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ANDROID BASED FALL ACCIDENT DETECTION POSITIONING AND RESCUE SYSTEM

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ABSTRACT

In this project deals with the RARe Fall system, which is a real-time activity recognition and fall detection system. It is tuned for robustness and real-time performance by combining human-understandable rules and classifiers trained with machine learning algorithms. The system consists of two wearable accelerometers sewn into elastic sports-wear, placed on the abdomen and the right thigh. The recognition of the user's activities and detection of falls is performed on a laptop using the raw sensors' data acquired through Bluetooth. The offline evaluation of the system's performance was conducted on a dataset containing a wide range of activities and different types of falls. The F-measure of the activity recognition and fall detection were 99% and 78%, respectively. Additionally, the system was evaluated at the EvAAL-2013 activity recognition competition and awarded the first place, achieving the score of 83.6%, which was for 14.2 percentage points better than the second-place system. The evaluation was performed in a living lab using several criteria: recognition performance, user acceptance, recognition delay, system installation complexity and interoperability with other systems.

Keywords: RARe Fall, dataset, Bluetooth

INTRODUCTION

Fall accident has been the major cause of injury to the elderly in recent years. To protect the elderly from the injury of fall accident events or to give an immediate assistance to the elderly after the occurrence of a fall accident event, many researches have been devoted to the design of a fall detection algorithm and system. The world's population is aging rapidly, threatening to overwhelm the society's capacity to take care of its elderly members. The percentage of persons aged 65 or over in developed countries is projected to rise from 7.5% in 2009 to 16% in 2050. This is driving the development of innovative ambient assisted living (AAL) technologies to help the elderly live independently for longer and with minimal support from the working-age population. To provide timely and appropriate assistance, AAL systems must understand the user's situation and context, making activity recognition (AR) an essential component. Fall detection (FD) is an important component of many AAL systems because approximately half of the hospitalizations of the elderly are caused by falls. Fear of falling is an important cause for nursing home admission, and "the long lie" (not being able to get up and call for help) is a good predictor of death within six months.

In our project we present the RAReFall system, for the fall accident detection and corresponding wide area rescue system based on a smart phone. This is a real-time activity recognition and fall detection system. It is tuned for robustness and real-time performance by combining human-understandable rules and classifiers trained with machine learning algorithms. The system consists of two wearable

accelerometers sewn into elastic sports-wear, temperature sensor and blood pressure sensor. One accelerometer is placed on the abdomen and another is placed on the right thigh. Once a fall accident event is detected, the user's position of the longitude and latitude data can be acquired by the global positioning system (GPS) or the assisted GPS (A-GPS), and sent to the android mobile through GSM so that the user can get medical help immediately and the recognition of the user's activities also sends. If any one of the temperature or blood pressure sensor parameter is abnormal means the sensed data is immediately send to the registered android mobile. The evaluation was performed in a living lab using several criteria: recognition performance, user acceptance, recognition delay, system installation complexity and interoperability with other systems. Moreover, as we will see in the experiment that a distinguished fall accident detection accuracy up to 92% on the sensitivity and 99.75% on the specificity can be obtained.

SYSTEM IMPLEMENTATION

1.TEMPERATURE SENSOR LM 35:

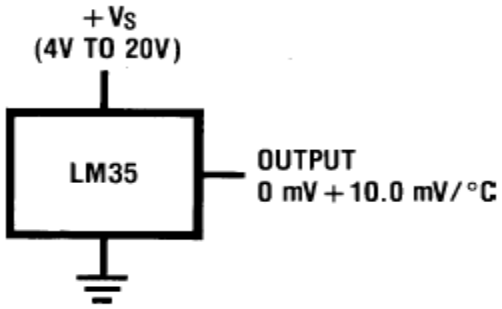
GENERAL DESCRIPTION:

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

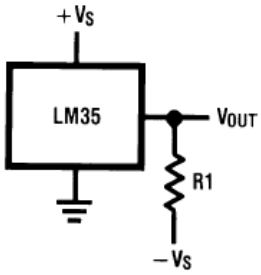
FEATURES:

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee able (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±1⁄4°C typical

Low impedance output, 0.1 W for 1 mA load



Basic Centigrade Temperature Sensor (+2°C to +150°C)



