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IOT ENABLED HEALTH MONITORING SYSTEM AND FALL DETECTION WITH GSM FACILITY

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ABSTRACT*:-*With an improvement in technology and miniaturization of sensors, there have been attempts to utilize the new technology in various areas to improve the quality of human life. One main area of research that has seen an adoption of the technology is the healthcare sector. The people in need of healthcare services find it very expensive this is particularly true in developing countries. As a result, this project is an attempt to solve a healthcare problem currently society is facing. The main objective of the project was to design a remote healthcare system. It's comprised of three main parts. Feedback actions based on the analyzed data can be sent back to the doctor or guardian through Email and/or SMS alerts in case of any emergencies. Loss of consciousness and fall-induced injury is one of the leading problems faced by the elderly. They are the leading cause for the transfer of senior citizens from the comfort of their residence to assisted care environments. The device mustn't be cumbersome, but rather wearable, so as to remove any social stigma related to the possession of such a device. It must have a high degree of reliability and differentiate activities of daily life from genuine falls. With the dawn of the IoT (Internet of Things) era, it is ideal that such a device be constantly relaying data via such a wireless network. This ensures seamless connectivity between the patient, doctor and relatives – and swift response.

1.INTRODUCTION

A Remote health monitoring system is an extension of a hospital medical system where a patient's vital body state can be monitored remotely. Traditionally the detection systems were only found in hospitals and were characterized by huge and complex circuitry which required high power consumption. Continuous advances in the semiconductor technology industry have led to sensors and microcontrollers that are smaller in size, faster in operation, low in power consumption and affordable in cost. This has further seen development in the remote monitoring of vital life
signs of patients especially the elderly. The remote health monitoring system can be applied in the following scenarios:

1.A patient is known to have a medical condition with unstable regulatory body system. This is in cases where a new drug is being introduced to a patient.

2. A patient is prone to heart attacks or may have suffered one before. The vitals may be monitored to predict and alert in advance any indication of the body status.

3.Critical body organ situation

4.The situation leading to the development of a risky life-threatening condition. This is for people at an advanced age and maybe having failing health conditions.

5.Athletes during training. To know which training regimes will produce better results.

In recent times, several systems have come up to address the issue of remote health monitoring. The systems have a wireless detection system that sends the sensor information wirelessly to a remote server. Some

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even adopted a service model that requires one to pay a subscription fee. In developing countries, this is a hindrance as some people cannot use them due to cost issue involved. There is also
the issue of internet connectivity where some systems to operate, good quality internet for a real-time remote connection is required. Internet penetration is still a problem in developing countries. Many of the systems were introduced in the developed countries where the infrastructure is

working perfectly. In most cases, the systems are adapted to work in developing countries. To reduce some of these problems there is need to approach the remote detection from a ground-up approach to suit the basic minimal conditions presently available in developing countries. A simple patient monitoring system design can be approached by the
number of parameters it can detect. In some instances, by detecting one parameter several readings can be calculated. For simplicity considerations parameter detection are: i) Single parameter monitoring system: In this instance, a single parameter is monitored e.g. Electrocardiogram (ECG) reading. From the ECG or heartbeat detection, several readings can be got
depending on the algorithm used. An ECG reading can give the heart rate and oxygen saturation. ii) Multi-parameter monitoring system: This has multiple parameters being monitored at the same time. An example of such a system can be found in High Dependency Units (HDU), Intensive Care
Units (ICU), during the surgery at a hospital theatre or Post surgery recovery units in Hospitals. Several parameters that are monitored include the ECG, blood pressure, respiration rate. The Multi parameter monitoring system basically proof that a patient is alive or recovering. In developing countries, just after retiring from their daily career routine majority of the elderly age group, move to the rural areas. In developed countries, they may move to assisted living group homes. This is where a remote health monitoring system can come in handy.

2. MATERIALS AND METHODS

A. Remote Health Monitoring

Remote health monitoring can provide useful physiological information in the home. This

monitoring is useful for elderly or chronically ill patients who would like to avoid a long hospital stay. Wireless sensors are used to collect and transmit signals of interest and a processor is programmed to receive and automatically analyze the sensor signals. In this project, you are to choose
appropriate sensors according to what you would like to detect and design algorithms to realize your detection.

During design the following characteristics of the future medical applications adhered

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a)Integration with current trends in medical practices and technology,

b)Real-time, long-term, remote monitoring, miniature, wearable sensors and long battery life of a designed device.
c) Assistance to the elderly and chronic patients. The device should be easy to use with minimal buttons.

