Anti Falling System for Elderly People Based on Single Chip Microcomputer

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Abstract. With the aggravation of the aging population, tha demand for home care of the elderly is increasing day by day. When the old people accidentally fall down without timely help, there will be very serious consequences. This paper designed a fall detector based on ADXL343 triaxial acceleration sensor, msp430-f149 low-power single-chip computer and master control module, remote communication module, fall detection module, GPS positioning module, voice alarm module and recording module. The three-axis acceleration sensor is used to collect the human body's three-dimensional acceleration value, and the single chip computer is used for analysis and calculation. The results are sent to the upper computer or mobile phone through the remote communication module. When a fall is detected, the mobile phone or upper computer sends an alarm signal to inform children or designated personnel such as the hospital. By analyzing the acceleration sensor data and writing software algorithm to judge human posture; Normal alarm after the old man falls; Analyze the possible false alarm phenomenon, judge whether the alarm is abnormal, and set the acceleration threshold to reduce the possibility of misjudgment. Set the button to prevent false alarm, and when the movement amplitude of the elderly is too large, the detector error alarm can be manually cancelled.

Introduction

With the rapid development of science, technology and social economy, people's quality of life has made a leap, but also brought a negative product. Population aging is one of them. It not only leads to the drastic reduction of social labor force and imbalance of labor, but also occupies more social resources to help the old and provide for the aged, which increases the economic burden of the society, the government and the family[1-3]. At present, China is still in the primary stage of socialism. The social status quo of getting old before getting rich makes the social burden of aging population become a huge challenge. According to statistics, falls are the leading cause of non-pathological hospitalization and death in elderly people aged 60 years and above, and the proportion is still increasing every year. At present, there is a lack of mature products to protect, predict and alarm the elderly people who fall. The misjudgment of elderly people's falling behavior and other similar processes is particularly obvious, and there are still many key scientific and technological problems to be solved in this field[4-6].Affected by the one-child policy and the rapid development of society, great changes of China's population structure, the aging situation is increasingly serious, the future of the society, growing competition pressure increasing, the younger generation of life outside of work is difficult to have more energy to care for the elderly[7,8], many old people can't get the proper care, multifunction remote monitoring system[9,10] is designed to solve the problem of old people who live alone no one to take care of this.Combined with advanced microcontroller technology, sensor technology, wireless network technology and android client development technology, this system can realize real-time monitoring of human body temperature, heart rate and location when falling. The main service object of this system is the elderly living alone, and of course it can also be used by other people who need this system.

Overall Concept Design

The elderly fall location alarm belt system includes the main control module, remote communication module, fall detection module, GPS positioning module, voice alarm module and recording module.The guardian and the system communicate with each other through mobile communication network. The overall system design block diagram is shown in figure 1. When the normal activity of the old man, the fall detection module of gyro moment on the old position change monitoring, once more than warning value, fall detection module produces a fall Alarm signal to the main control module, main control module controls the voice alarm module to produce alarm sound immediately around the old man's attention and control to record the sound module began to record the sound of the scene.At the same time, the GPS positioning module extracts the longitude and latitude positioning information of the elderly location and sends it to the master control module, and then sends the fall alarm information and longitude and latitude positioning information to the guardian through the remote communication module. The guardian can reply corresponding instructions and control the whole system to complete corresponding actions as required, such as turning off the alarm sound, reacquiring the positioning information, making phone calls, etc. In this way, the real-time situation of the elderly can be timely and effectively mastered, so as to arrive at the scene in time to deal with relevant issues after the incident.

The design of the reset circuit, its performance determines whether the single-chip computer can be restored to normal working state in time through the reset if the phenomenon such as "crash" or "run and fly" occurs during the operation of the system. In this system, power on reset is adopted, and high level of RST pin is ensured by 100k pull-up resistance and capacitance of 0.1uf. However, due to the characteristics of ultra-low power consumption of MSP430F149 single chip microcomputer, the phenomenon that the charge stored in the capacitance of the system fails to be fully released immediately after power failure occurs. Therefore, a diode IN4008 is added at both ends of the resistance in the design to discharge rapidly, thus improving the reliability of the reset circuit.

