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Real Time Outdoor Intelligent Healthcare Monitoring System for Elders and Heart Disease Patients using Smart Clothing

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ABSTRACT: In this paper a novel approach for patient management using telemonitoring system is presented. For monitoring patients at distance, various information technologies is used to transmit physiological signals and falling events to a healthcare center at any time and from any place. A systematic review on chronic illnesses such as pulmonary conditions, hypertension, and cardiovascular diseases is discussed here. The occurrence of the falling event, blood pressure and heart beat rate is simultaneously detected using the accelerometer sensor and arm cuff respectively. If any abnormalities detected, a notification is sent to the nearby health care system. These sensors are integrated in the normally using cloth. The Global Positioning System (GPS) is used to find the relative position of the patient during the abnormal conditions.

KEYWORDS: Global Positioning System (GPS), arm cuff, accelerometer sensor, pressure sensor, Zigbee, internet.

I.INTRODUCTION

Now a days, telemedicine information systems have become increasingly essential, particularly intelligent systems used to provide high-quality healthcare monitoring, which save on medical and manpower costs [1]-[8]. Due to the progress of civilization and medicine, the primary cause of death has changed from infectious to chronic diseases. Thus, rescuing elderly patients in the event of accidents and illness are of primary importance [9]. There are number of challenges should be overcome in developing a healthcare system, namely, 1) the timely and accurate delivery of physiological signals and the location of elderly patients to the healthcare center; and 2) the detection of any falling event of the elderly patients without the use of sensors through which a rescue notification is sent to the nearest healthcare centre and to the families concerned.

Several tending applications have conjointly been given. Lin et al. [10] proposed a period multiuser wireless physiological observance system with bidirectional communication. The system comprises mobile physiological examination devices that record body temperature, blood pressure, and pulse signals. Zhou Associate in Nursing Hour [11] planned a comprehensive internal organ observance system to support an present computing and period internal organ observance service. Additionally, the system presented four operation modes and outlined the transmission priorities of symptoms for totally different patients. However, the proposed instruments by each sculptor and Chou dynasty did not permit remote access from the tending center for immediate management of the system. An intelligent computer-aided nursing system planned by Wang et al. [12] examined blood pressure Associate in Nursing pulse signals using an intelligent tending box. A network simulator was used to simulate the physical signal in situ of a period experiment to alter the measure setup. Kang et al. [13] proposed Associate in nursing present integrated biotelemetry system for emergency tending application. The system was used to monitor the patient before arrival to the hospital. The corresponding physiological signals and video were sent to the hospital through a wireless network. The system recorded the ultrasonic graph and skin image of the patient, as proposed by Cheon et al. [14], and real-time N-to-N network communication was used to enhance the transmission performance of videos and therefore the continuous ECG waveforms.

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Vaidehi et al. [15] used a camera placed inside the space of a patient to find a falling event. The drawback of the system was that the patient had to remain within the same place for a chronic amount. Hsieh et al. [16] presented a system that utilizes a wrist-worn motion-sensing device to find falling events; the sensing device consists of a tri-axis measuring instrument and a three-axis rotating mechanism, but the location of falling objects couldn't be determined straight off. Wang et al. [17] proposed associate degree increased fall detection system primarily based on a sensible device worn on the body, for elderly observance and in operation through shopper home networks. Bai et al. [18] used the accelerometer of a smart phone to style and implement a fall monitor with a world positioning system (GPS) perform for the user; the system analyzes not solely the modification of acceleration however conjointly the six typical actions of humans.

In this paper, various sensors are used to implement the concept of telemonitoring. The accelerometer sensor, arm cuff are used to analyse the health condition of the patients. In this project, these sensors are integrated in the normally worn cloths of the humans. The GPS module is integrated with this system to send the location of the patient to the nearest health care system during abnormal condition. The system is programmed in such a way that it continuously monitors the humans at regular interval of time.