B. Definition of Fall

A fall is defined as an event which results in a person coming to rest inadvertently on the ground or floor or other lower level. Fall-related injuries may be fatal or non-fatal though most are non-fatal. For example, of children in the People's Republic of China, for every death due to a fall, there are 4 cases of permanent disability, 13 cases requiring hospitalization for more than 10 days, 24 cases requiring hospitalization for 1–9 days and 690 cases seeking medical care or missing work/school

C. Types Of Falls

(i). Falls On A Single Level

Falls that occur while a person remains on a single working level are classified as “slips and falls” or sometimes “slips and trips.” Trips result from footways that are uneven, have curved surfaces, or are encroached by fixtures or equipment. Slips can also be a result of the materials coating the footway, for example ice or grease.

(ii). Falls On A Lower Level

Most fatalities and serious fall-related injuries result from falls from an elevated level to a lower level. Examples of falls to a lower level include persons falling from mezzanines or from the top of vehicles.

(iii). Swing Falls

Swing falls can also be categorized as a fall to a lower level, but these types of falls are unique. Swing falls occur when a person falls from an elevated platform while attached to a fall arrest system and the location of a system’s attachment point is not directly over the person’s head.

D. Phases Of Falls

A fall is generally the consequence of a normal activity of day-to-day life and is triggered by a hard-predictable event such as slips, trips or loss of balance. It is possible to distinguish five phases of fall.

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• Activity of daily living.
• Hard -predictable event.
• Free -fall.
• Impact.

E. Fall Detection

Fall detection is a major challenge in the public healthcare domain, especially for the elderly as the decline of their physical fitness, and timely and reliable surveillance is necessary to mitigate the negative effects of falls. Our develops a novel fall detection system based on a wearable device. The system monitors the movements of human body, recognizes a fall from normal daily activities by an effective quaternion algorithm, and automatically sends request for help to the caregivers with the patient's location. Several kinds of fall detection methods have been developed or applied in our life.

There are several kinds of detection methods which differ in constitution of motion sensors and detection algorithms. The first kind of detection method is using an accelerometer. A single triaxial accelerometer can provide object'saccelerations in three directions which include the influence of gravity. A coordinate will be built when the accelerometer is fixed on human's body. The influence of gravity or dynamic acceleration is available by using a low pass filter or a high pass filter. Some kinds of angular movement information can also be calculated based on the relationship between acceleration components and their vector sum.

In the existing system, we use active network technology to network various sensors to a single PMS. Patients' various critical parameters are

continuously monitored via single PMS and reported to the Doctors or Nurses in attendance for timely response in case of critical situations. The sensors are attached to the body of the patients without causing any discomfort to them. In this PMS we monitor the important physical parameters like body temperature, ECG, heart beat rate and blood pressure using the sensors which are readily

available. Thus, the analog values that are sensed by the different sensors are then given to a microcontroller attached to it. The microcontroller processes these analog signal values of health parameters separately and converts it to digital values using ADC converter. Now, the digitalized values from more than one microcontroller are sent

to the Central PMS. Each of the sensors attached microcontroller with a transceiver will act as a module which has its own unique ID. Each module

transmits the data wirelessly to the gateway attached to the PC of the Central PMS. The gateway is attached to the PC i.e. Central PMS which is situated in the medical center, is capable for selecting different patient IDs and allowing the gateway to receive different physical parameter values the patient specified by the ID. The software designed using Graphical User Interface (GUI) can operate on different physical parameters of each patient, consecutively with a specified time interval for each patient

3. RESULTS AND DISCUSSIONS

A. Accelerometer

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We used a accelerometer in this fall detection system. In order to sense angular position and acceleration we use the ADXL 337 MEMS- based accelerometer. It is a 3 axis system which gives analog output corresponding to the X, Y and Z axes of the orthogonal coordinate system. The advantage of this sensor is twofold-

i. Extremely low noise
ii. Low power consumption of approximately just 320 micro Amperes

B. Arduino Uno

The Uno is a microcontroller board that is based on the ATmega328. It is widely preferred for its ease-of-use, programming capabilities and large pool of online documentation. It operates on very low current of 40-50 mA and has a logic level of 0 to 5V. It possesses 14 digital I/O pins (6 with PWM functionality). 6 analog inputs, onboard LEDs, a reset switch and ceramic resonator. It can be supplied power through USB connection or external power jack. It has a memory size of 32 KB, programmable via Arduino IDE. One could otherwise employ IoT ready boards such as the Texas Instruments cc3200 or Arduino Yun or IoT implementable boards such
as the Intel Galileo.