Power module considering the convenience of system use, the power supply of this system adopts 3.7v lithium battery.The power supply of GSM module is realized by adding filtering and decoupling capacitance on the 3.7v power supply.In addition, the power supply of MSP430F149 single chip and ADXL345 acceleration sensor requires a voltage of 3.3v, so ame8827-3.3 stabilized voltage module is adopted in this design to complete the output of 3.3v voltage. AME8827 3.3 is a kind of low dropout linear regulators, its input voltage range of 2.5-5.5 V, 3.3 V can be fixed output voltage, the peripheral circuit is simple, only need to input a 1 uf capacitance in parallel to suppress noise and improve the circuit transient response, the output end and united a 4.7 uf capacitor to reduce the output noise and negative transient response of the circuit.

In the fall detection system based on acceleration sensor, this paper constructed by ADXL343 triaxial acceleration sensor, a F149 MSP430 MCU, low power consumption NRF24L01 ultra low power wireless communication module, GPRS module as the main component of real-time fall detection system, based on the human body three axis acceleration fall detection algorithm for synthesis of threshold value, and to conduct a comprehensive system of repeatability test, verify the feasibility of the system.

Hardware Design

This system adopts the ADXL343 triaxial acceleration sensor, a F149 low power consumption MCU MSP430 connection complete home old man fall detection, real-time detection by ADXL343 triaxial accelerometer old man walk three axial acceleration, and then by the MSP430 F149 low-power microcontroller in collected data to determine whether the old man fell down, in the event of falling phenomenon, is the first time via the GSM short message to his family.

The hardware includes main control module, remote communication module, fall detection module, GPS positioning module, voice alarm module and recording module. The main control module USES the chip STM32F103 as the control chip of the whole system. It is responsible for the determination of

the fall alarm signal, the extraction of GPS positioning information, the processing of the guardian's control command, the control of the message sending and receiving of the remote communication module and the switch of the alarm sound in the voice alarm module.

Three-axis accelerometer can collect real-time triaxial acceleration of the human body and through 12 c interface is sent to the single-chip microcomputer, microcomputer data processing through the wireless module is sent to the upper monitoring platform, single-chip microcomputer and upper monitoring platform using the threshold value judgment algorithm to determine the threshold, if the judge falls, superior sound an alarm, while GPRS SMS module sent text messages to friends and family and children.

Main Control Module.

The main control module is the core of the elderly falling location alarm belt system based on mobile communication, which controls the operation of the whole system. It mainly includes GPS control unit, gyroscope control unit, information processing unit, remote communication control unit and voice control unit. The GPS control unit is the program to control the GPS signal acquisition. The program processes the information collected by GPS and extracts the required positioning information. By comparing the monitoring value returned by the gyroscope with the warning value in the program, the program determines whether a fall occurs and generates a fall alarm signal. The information processing unit, which analyzes and stores the signals of each unit for use by other units, is the center of information convergence. The remote communication communication control unit is the communication bridge between the system and the guardian. It controls the communication between the remote communication module and the guardian. It is responsible for sending the old man's falling alarm information and longitude and latitude information to the guardian. The voice control unit is responsible for controlling the voice alarm module to generate alarm sound when there is a fall alarm signal, so as to attract the attention of people around so as to timely help the elderly.

Voice Alarm Module.

Voice alarm module is controlled by a master, once fell alarm signal can make the timer interrupt, enter the interrupt service subroutine produce high and low level of different frequency to drive the buzzer to approximate the police car alarm sound, to attract the attention of the people around, in time for the old man to ask for the help you can reach. Alarm sound can be sent by the guardian control command and the system with the close button closed.

Detection Module.