II. SYSTEM ARCHITECTURE

A healthcare system is helpful for older persons as a result of it allows them to require care of themselves on a daily, because the occurrences of accidents once associate older UN agency is alone is terribly dangerous. Thus, a healthcare system is projected to scale back medical prices. The proposed system will perpetually record the position standing and blood pressure of the patient. In the event of a fall or upon transmission of an abnormal BP signal, the device can send Associate in nursing emergency notification to each the attention center and a family member to facilitate emergency rescue.

A. Blood Pressure Monitor

Blood pressure monitor operation is predicated on the oscillometric method. This method takes advantage of the pressure pulsations taken throughout measurements. An occluding cuff is placed on the left arm Associate in Nursing is connected to an air pump and a pressure detector. Cuff is inflated until a pressure bigger than the typical pulse price is reached, then the cuff is slowly deflated. As the cuff deflates, when pulse pressure price approaches, pulsations start to seem. These pulsations represent the pressure changes due to ventricle contraction and might be wont to calculate the heartbeat rate. Pulsations grow in amplitude until mean blood vessel pressure (MAP) is reached, then decrease until they disappear. Fig. 1 shows the cuff pressure vs. pulsations. Oscillometric method determines the MAP by taking the cuff pressure once the pulse with the most important amplitude seems. Systolic and beat values are calculated victimization algorithms that vary among completely different medical instrumentality developers. Free scale Blood Pressure Monitor calculates the systolic and blood pressure by considering that blood pressure is close to adequate to the pressure menstruation taken within the cuff once a pulse with seventieth of the amplitude of the MAP pulse seems whereas the cuff pressure is on top of the MAP price. Diastolic pressure is close to adequate to the cuff pressure price registered once a pulse with five hundredth of the MAP pulse amplitude seems whereas the cuff pressure is underneath the MAP price.

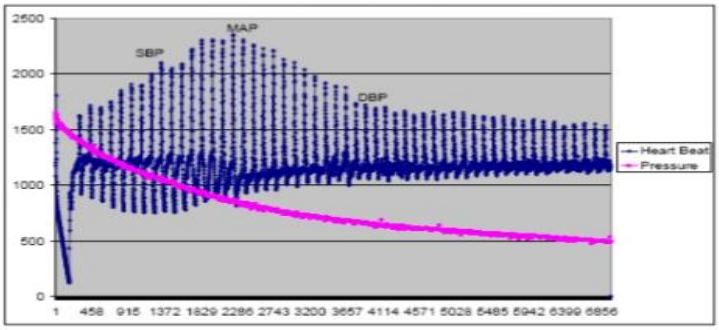

Fig. 1. Cuff Pressure vs Heartbeat Signal

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MED-BPM Analog Front End (AFE) may be a demo board designed for work as a pressure monitor in conjunction with a Free scale medical-oriented MCU. MED-BPM communicates with the MCU using the medical connection, and allows for straightforward prototyping and reduced time to plug by exploitation the free scale Tower System. MED-BPM block diagram is shown below (MED-BPM analog front end).

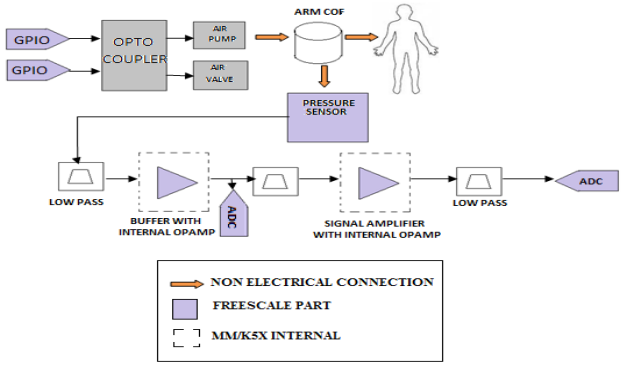

Fig. 2. MED-BPM Block Diagram

B. Arm Cuff Pressure Control

MED-BPM works using associate oscillometric technique for blood pressure measurements. This is a non-invasive technique which needs associate external arm cuff so as to impede the patient's arm and find the heartbeat and heartbeat blood pressure. The arm cuff is inflated using associate external air pump controlled with associate MCU GPIO pin, and deflated by activating an escape valve with another GPIO pin. Because the current provided by the USB port (500 mA) isn't enough to activate the pump and also the valve (600 mA), those external components area unit activated by exploitation associate external power supply that provides adequate current. An optocoupler is required for coupling MCU management signals with the parts to activate. Fig. 3. shows the coupling stage. Output from the optocoupler is connected to a MOSFET working as a switch, so the pump and valve mechanisms will be activated with success.