Choose $R_1 = -V_S/50\ \mu A$
V_{OUT} = +1,500 mV at +150°C
= +250 mV at +25°C
= −550 mV at −55°C

Full-Range Centigrade Temperature Sensor

APPLICATION:

The LM35 can be applied easily in the same way as other integrated-circuit temperature sensors. It can be glued or cemented to a surface and its temperature will be within about 0.01°C of the surface temperature. This presumes that the ambient air temperature is almost the same as the surface temperature; if the air temperature were much higher or lower than the surface temperature, the actual temperature of the LM35 die would be at an intermediate temperature between the surface temperature and the air temperature.

This is especially true for the TO-92 plastic package, where the copper leads are the principal thermal path to carry heat into the device, so its temperature might be closer to the air temperature than to the surface temperature. To minimize this problem, be sure that the wiring to the LM35, as it leaves the device, is held at the same temperature as the surface of interest.

The easiest way to do this is to cover up these wires with a bead of epoxy which will insure that the leads and wires are all at the same temperature as the surface, and that the LM35 die's temperature will not be affected by the air temperature.

2.BLOOD PRESSURE SENSOR:

Reads blood pressure and heart rate and outputs at 9600 baud rate.

Blood Pressure & Pulse reading are shown on display with serial out for external projects of embedded circuit processing and display. Shows Systolic, Diastolic and Pulse Readings. Compact design fits over your wrist like a watch. Easy to use wrist style eliminates pumping.

FEATURES:

- Intelligent automatic compression and decompression
- Easy to operate, switching button to start measuring

- 60 store groups memory measurements
- Can read single or all measures
- 3 minutes automatic power saving device
- Intelligent device debugging, automatic power to detect
- Local tests for : wrist circumference as 135-195mm
- Large-scale digital liquid crystal display screen, Easy to Read Dsplay
- Fully Automatic, Clinical Accuracy, High-accuracy
- Power by External +5V DC
- Serial output data for external circuit processing or display.

SPECIFICATION:

- Working Voltage: +5V, 200Ma regulated
- Output Format :Serial Data at 9600 baud rate(8 bits data, No parity, 1 stop bits). Outputs three parameters in ASCII.
- Sensing unit wire length is 2 meters

SENSOR PINOUTS:

- TX-OUT = Transmit output. Output serial data of 3V logic level, Usually connected to RXD pin of microcontrollers/RS232/USB-UART.
- +5V = Regulated 5V supply input.
- GND = Board Common Ground
-

BLOOD PRESSURE BASICS:

Blood pressure is the pressure of the blood in the arteries as it is pumped around the body by the heart. When your heart beats, it contracts and pushes blood through the arteries to the rest of your body. This force creates pressure on the arteries. Blood pressure is recorded as two numbers— the systolic pressure (as the heart beats) over the diastolic pressure (as the heart relaxes between beats). The unit which measures this is called Sphygmomanometer.

Monitoring blood pressure at home is important for many people, especially if you have high blood pressure. Blood pressure does not stay the same all the time. It changes to meet your body's needs. It is affected by various factors including body position, breathing or emotional state, exercise and sleep. It is best to measure blood pressure when you are relaxed and sitting or lying down.

Classification of blood pressure for adults (18 years and older)

	Systolic (mm Hg)	**Diastolic (mm Hg)**
Hypotension	< 90	< 60
Desired	90–119	60–79
Prehypertension	120–139	80–89
Stage 1 Hypertension	140–159	90–99
Stage 2 Hypertension	160–179	100–109
Hypertensive Crisis	≥ 180	≥ 110

High blood pressure (hypertension) can lead to serious problems like heart attack, stroke or kidney disease. High blood pressure usually does not have any symptoms, so you need to have your blood pressure checked regularly.

OUTPUT READINGS:

Following are example output readings from sensor. Each reading consist of **15 bytes** at 9600 baud rate. The reading packet's last byte is always enter key character(0x0A in hex and 10 in decimal) so you can view each reading on new line. Also this character can be used to sync in microcontrollers after reach readings.

The output reading is 8bit value in ASCII format fixed digits, from 000 to 255.Typical reading will be like below where the three values 22eparated by comma and space.