Initialization gyroscope will move in different directions according to the objects produce different parameter values, this value passed to the main control module fall detection program and compared with early warning value than the right, if beyond the early warning value fall accident, decision is what is immediately rises fall alarm signal trigger the voice alarm module, the remote communication module, audio module function.The module ures mpu-6050, which is a MEMS3 axis accelerometer from ADI's digital output. The device has an ultra-low power consumption of 40uA ~ 145uA, standard C interface, level 32 FIFO storage, a variety of in-built motion state detection options, and a living interrupt system. Using these functions can greatly simplify the falling algorithm.

Recording Control Module.

The recording module consists of a recording chip and a corresponding peripheral circuit. The recording control program drives the recording module to start recording when the old man falls and produces a fall alarm signal. At present, the simple and practical recording chip is ISD series, which can record 8 or 16 minutes of audio signal, by triggering REC to start recording audio from the designated address and save it in the chip, and automatically shut down recording function after reaching the upper limit of recording time. After the recording is finished, the PLAY is triggered to start the recording from the designated start recording address. The recorded audio can be played repeatedly. When a new recording begins, an unprecedented recording of audio is cleared.

Remote Communication Module.

Remote communication module adopts Siemens GSM TC35 module as the core of communication. When a fall alarm signal is generated, the main control program sequence control GSM TC35 module sends the fall alarm information and longitude and latitude positioning information to the guardian

mobile phone. After receiving the alarm short cancellation, the guardian replies to the corresponding control command SMS. After receiving the short message, the GSM TC35 module parses it, and then sends the parsed control instruction back to the master control module through the serial port. The master control module completes corresponding actions according to the received short message control instruction. Such as re-extracting longitude and latitude positioning information, turning off alarm sounds, and making phone calls, etc., to realize information interaction between the two parties.

Software Design

After the system starts, it will enter a configuration stage, which requires the initialization of single chip computer, MCU6050, GPS module, GSM module and PDU SMS mode. When the fall detection module detects the occurrence of fall, it will send a fall alarm signal to the main control system, turn on the voice alarm module to generate alarm sound when timing interrupt, and start the recording module at the same time. The remote communication module then sends the falling alarm and longitude and latitude information to the guardian. Guardians can according to need to reply to the corresponding control instruction to control system, when the guardian from external command, first to determine whether a text message from the guardian, if yes, then according to the SMS commands to perform the corresponding action, such as closing alarm sounds, to extract the longitude and latitude, make calls, etc., after the execution reply guardian completion, and then return to wait.

The system software mainly realizes the following functions.

1) monitor the normal work of each unit, and timely deal with the abnormal situation when it is found.

2) real-time acquisition of acceleration. The acceleration vector of X, Y and Z axis is collected in real time for data noise processing and data transmission is carried out on the monitoring platform.

3) realize human-computer interaction. The upper interface draws real-time triaxial acceleration data and stores the data.

4) fall detection. Based on the threshold point algorithm, the fall is judged.

5) alarm processing. Display on the man-machine interface.

Conclusions

With the intelligent endowment gradually entering people's life, the fall detection system will also be an important part in promoting the intelligent endowment process. The fall detection system is a personal remote monitoring system, which protects the health and safety of the elderly population. Therefore, the fall detection technology is more and more valued by scientific research institutes from all walks of life. The system solution is realized by ADXL345 hardware interrupt with low algorithm complexity and high detection accuracy. At the same time, MSP430F149, a microcontroller of ultra-low power consumption, is used as the main control chip for fall detection, which is cheap, convenient and practical, and can be widely used in production. This system has strong portability, low power consumption, wide application range, no distance limit, low cost, high reliability, portable and other advantages. The whole belt is small and convenient to carry. It can also provide the carrying function of some daily articles for the elderly and reduce the burden of travel for the elderly. The seamless coverage of the GSM network now allows guardians to keep abreast of the elderly's location and safety. After the old man falls down, the guardian will know the old man's position information within the shortest time, so as to take timely rescue measures, and at the same time, remind the surrounding people and provide help within the capacity to minimize the loss. The device is practical in design, reliable and accurate in system, small in size, easy to carry, simple and easy to operate, low in cost, and has high promotion value and market development potential.

Acknowledgements

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