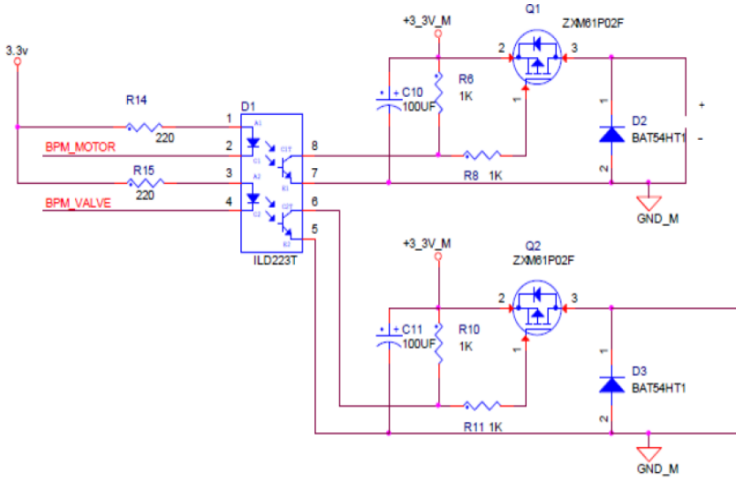

Fig. 3.Coupling Stage

C. Pressure Sensor

The functionality of the oscillometric methodology is based mostly on the activity of the pressure variations within the arm cuff. Pressure in the cuff is measured by using the free scale Pressure detector MP3V5050 that integrates on-

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chip, bipolar OpAmp circuitry and skinny film resistance networks to give a high signal and temperature compensation. Main characteristics of the MP3V5050 are featured in the following table

TABLE I. MPV3V5050 MAIN CHARACTERISTICS

Characteristic	Value	Unit
Pressure range	1–50	kPa
Supply voltage	2.7–3.3	V_{DC}
Accuracy	±2.5	$\%V_{FSS}$
Sensitivity	54	mV/kPa

D. Accelerometer Sensor

The ADXL335 is a complete 3-axis acceleration measurement system. The ADXL335 has a measurement vary of ±3 g mini-mum. It contains a polysilicon surface-micro machined sensor associated signal learning electronic equipment to implement an open-loop acceleration measure design. The output signals area unit analog voltages that are proportional to acceleration. The accelerometer will live the static acceleration of gravity in tilt-sensing applications as well as dynamic acceleration ensuing from motion, shock, or vibration.

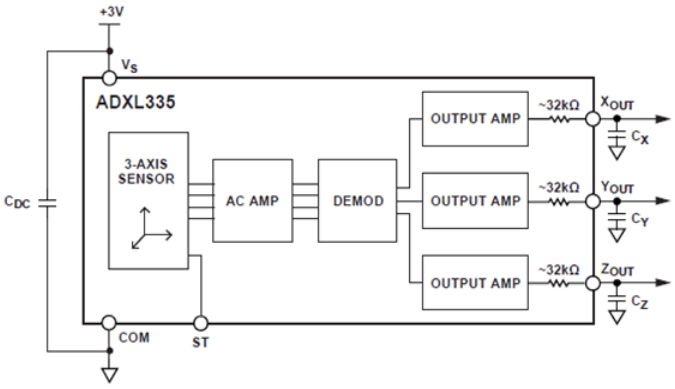

Fig.4. Functional Block Diagram

The sensor is a polysilicon surface-micro machined structure designed on high of a semiconducting material wafer. Polysilicon springs suspend the structure over the surface of the wafer and provide a resistance against acceleration forces. Deflection of the structure is measured using a differential condenser that consists of freelance mounted plates and plates hooked up to the moving mass. The fixed plates area unit driven by 180° out-of-phase sq. waves. Acceleration deflects the moving mass and unbalances the differential capacitor ensuing in a detector output whose amplitude is proportional to acceleration. Phase-sensitive demodulation techniques area unit then used to verify the magnitude and direction of the acceleration.

