Real Time Activity Monitoring And Detecting Fall Of Oldster By Sending Alert Messages

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***Abstract*— In this modern and fast-moving world, the elderly safety and security have become an important issue. The emergency impact that occurs among the elderly people may not be noticed timely by the caregivers, such as falling down to the ground in the washroom. To reduce the worries about elderly who live alone at home and going out, elderly fall detection system is required for continuous monitoring. In our project, accelerometer sensor senses the fall detection and sending alert messages are automatically triggered without manual operations is developed by using the GSM, GPS, IoT and Arduino technologies. Our proposed system also provides real-time monitoring of temperature and heart rate by sending the data from the sensors to cloud Thing speak using the Wi-Fi module ESP8266. To provide high efficiency and accuracy, the sensor readings are processed and monitored on the cloud platform. The temperature sensor and the heart beat sensor senses the temperature and hear beat of the elderly people and the data are uploaded to the cloud for further references by using the Wi-Fi module. This system enhances the quality of a life of elderly people.**

Keywords—Fall detection, Internet-of-Things; wearable sensor; Smart IoT Gateway; accelerometer; elderly people

I. INTRODUCTION

Falls of the elderly always lead to serious health issues as the decline of their physical fitness. Fracture is the most common injury in fall of an elderly and there is also a certain possibility to get coma, brain trauma, and paralysis. At most fall situations, the fall process is the main source of injury because of the high impact. Progress of technology brings more possibilities to help us protect the elderly. Low power consumption components make it possible to realize wearable monitoring device. MEMS (Microelectro Mechanical Systems) sensors have simplified the design and implementation of sensor system. With increasing number of older people, the demand for healthcare service increase rapidly. Most of the people aged 60 or above are hospitalized due to falls. A global report by the World Health Organization (WHO) states that 28-35 percent of older people aged 65 and above experienced fall each year and it is increasing to 32-42 percent for those 70 years and above.

Falls are one of the major problems in the elderly and are considered one of the "Geriatric Giants". A fall not assisted in time can cause functional impairment in an elder and a significant decrease in his mobility, independence and life quality. Risk factors for falls include muscle weakness, a history of falls, use of four or more prescription medications, use of an assistive device, arthritis, depression, age older than 80 years, and impairments in gait, balance, cognition, vision, and activities of daily living. Most falls result from a complex interplay of predisposing and precipitating factors in a person's environment. One half to two thirds of falls occur in or around the patient's home. Elderly people who are living independently have a high risk of falling and injured themselves. Falling down that leads to unconscious state can be fatal because nobody is aware of this falling event which may lead the faller to have more severe injuries. It is important to have a quick response and rescue time if falling event occurs. Therefore, there is a need for a device that can detect fall and transmit signal for help automatically.

In order to reduce the risk of elderly people getting harm from fall, medical attention needs to be provided immediately. Therefore, a reliable IoT based fall detection system can help to detect fall in elderly people and contact the caretaker for help and support. The fall detection system need to be user friendly which is easy for the user.

II RELATED WORKS

REFERENCES	DESCRIPTION	LIMITATIONS
Toshiyo Tamura , Takumi Yoshimura ,Masaki Sekine, Mitsuo Uchida, Osamu Tanaka	A wearable airbag that uses both acceleration and angular velocity signals to trigger inflation of the airbag.	Increased false alerts
Nor Surayahani Suriani, Fadilla Atyka Nor Rashid and Nur Yuzailin Yunos	Determines the optimal sensor placement especially for lower limb activity	Lower limb exercise are also detected as a fall
Zhen-Peng Bian, Junhui Hou, Lap-Pui Chau	Analyzes the tracked key joints of the human body using a single depth camera	Inaccurate and compatible only in a constrained environment.
Omar Mohammad, Ho- jin Choi, youssef Iraqi	Fall detection and activity monitoring of elderly using audio surveillance.	Audio based alert has less precision and accuracy
Laura Montanini , Antonio Del Campo ,Davide Perla, Susanna Spinsante, Ennio Gambi	Fall detection that relies on a pair of smart shoes, equipped with force sensors and accelerometer	Smart shoes cannot be worn by the elderly people throughout the day

II EXISTING SYSTEM

The main idea of the designed system is to measure the abrupt changes of the human body which are further used to detect or identify the falls from normal activities of daily living (ADL).