- Systolic
- Diastolic
- Pulse

BLOOD PRESSURE UNIT:

3. ACCELERATION SENSOR:

Accelerometer sensor can measure static(earth gravity) or dynamic acceleration in all three axis. Application of the sensor is in various fields and many applications can be developed using this sensor.

Accelerometer sensor measures level of acceleration where it is mounted this enable us to measure acceleration/deceleration of object like car or robot, or tilt of a platform with respected to earth axis, or vibration produced by machines. Sensor provides 0G output which detect linear free fall.

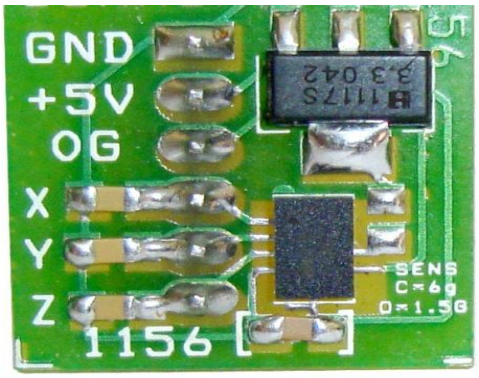


Figure Accelerometer sensor

Acceleration is a vector force which has direction and measured in meters per second. Earth produces gravitational acceleration on all objects on earth. By monitoring the three axis acceleration one can measure the level of tilt of any platform.

FEATURES:

- Simple to use
- Analog output for each axis
- +5V operation @1ma current
- High Sensitivity (800Mv/g @ 1.5g)
- Selectable Sensitivity (+- 1.5g, +- 6g)
- 0g detect for free fall detection
- Robust design, high shock survivability
- Low Cost

APPLICATION:

- 3D Gaming: Tilt and Motion Sensing, Event Recorder
- HDD MP3 Player: Freefall Detection
- Laptop PC: Freefall Detection, Anti-Theft
- Cell Phone: Image Stability, Text Scroll, Motion Dialing, E-Compass
- Pedometer: Motion Sensing / PDA: Text Scroll
- Navigation and Dead Reckoning: E-Compass Tilt Compensation
- Robotics: Motion Sensing
-

PROPOSED SYSTEM

GSM

A **GSM modem** is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages.

A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities. For the purpose of this document, the term GSM modem is used as a generic term to refer to any modem that supports one or more of the protocols in the GSM evolutionary family, including the 2.5G technologies GPRS and EDGE, as well as the 3G technologies WCDMA, UMTS, HSDPA and HSUPA.

A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, such as the Falcom Samba 75. (Other manufacturers of dedicated GSM modem devices include Wavecom, Multitech and iTegno. We've also reviewed a number of modems on our technical support blog). To begin, insert a GSM SIM card into the modem and connect it to an available USB port on your computer.

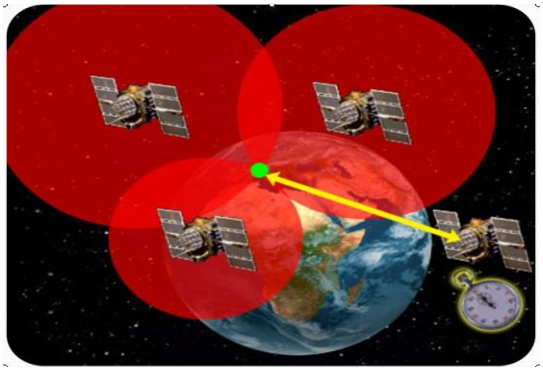
A GSM modem could also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port or USB port on your computer. Any phone that supports the "extended AT command set" for sending/receiving SMS messages, as defined in ETSI GSM 07.05 and/or 3GPP TS 27.005, can be supported by the Now SMS & MMS Gateway. Note that not all mobile phones support this modem interface. Due to some compatibility issues that can exist with mobile phones, using a dedicated GSM modem is usually preferable to a GSM mobile phone. This is more of an issue with MMS messaging, where if you wish to be able to receive inbound MMS messages with the gateway, the modem interface on most GSM phones will only allow you to send MMS messages. This is because the mobile phone automatically processes received MMS message notifications without forwarding them via the modem interface. It should also be noted that not all phones support the modem interface for sending and receiving SMS messages. In particular, most smart phones, including Blackberries, iPhone, and Windows Mobile devices, do not support this GSM modem interface for sending and receiving SMS messages at all at all. Additionally, Nokia phones that use the S60 (Series 60) interface, which is Symbian based, only support sending SMS messages via the modem interface, and do not support receiving SMS via the modem interface.

