like temperature, heartbeat and fall detection. The parameters of the patient can be compared with threshold values and if there is any variations immediate alert messages could be sent to the doctor and caretaker. The sensor values are stored in a file in Raspberry Pi and the same file is uploaded to the cloud through internet. The sensor values are displayed on a LCD display. The detection of falls in an elderly society is an active field of research. It is a new accelerometer-based fall detection system integrated into an intelligent building. The developed system consists of three main components. Fall detection is realized inside a small customized wearable device that is characterized by low costs and low-energy consumption. The heart beat sensor, temperature sensor & accelerometer is connected with MCP 3008 IC, which is connected with raspberry pi. Fall detection is detected with help of machine learning technique and then GPS location send to the care taker/hospital/ambulance.*

Key Words: Accelerometer, heartbeat sensor, temperature sensor, LCD display.

1. INTRODUCTION

Internet of Things is a network of devices which is built with embedded systems, electronic things, actuators, sensors and network connectivity. The most importance of healthcare on IoT is increasing to support the quality of care, improve the access to care and finally to decrease the cost of care. A major aspect in the healthcare system is the monitoring of the patient's vital signs such as temperature, blood pressure and heart rate. Many monitoring devices that display the patient's vital signs are commonly present in the critical care units in operating rooms. But there could be instances where the doctor couldn't be alerted in time when there is an emergency, despite of 24 hours of monitoring. Also the data couldn't be shared remotely with the other doctors who are specialists in that field and the family members. Technology that enables all these activities are available but aren't accessible and affordable by many people in developing nations. IoT is the interconnecting of devices and services that reduces human intervention to live a better life.

2. LITERATURE SURVEY

In 2018,Haoran Ren, et al proposed "A Novel Cardiac Auscultation Monitoring System Based on Wireless Sensing for Healthcare"**.** In this existing paper, a novel wireless sensing system to monitor and analyze cardiac condition is proposed, which sends the information to the caregiver as well as a medical practitioner with an application of the Internet of Things (IoT). An integrated system for heart sound acquisition, storage, asynchronous analysis has been developed, from scratch to information uploading through IoT and signal analysis. Cardiac auscultation sensing unit has been designed to monitor cardiovascular health of an individual. Bluetooth protocol is used to offer power efficiency and moderate data transmission rate. The Hilbert-Huang transform is used to eliminate interference signals and to help to extract the heart sound signal features.

In 2018 Malcolm Clarke et al proposed "Interoperable End-to-End Remote Patient Monitoring Platform based on IEEE 11073 PHD and ZigBee Health Care Profile**".**This existing paper described the implementation of an endto-end remote monitoring platform based on the IEEE 11073 standards for Personal Health Devices (PHD).It provides an overview of the concepts and approaches and describes how the standard has been optimized for small devices with limited resources of processor, memory and power and that use short range wireless technology. It explains aspects of IEEE 11073, including the Domain Information Model, state model and nomenclature, and how these support its plug-and-play architecture.