The system consist of the inertial accelerometer sensor which is used to detect the abrupt changes and analyse the gait patterns of the elderly people. In addition to this, the external sensors such as camera, sound sensors, and pressure sensors are attached around the surrounding where the elderly people stays in such as bedroom or a home to detect a fall. The accelerometer sensor detects a fall and alerts the caretaker whenever there is an abrupt change in the human body. The external sensors i.e. camera, records the complete movements of the elderly people inside the living environment.

The sound sensor notifies the caretakers when the fall noise exceeds the threshold value. The pressure sensor collects the vibration signal from the floor and the notification is triggered to the caretakers.

Here, we gather a raw data from all these inertial and external sensors that is connected to the Arduino microcontroller and sends the data to the mobile phones of the caretakers using Bluetooth. Therefore, it makes the caretakers to monitor the elderly people in a home environment. By using this model, the monitoring of the elderly people is easy from anywhere in the house by doing any work. In Existing system, the elderly people monitoring data will be displayed to the caretakers only if the mobile phone is connected via Bluetooth technology. But Bluetooth has a lot of limitations. There is specific range for the existing modules. The sound sensor notifies if it exceeds the threshold value. There is a lot of possibilities of generating false alerts in case of external surrounding noise. The pressure sensor has the ability to sense all the vibrations that are received by the floor which also has the possibility of false alerts. The elderly people can be monitored only inside a home environment. This system don't have the facility to monitor them if they are away from home. Monitoring elderly people under camera will have storage issues.

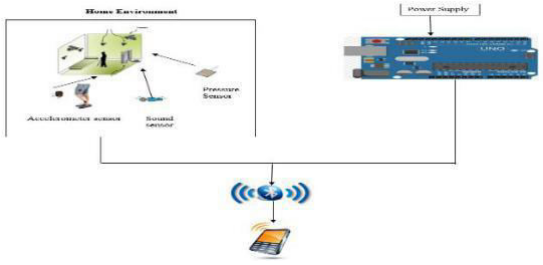


Fig. 1. Architecture Diagram of the Existing System

III. PROPOSED SYSTEM

The proposed work presents an innovative IoT-based system for detecting falls of elderly people wherever they go. For this purpose, the device consists of a Temperature Sensor (LM35), a Heart Rate Sensor and Micro-Electro-Mechanical Systems (MEMS) Accelerometer Sensor embedded into the Arduino Uno. The Arduino Uno is responsible for collecting data from the elderly people with these sensors on their body. When an elderly fall is detected, the axis of MEMS Accelerometer Sensor changes abruptly and the alert is triggered automatically by sending notifications to the people who is responsible for the care of the elderly people without manual operations.

Our proposed system also provides real-time monitoring of temperature and heart rate by sending the data from the sensors to cloud Thing speak using the Wi-Fi module ESP8266. If any immediate support is given to the elderly people by the outsider, then the caretaker will receive an alert regarding this immediate support when the help button is pressed by the outsider so that the caretaker need not get panic. In addition to our project, if the elderly people is conscious and in need of help he can manually activate the panic button so that the caretaker will be notified in case of emergency. Low cost biomedical sensor is used for monitoring the temperature and heart rate for seniors. It is easy to implement and highly reliable.

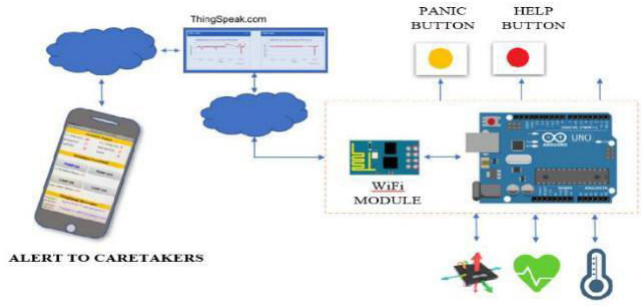


Fig. 2. Architecture Diagram of the Proposed System

IV SYSTEM ARCHITECTURE

The implemented system consists of a microcontroller (ATmega328) as a main processing unit for the entire system and all the sensor and devices can be connected with the microcontroller. The sensors can be operated by the microcontroller to retrieve the data from them and it processes the analysis with the sensor data and updates it to the internet through Wi-Fi module connected to it.