GPS (GLOBAL POSITIONING SYSTEM):

Official name of GPS is NAVigational Satellite Timing And Ranging Global Positioning System (NAVSTAR GPS).Global Positioning Systems (GPS) is a form of Global Navigation Satellite System (GNSS)Only. completely functional one of its kind at this time.First developed by the United States Department of Defense.Consists of two dozen GPS satellites in medium Earth orbit (The region of space between 2000km and 35,786 km). Made up of two dozen satellites working in unison are known as a satellite constellation.This constellation is currently controlled by the United States Air Force 50th Space Wing.It costs about $750 million to manage and maintain the system per year.Mainly used for navigation, map-making and surveying.

OPERATION:

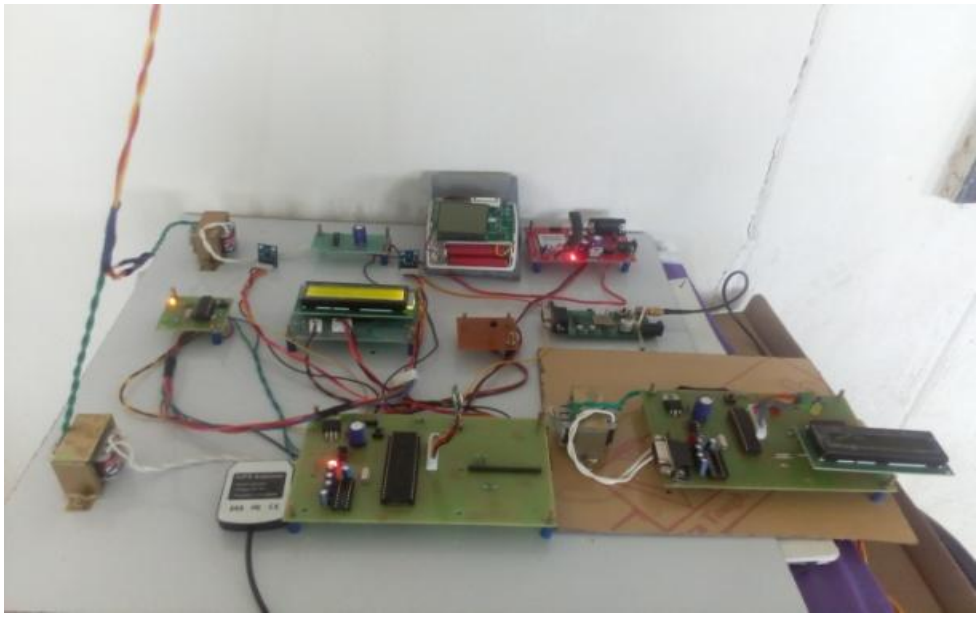
A GPS receiver can tell its own position by using the position data of itself, and compares that data with 3 or more GPS satellites.To get the distance to each satellite, the GPS transmits a signal to each satellite. The signal travels at a known speed. The system measures the time delay between the signal transmission and signal reception of the GPS signal.The signals carry information about the satellite's location.Determines the position of, and distance to, at least three satellites, to reduce error.