The demodulator output is amplified and brought off-chip through a thirty two kΩ resistance. The user then sets the signal bandwidth of the device by adding a condenser. This filtering improves measurement resolution and helps stop aliasing.

III. SYSTEM IMPLEMENTATION

As shown in Fig. 4, a prototype of the telemonitoring system is the BP monitor's physical signals to record the position of the elderly and to transmit the data. An PIC micro controller, including the BP monitor, blood pressure

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sensor, accelerometer sensor, GPS, and ZigBee modules, the details of which are described in the following subsections.

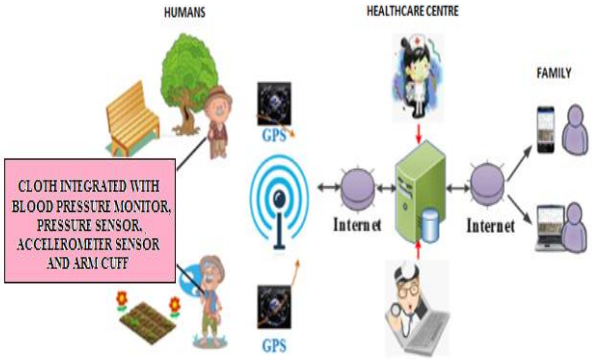

Fig. 5. Architecture Of The Healthcare System

A. Gps Module

An analysis board with a GPS chipset is adopted to implement the GPS module. The position data of international Positioning System Fix knowledge [19] and RMC parameters received from the GPS module are transmitted to the PIC through a UART serial instrumentation. The 16-bit microprocessor in the verification board detects the autumn per the GGA and RMC parameters, and the blood pressure examination knowledge is kept within the SDRAM. The GPS receiver standard interface with NMEA 0183 [19] is used to estimate altitude difference and attraction acceleration. The information on the aged, including time, position, and related knowledge, is recorded in GGA format. Moreover, the RMC can offer the minimum navigation data. According to the info format (GGA and RMC), the altitude difference and attraction acceleration will be calculated. The data on GGA and RMC also are illustrated.

B. Zigbee RF Transceiver Modules

The ZigBee transmitter is connected to the PIC, and the ZigBee receiver is integrated with the pc server via Ethernet to speak with the aid centre. A ZigBee development board with an embedded chipset is adopted to establish wireless communication. The chipset is compatible L.-H. Wang et al. An outside Intelligent aid displays for the aged 131 with IEEE 802.15.4 and possesses a cheap, low-power, and high-mesh wireless controller to convey the captured blood pressure signal expeditiously and properly.

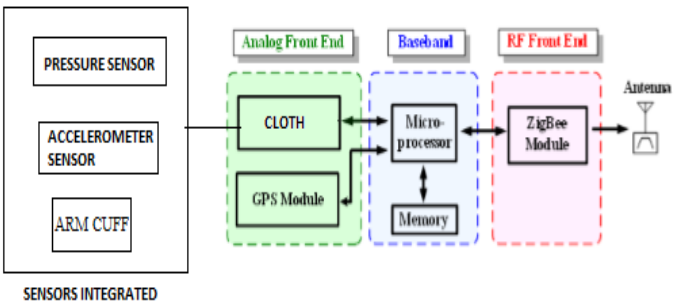

Fig. 6. Block Diagram of The Smart Clothing

C. Health Care Centre

The healthcare centre receives the patient data, including personal identification information (ID), name, and status, which square measure hold on in the info. In the surveillance shopper, doctors and nurses can monitor physical signals

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through the police work monitor, as shown in Fig. 5. If the patient falls, the rescue notification given by the integrated sensors is sent to the medical staff and family at once.