3. BLOCK DIAGRAM

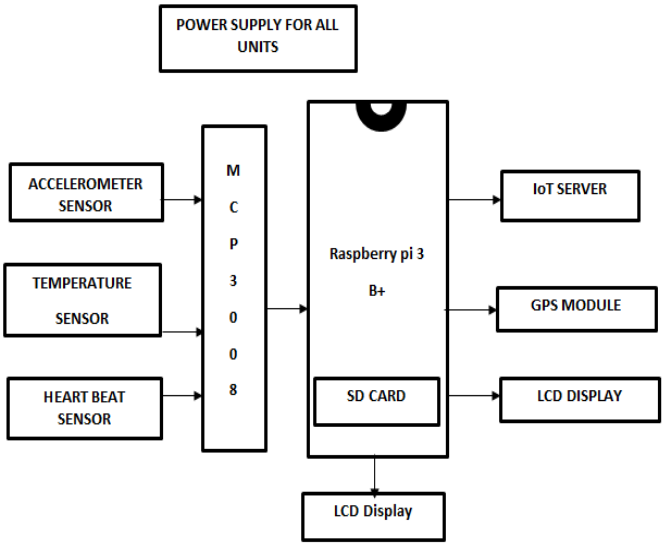

Fig 1: Wearable sensor unit

I. Accelerometer ADXL 335

Breakout board for the 3 axis ADXL335 from Analog Devices. This is the latest in a long, proven line of analog sensors The ADXL335 is a triple axis MEMS accelerometer with extremely low noise and power consumption - only 320uA. An accelerometer is a device that measures proper acceleration; proper acceleration is not the same as coordinate acceleration (rate of change of velocity). This is placed in wrist of patient knee & ankle. An accelerometer at rest on the surface of the Earth will measure acceleration due to Earth's gravity, straight upwards (by definition) of g ≈ 9.81 m/s2. By contrast, accelerometers in free fall (falling toward the center of the Earth at a rate of about 9.81 m/s2) will measure zero. The sensor has a full sensing range of +/- 3g.Board comes fully assembled and tested with external components installed. The included 0.1uF capacitors set the bandwidth of each axis to 50Hz. and onboard regulator 3.3volts.

Fig 2: Acclerometer ADXL 335 sensor

II. Heartbeat sensor

Heartbeat sensor the sensor consists of a super bright red LED and light detector. The heart beat sensor is placed in index of the finger nose & output of the heart sensor is connect to PIC microcontroller RB0th pic. The LED needs to be super bright as the maximum light must pass spread in finger and detected by detector. When the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified through an amplifier which outputs analog voltage between 0 to +5V logic level signal.

It works on the principle of light modulation by blood flow through finger at each pulse

Fig 3: Heartbeat sensor

III. Temperature sensor

LM35 Temperature Sensor the LM35 series are precision integrated-circuit LM35 temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The temperature is placed in surface of the skin. The temperature output is given to the RA0 pin.The LM35 sensor thus has an advantage over linear temperature sensors calibrated in ° Kelvin.

Fig 4: Temperature sensor

IV. Raspberry Pi3 B model

A broad com system on a chip (SoC), It includes an ARM compatible central processing unit (CPU) and an on-chip graphics processing unit (GPU, a Video Core IV). CPU speed ranges from 700 MHz to 1.2 GHz .It has on board memory range from 256 MB to 1 GB RAM. HDMI and composite video output, and a 3.5 mm phone jack for audio. Lower level output is provided by a number of GPIO pins which support common protocols like I^2C. The B-models have an 8P8C Ethernet port and the Pi 3 has on board Wi-Fi 802.11n and Bluetooth. Secure Digital (SD) cards are used to store the operating system and program memory in either the SDHC or Micro SDHC sizes. Most boards have between one and four USB slots. Raspberry Pi has an Ethernet port .4 USB ports used to connect devices like a keyboard, mouse, camera, and other devices that connect through a USB port, and an HDMI port .It has 40 pins that allow us to receive and send signals. They are divided in half into two groups: the 3V, and the 5V group.

One side of the microcontroller gives a voltage of 3V, and the other 5V.Besides the 40 voltage pins, it has pins that are used to receive signals, which in our case was used to connect the button, that will send the signal for the face identification.

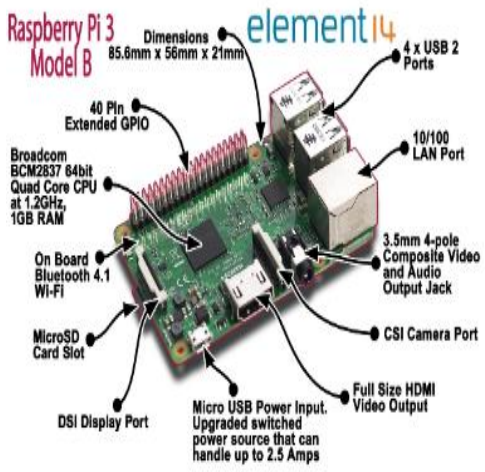

Fig 5: Raspberry Pi3 B model

V. LCD display

Liquid Crystal Display a type of display used in digital watches and many portable computers. It is used to display the measured data. In this project 16 x 2 Alphanumeric Display are used, it can display two lines with maximum of 16 characters in one line. A16x2LCDmeansitcan display16characters per line and there are 2 such lines. In this LCD each character is displayed in5x7 pixel matrix.