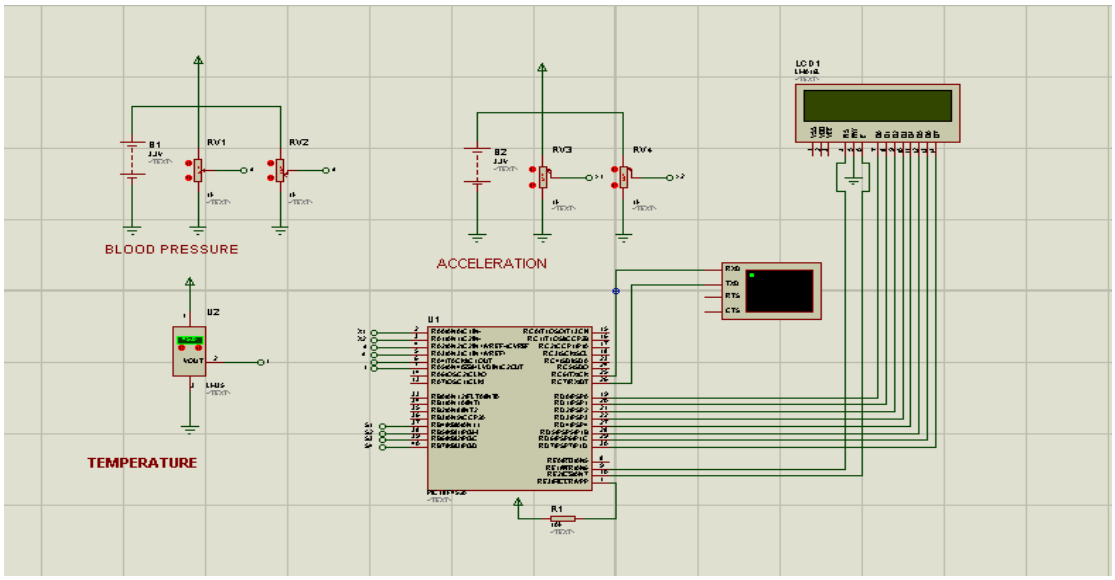
GPS FUNCTIONALITY:

- GPS systems are made up of 3 segments
  - Space Segment (SS)
  - Control Segment (CS)
  - User Segment (US

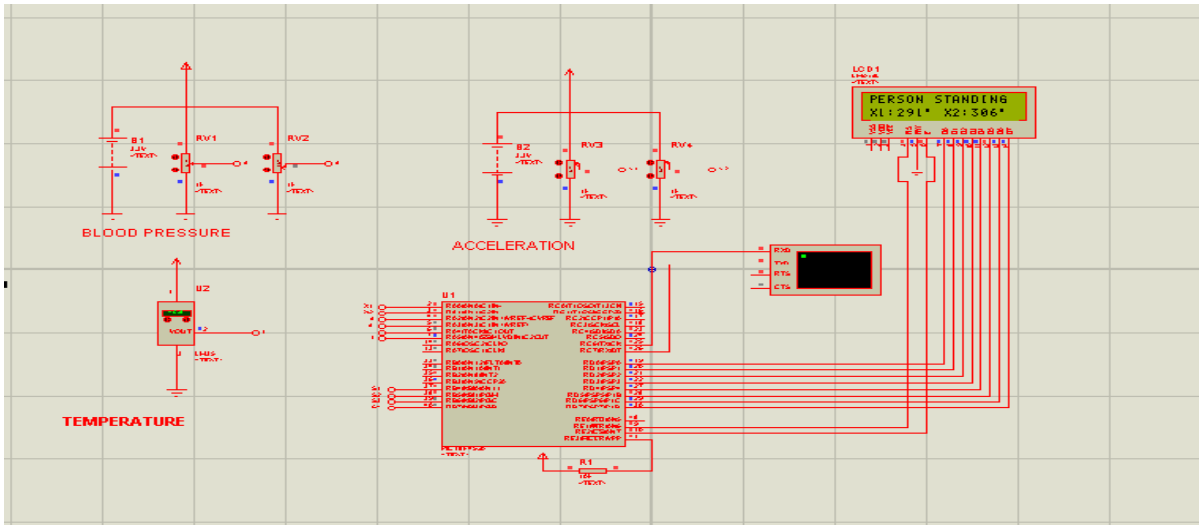
HARDWARE IMPLEMENTATION



SIMULATION IMPLEMENTATION



SIMULATION RESULT



CONCLUSION

This paper and demo presented a system for real-time AR andFD, called RAReFall. It was designed for robust performancein real life, so it uses a combination of relatively mature butfinely tuned methods. The competition setting is closer to reallife than most AR evaluations, so our result at the competitionis evidence of RAReFall's practical applicability.

While sewing the sensors into clothing contributed to useracceptance, more work on ergonomics is needed. A smartphone implementation is also considered for future development.

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