IV. EXPERIMENTAL RESULTS

The experiment on fall detection is based on observations of aged behaviour. The integrated sensors is an auxiliary equipment that monitors the GPS and EKG information to evaluate the position and examine the physical signals, respectively. The fall is decided by the altitudinal modification of the antenna position on the GPS module. Movement, location variation, and environmental interference present challenges to the productive chance and accuracy of detection. The hardware circuit connections in proteus is shown in Fig.7

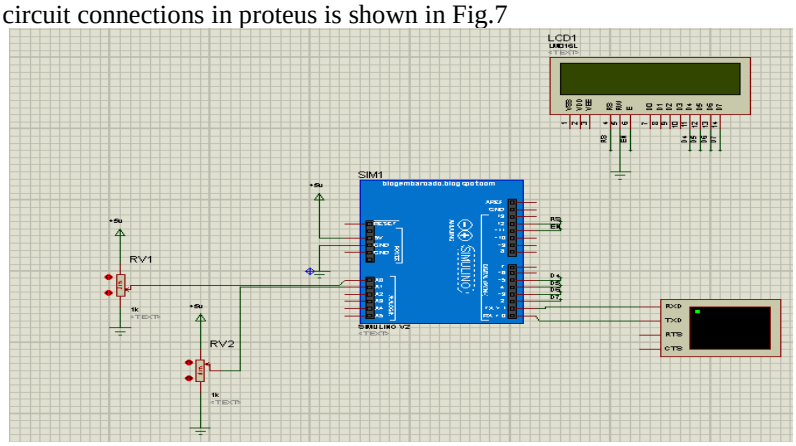

Fig. 7. Initial Circuit Diagram

In Fig.8. the output has no response as the heart beat sensor and motion sensor values are normal.this shows that the patient is safe.

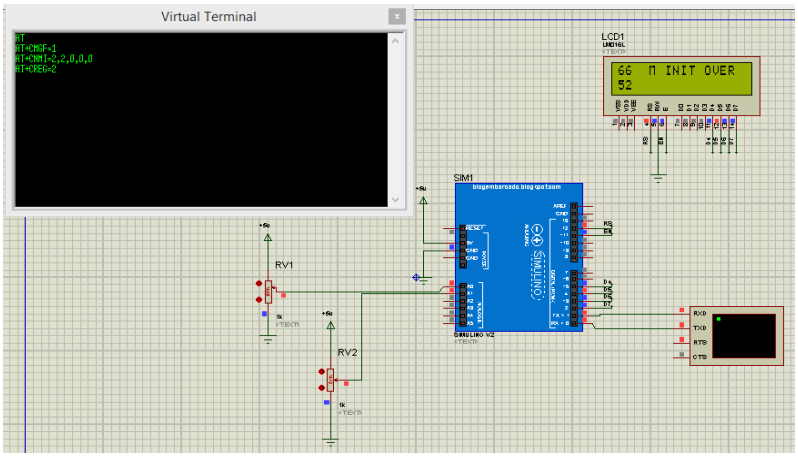

Fig. 8. HBS-normal AM-Normal

The output has no response when the heart beat sensor is normal and motion sensor abnormal is shown in Fig.9. Here the status of the patient may be falling dowm or he may be lying.The output is indicated to the patient when the heart beat sensor is abnormal and motion sensor normal is shown in Fig.10. Here the status of the patient may abnormal pulse or sensor may be removed.