ARDUINO UNO

Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog input/output (I/O) pins that can interface to various expansion boards (termed shields) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages C and C++.

Fig. 3 Arduino Uno with Atmega 328

GSM MODULE

SIMCom Wireless Solutions is a subsidiary of SIM Technology Group Ltd. It is a fast-growing wireless M2M company, designing and offering a variety of wireless modules based on GSM/GPRS/EDGE, WCDMA/HSDPA and TD-SCDMA technical platforms. This GSM Modem can accept any GSM network act as SIM card and just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module featuring an industry-standard interface; the SIM800 delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM800 can fit almost all the space requirements in your applications, especially for slim and compact demand of design.

Fig. 4 GSM Module

GPS MODULE

The NEO-6M GPS module is a well-performing complete GPS receiver with a built-in 25 x 25 x 4mm ceramic antenna, which provides a strong satellite search capability. The NEO-6 module series brings the high performance of the u-blox6 position engine to the

miniature NEO form factor. U-blox6 has been designed with low power consumption and low costs in mind. The DDC interface provides connectivity and enables synergies with U-blox6 LEON and LISA wireless modules. It is a complete GPS module with an active antenna integrated, and a built-in EEPROM to save configuration parameter data equipped with power and signal indicator lights and data backup battery. The U-blox6 NEO-6M GPS module has serial TTL output, it has four pins: TX, RX, VCC, and GND. The module works well with a DC input in the 3.3- to 5-V range.

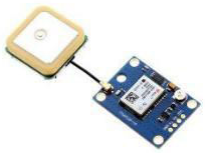


Fig.5 NEO-6M GPS Module

Wi-Fi Module

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware. The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. To communicate with the ESP8266 module, microcontroller needs to use set of AT commands.

Fig. 6 ESP 8266 Wi-Fi Module

Accelerometer Sensor

An accelerometer is an electromechanical device that will measure acceleration force. The ADXL335 gives complete 3-axis acceleration measurement. It measures the acceleration in the form of analog inputs, in three dimension direction such as X, Y and Z. It is low noise and less power consume device. When it is used for acceleration measure purposes then it is interfaced with any type of controller such as microcontroller or Arduino etc. Every ADXL 335 accelerometer consists of five pins VCC, GND, X, Y, Z pins. So, after making all connections, a logic program is written in Arduino library then this program is up load in Arduino board with the help of Arduino IDE software. Then triple axis reading are attained through Arduino board.

Fig.7 Accelerometer

Sensor Temperature Sensor

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. LM35 is a precision IC temperature sensor with its output proportional to the temperature. The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possess low self-heating and does not cause more than 0.1 oC temperature rise in still air. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range.

Fig.8 Temperature Sensor

Heart Rate Sensor

The front of the sensor is the pretty side with the Heart logo. This is the side that makes contact with the skin. On the front you see a small round hole, which is where the LED shines through from the back, and there is also a little square just under the LED. The square is an ambient light sensor, exactly like the one used in cell phones, tablets, and laptops, to adjust the screen brightness in different light conditions. The LED shines light into the fingertip or earlobe, or other capillary tissue, and sensor reads the light that bounces back.

Fig.9 Heart Rate Sensor

Thingspeak

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyse live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. With the ability to execute MATLAB® code in ThingSpeak you can perform online analysis and processing of the data as it comes in. ThingSpeak is often used for prototyping and proof of concept IoT systems that require analytics.

ThingSpeak allows you to aggregate, visualize and analyse live data streams in the cloud. Some of the key capabilities of ThingSpeak include the ability to easily configure devices to send data to ThingSpeak using popular IoT protocols, Visualize your sensor data in real-time. Aggregate data on-demand from third-party sources. Use the power of MATLAB to make sense of your IoT data. Run your IoT analytics automatically based on schedules or events. Prototype and build IoT systems without setting up servers or developing web software

V IMPLEMENTATION

In this implementation model we used Arduino UNO board with Wi-Fi module is as embedded device for sensing and storing the data in cloud. Arduino UNO board consist of analog input pins (A0-A5), digital output pins (D0-D13), inbuilt ADC and Wi-Fi module connects the embedded device to internet. Sensors are connected to Arduino UNO board for monitoring, ADC will convert the corresponding sensor reading to its digital value and from that value the corresponding environmental parameter will be evaluated. The Wi-Fi connection has to be established to transfer sensors data to end user and also send it to the cloud storage for future usage.