4. Proposed system

Fall detection is a major problem in the healthcare department. Elderly people are more prone to fall than others. There are more than 50% of injury-related hospitalizations in people aged over 65. Commercial fall detection devices are expensive and charge a monthly fee for their services. A more affordable and adaptable system is necessary for retirement homes and clinics to build a smart city powered by IoT and artificial intelligence. An effective fall detection system would detect a fall and send an alarm to the appropriate authorities. Our proposed method is based on automating the method of gathering patients data via sensors connected to medical devices and conveying this information to the medical centre cloud for the purpose of storage and processing using Raspberry Pi. The proposed method of patient health monitoring system is to monitor patient's body temperature, heart rate using Raspberry Pi3. The heart Rate sensor senses heart beat from the patient's body and sends the information to the Raspberry Pi3.The temperature sensor (LM 35) collect the patient body temperature, the information obtained from the temperature sensor is in the analog form, in order to convert it into digital form analog-to-Digital Converter is used. This obtained Digital output send to the Raspberry Pi3. The output obtained from Raspberry Pi3 is displayed at the LCD display. This System is made to avoid critical situations and treatment on time and immediately. When abnormal data is indicated, information will be sending to doctor's mobile. And it can avoid risk and handle critical situation. It also gives advantage that it reduces time laps between situation and their alert to doctor, that means doctor will know situation as immediately it happens. Heart Beat Sensor (TCRT1000): The Heart Beat Sensor is based on the principle of photo phlethysmography. It measures the variation in the volume of blood through any regions of the body which causes a change in the light intensity through that region (a vascular region).When the index finger is placed on the heart beat sensor, the variation in an optical power takes place when the light falls on the index finger is scattered or absorbed during the path through the blood as the change in heartbeat.

5. SOFTWARE

It deals with the Raspbian Operating System (OS) that is used in the Raspberry Pi, python language which is used for programming of Raspberry Pi and putty simulator.

1) Python: Python is an interpreted, object oriented, high-level programming Language with dynamic semantics. Its high-level built in data structures, combined with dynamictyping and dynamic binding makes it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages,

whichencourage modularity and code reuse. The python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed. Python 2.7 version, which is pre-installed in Raspbian OS, is used in the project for programming of Raspberry Pi.

2) Putty Simulator: The name "Putty" has no definitive meaning. Putty was originally written for Microsoft Windows, but it has been ported to various other operating systems. Official ports are available for some Unix-like platforms, with work-in-progress ports to Classic Mac OSandmac OS, and unofficial ports have been contributed to platforms such as Symbian , Windows Mobile and Windows Phone.

3) Raspbian Operating System (OS: Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages; pre-compiled software bundled in a nice format for easy installation on Raspberry Pi. Raspbian is highly optimized for the Raspberry Pi line's low-performance ARM CPUs.

6. CONCLUSION

We have illustrated part of the process of the development of an IoT system to detect falls. This process involves different types of testing, we have been using IoT and machine learning to generate the test events in order to replicate the behavior of the sample falls. The implemented functionality allows to generate events by defining rules which describe a desired behavior. We can assign behavior rules as many event attributes as the event type contains, and the values of each event attribute will follow the assigned behavior. Moreover in this project we added different types of sensors such as an accelerometer sensor, temperature sensor, and heart sensor are the medical data, in order to identify and characterize the falls. The future work related to IoT-machine learning is to improve it in order to generate faithful test events which simulate the relevant situations that need to be filtered and, sometimes, are very difficult to imitate: adverse environment conditions, rise or fall in blood pressure, heart attack, falls...To generate test events, reliable data transmission of all sensor nodes must be guaranteed. The synchronization problem can lead to data loss during data transmission and thus influences the analysis of falls. So, the use of a real-time system capable microcontroller platform is planned, which facilitates the synchronization of the sensor nodes using apriority-controlled task scheduler. Moreover, after studying the work [24], different post-fall postures will be analyzed. Thus, new developments will include hazard analysis methods, e.g. STAMP/STPA, to satisfy safety standards, i.e. IEC61508, IEC60601, etc. Finally, in our final product, a unique identification of the Human Body will be included, so a patient/user management could be added. Moreover, the final system will include security aspects inside the Body Area Network .

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