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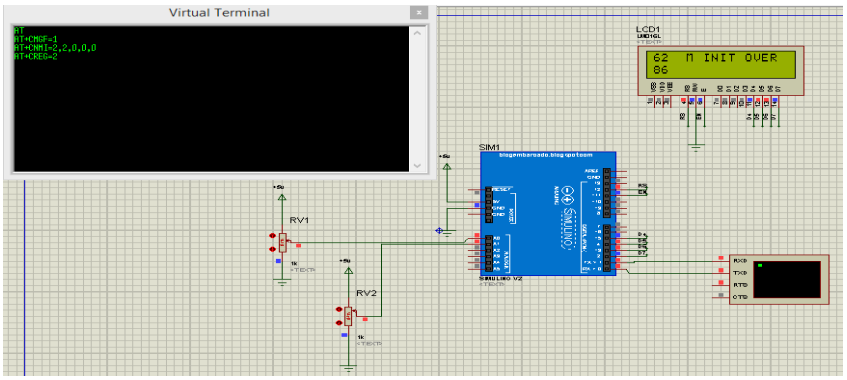

Fig. 9. HBS-normal AM-Abnormal

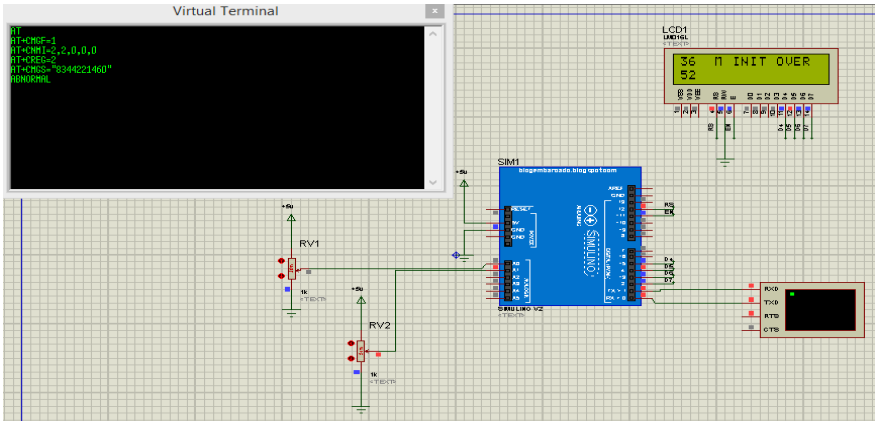

Fig. 10. HBS-Abnormal AM-Normal

The output is to provide rescue operation when the heart beat sensor is normal and motion sensor abnormal is shown in Fig.11. Here the status of the patient is at risk.

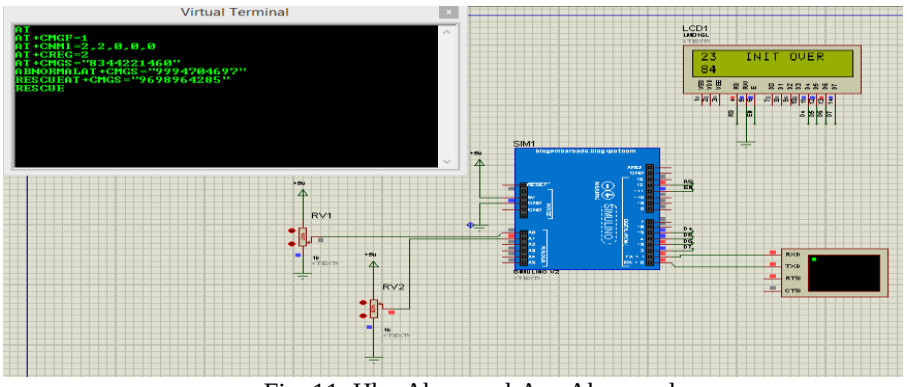

Fig. 11. Hbs-Abnormal Am-Abnormal

V. CONCLUSION

An intelligent tending system was projected to monitor the condition of aged persons employing various sensors in the normally worn cloths. The proposed system will assist doctors and nurses in right away perceptive the physical

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condition of their aged patients. The sensors were enforced to collect the situation knowledge and examination signals exploitation GPS and EKG acquisition modules, respectively. The system can discover whether or not the person is falling by analyzing the collected GPS info. The blood pressure module is associate degree auxiliary equipment that is accustomed confirms the standing of aged patients. The healthcare center would be notified that would like for rescue once the autumn was unendingly detected supported the GPS and EKG interaction observance info.

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