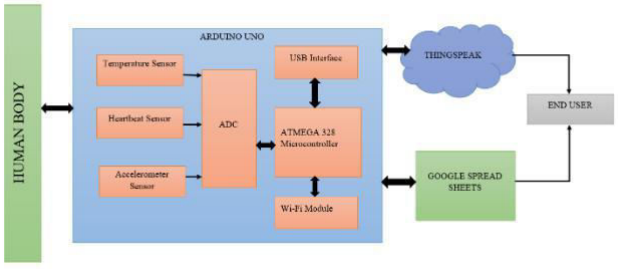


Fig.10 Schematic Diagram Of Implementation Model

VI SIMULATION RESULTS

The sensed data will be stored in cloud (Google Spread Sheets). The data stored in cloud can be used for the Analysis of the parameter and continuous monitoring Purpose. The figure 14 shows the real-time data of the elderly people. All the above information will be stored in the cloud.

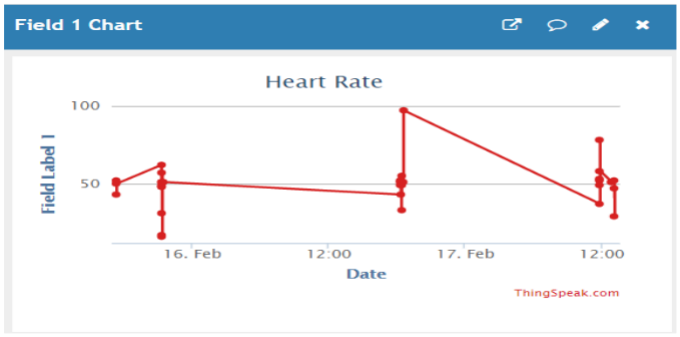


Fig.11 Heart Rate Monitoring

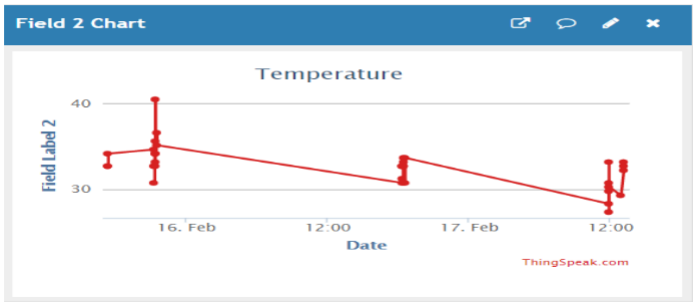


Fig.12 Temperature Monitoring

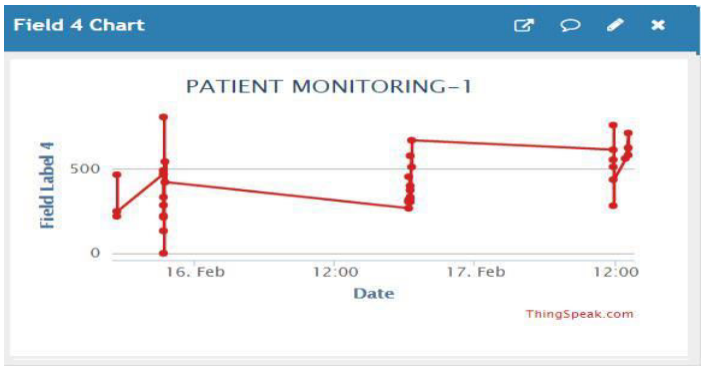
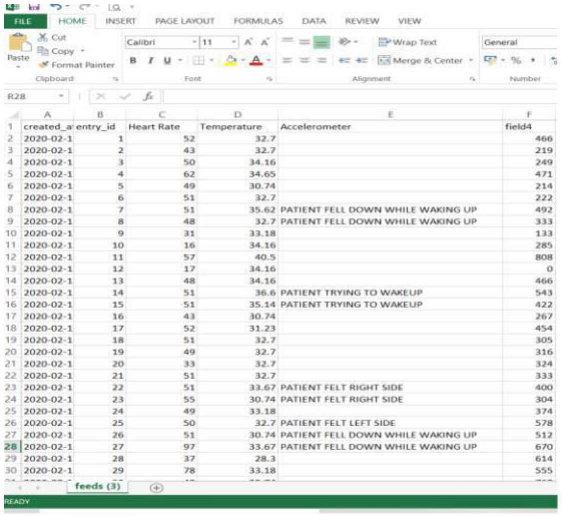