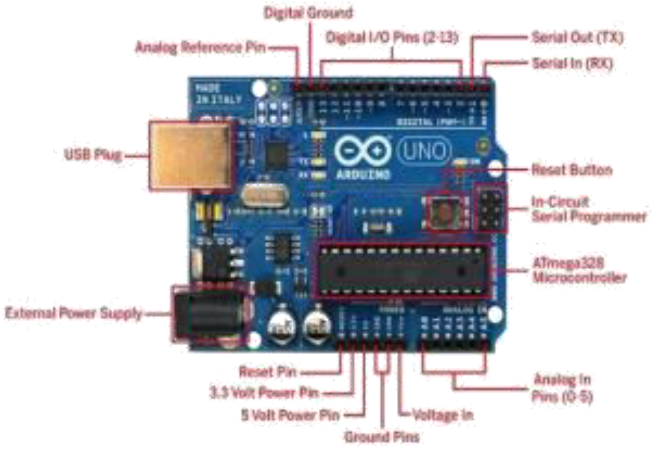

Fig :- 3.1 Arduino UNO

C. GSM Module

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM/GPRS Modem-RS232 is built with Dual Band GSM/GPRS engine- SIM900A, works on frequencies 900/ 1800 MHz The Modem is coming with RS232 interface, which allows you connect PC as well as microcontroller with RS232 Chip(MAX232). The baud rate is configurable from 9600-115200 through AT command. The GSM/GPRS

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Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply . Using this modem,you can make audio calls, SMS,

Fig 3.2. GSM Module

D. Piezo Buzzer

A buzzer is an audio signaling device, which may be mechanical, electromechanical or piezoelectric. Typical uses of buzzers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke. The working principle of this buzzer is that, whenever an electric potential is
applied across a piezoelectric material, a pressure

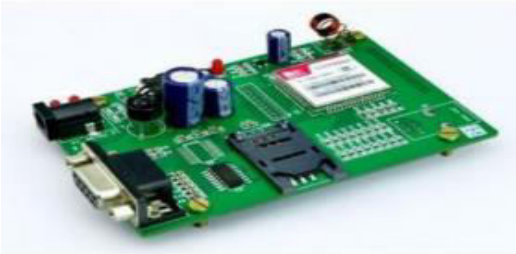

Fig:3.3 Piezo buzzer

E. Pressure Sensor

A pressure sensor, as the name suggests, is a device that senses and measures pressure (usually of gases or liquids). The pressure sensor in electronic circuits is in the form of an integrated circuit that acts as a transducer, that is, it replicates (in the form of an electrical signal) the signal it receives as a function of imposed pressure. A pressure sensor is also known as a pressure transducer, pressure transmitter, pressure sender, pressure indicator, piezo meter and manometer. This sensor is very easy to use, wire it with your board and here we go, there are also some useful codes in the sensor library. The optical system for heart beat measure consists of a LED that glow on the basis of light on the skin and a photodiode that receives the reflected light, and everytime there's a blood flow the light received by the photodiode changes value, and this signal should be clean from noises and amplified so it's easy to detect... But for a cheap one the two lasts operations are quiet dodgy.

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F. Humidity Sensor

A humidity sensor (or hygrometer) senses, measures and reports the relative humidity in the air. It therefore measures both moisture and air temperature. Relative humidity is the ratio of actual moisture in the air to the highest amount of moisture that can be held at that air temperature. The warmer the air temperature is, the more moisture it can hold. Humidity / dew sensors use capacitive measurement, which relies on electrical capacitance. Electrical capacity is the ability of two nearby electrical conductors to create an electrical field between them. The sensor is composed of two
metal plates and contains a non-conductive polymer film between them. This film collects moisture from the air, which causes the voltage between the two plates to change. These voltage changes are converted into digital readings showing the level of moisture in the air.

G. **Heartbeat Sensor**

Heartbeat sensor provides a simple way to study the function of the heart which can be measured based on the principle of psycho-physiological signal used as a stimulus for the virtual-reality system. The amount of the blood in the finger changes with respect to time. The sensor shines a light lobe (a small very bright LED) through the ear and measures the light that gets transmitted to the Light Dependent Resistor. The amplified signal gets inverted and filtered, in the Circuit. In order to calculate the heart rate based
on the blood flow to the fingertip, a heart-rate sensor is assembled with the help of LM358 OP-AMP for monitoring the heartbeat pulses.

4. CONCLUSION AND FUTURE WORK

The System is based on real-time monitoring and can be attached to the human body at ease. Therefore, the system interferes minimally with people performing their usual activities and can give the people concerned about the real-time information of elderly people. This usefulness allows the monitoring of people in their daily environment and can let alert their known as early as possible in an emergency situation. Also, we could distinguish the fall patterns when people sit, stand, fall forward and fall backward with our system by the threshold parameters that we have set. For future work, we will study other time delay related issues such as real-time applications, the use of different sorting techniques and optimization of various fall parameters to improve performance and the application can also be extended to allow the user to call emergency numbers as soon as the fall is detected.

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