Fig.13 Patient Monitoring



	A	B	C	D	E	F
1	created_at	entry_id	Heart Rate	Temperature	Accelerometer	field4
2	2020-02-1	1	52	32.7		466
3	2020-02-1	2	43	32.7		219
4	2020-02-1	3	50	34.16		249
5	2020-02-1	4	62	34.65		471
6	2020-02-1	5	49	30.74		214
7	2020-02-1	6	51	32.7		222
8	2020-02-1	7	51	35.62	PATIENT FELL DOWN WHILE WAKING UP	492
9	2020-02-1	8	48	32.7	PATIENT FELL DOWN WHILE WAKING UP	333
10	2020-02-1	9	31	33.18		133
11	2020-02-1	10	16	34.16		285
12	2020-02-1	11	57	40.5		808
13	2020-02-1	12	17	34.16		0
14	2020-02-1	13	48	34.16		466
15	2020-02-1	14	51	36.6	PATIENT TRYING TO WAKEUP	543
16	2020-02-1	15	51	35.14	PATIENT TRYING TO WAKEUP	422
17	2020-02-1	16	43	30.74		267
18	2020-02-1	17	52	31.23		454
19	2020-02-1	18	51	32.7		305
20	2020-02-1	19	49	32.7		316
21	2020-02-1	20	33	32.7		324
22	2020-02-1	21	51	32.7		333
23	2020-02-1	22	51	33.67	PATIENT FELT RIGHT SIDE	400
24	2020-02-1	23	55	30.74	PATIENT FELT RIGHT SIDE	304
25	2020-02-1	24	49	33.18		374
26	2020-02-1	25	50	32.7	PATIENT FELT LEFT SIDE	578
27	2020-02-1	26	51	30.74	PATIENT FELL DOWN WHILE WAKING UP	512
28	2020-02-1	27	97	33.67	PATIENT FELL DOWN WHILE WAKING UP	670
29	2020-02-1	28	37	28.3		614
30	2020-02-1	29	78	33.18		555

Fig.14 Cloud Storage(Google Spread Sheets) for sensor data

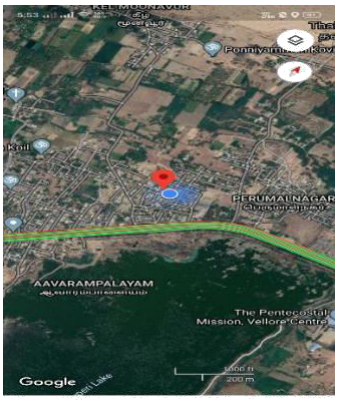


Fig.15 Screenshots Displaying the Location of Fall of Elderly People

VII CONCLUSION

The progress in bio medical engineering, science and technology paved way for new inventions and technologies. ARDUINO was found to be more compact, user friendly and less complex, which could readily be used in order to perform several tedious and repetitive tasks. Simulation is performed using Arduino software by placing appropriate sensors like temperature and heart beat rate for sensing the health condition and the results are monitored under normal conditions and abnormality conditions. For the purpose of improving the quality of medical care, more and more health care systems are intensely increasing. In our project, we propose a real-time FDS for seniors, which uses the MEMS acceleration sensor and quickly notifies the caretakers by using GSM of such an event through the smartphone. Therefore, it is possible to find the position more quickly in the case of emergency and to track the real-time position. We have monitored the Patient Health status simultaneously using Health care sensor and wireless technologies. We have developed a hardware for detecting the fall of elderly people.

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