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Automatic Accident Detection via Embedded GSM message interface with Sensor Technology

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Abstract- An automatic alarm device for traffic accidents is introduced in this paper. It can automatically find a traffic accident, search for the spot and then send the basic information to first aid center within two seconds covering geographical coordinates, the time and circumstances in which a traffic accident takes place. GPS software is fitted in the vehicle will now start communicate with the satellite and get the latitude and longitude values and send the information to the centralized server.

Then the server will search the nearest hospital and send the accident information to the hospital. The hospital will then be sending the ambulance to the accident zone. Then the injured people will be saved as soon as possible. This process will save time in particular for the areas in the outer part of main zone.

Index Terms- GSM, MEMS, automatic accident detection, GPS.

I. INTRODUCTION

The rapid development of economic construction and people's living standard continues to improve. as well as road traffic accident take place frequently which caused huge losses of life and property to the country and people. Traffic has become an important event in the national interest. it will be a serious consequences if people cannot sent weft to the outside for help when traffic occur. Poor emergency incident is a major cause for the high number of traffic fatalities and the death rate in our country.

The design is a equipment which can detect accidents ,search of accident place and sent rescue alarm automatically. application of this device can significantly shorten the warning time of the accident and determine the accident site. accident detection and information sending are
full automated, which win a valuable rescue time. It plays a significant role in rescuing the wounded lives and reducing loss of lives and property of the State and people to reduce road traffic hazards. This design has acquired the utility patent of State Intellectual Property Office, patent number: ZL 200920089697.9.

II. SYSTEM ARCHITECTURE

The design is a traffic accident automatic detection and long-distance alarm device.It makes up of the control module MC9S08AW60, information detection module includes large range dual-axis accelerometer MMA621010EG and small-scale three-axis accelerometer sensor MMA7260QT, GPS positioning module GS-87, people machine interaction module, including the keyboard and LED, and message sending module TC35i module. When a vehicle collision accident occurred,large number dual-axis accelerometer MMA621010EG detects the level of the collision automatically, vehicle rollover accident occurred, the Z-axis of small range acceleration sensor automatically detects the vehicle roll angle . Accident signal is sent when the angle is greater than the set value given. using mobile phone text messages of accident information (accident geographical coordinates, altitude, license plate number, time, date) through the TC35i sent to the owner's family and friends, rescue units and the transport sector.block diagram shown in Figure 1.

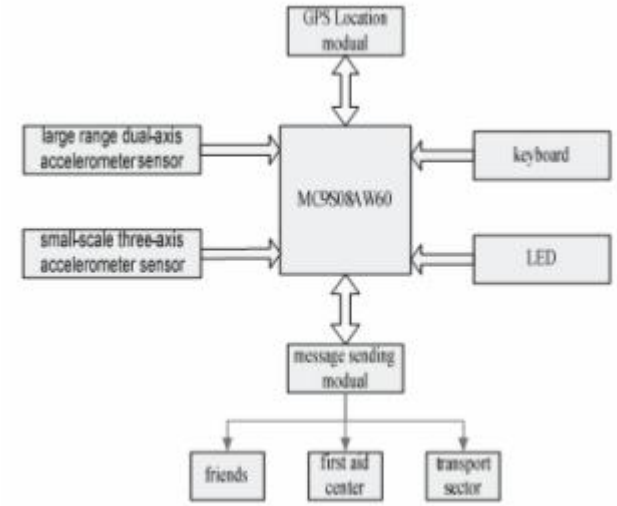

Figure.1: System structure diagram

GS-87 real-time search for satellite signals, through the program to extract the geographic coordinates, altitude, time, date and other information. The phone number to receive text messages and the license plate numbers can be directly solidified in the program. Keyboard keys are "false alarms", emergency", "reported safety" and "close the colorful LED". LED lights indicate system functions were normal, the system fails, GPS satellite signal search, and send information the normal and abnormal signals.

III. HARDWARE DESIGN

A. The Information Detection Module

Information detection module consists of large-range dual-axis accelerometer MMA621010EG and small-scale three-axis accelerometer sensor MMA7260QT. MMA621010EG is a proven special car accident sensor which is integrated XY-axis accelerometer and built-in serial peripheral interface SPI bus, compatible with 3.3V and 5V voltage .The accelerometer has self-test function .mechanical and circuit can be calibrated performance before and after the installation. advanced converter design to improve the sensor offset and over damped response, to improve system reliability and reduce the high frequency , high amplitude attenuation of the parasitic resonance.

The sensor can help identify false status which may lead to an accident situation, to ensure accurate detection of accident information. Accelerometer MMA7260QT, can read low order of magnitude drop, tilt, locomote, orientation, shock and vibration errors. Sensitivity is 1.5g, 2g, 4g and 6g. It has 3 3A sleep mode configuration, 500 3A low operating current, 1.0 ms fast response power supply, which can effectively detect vehicle rollover accident information, etc.

B. GPS Location Module

GPS location module GS-87 is the third generation of GPS receiver chip designed by the United States SiRF star III company, which consists of a radio frequency integrated circuit, a digital signal processing circuit and standard embedded GPS software composition .Radio frequency integrated circuit is used to detect and process GPS RF signal. Digital signal processing circuit is used to process the IF signal. The standard embedded GPS software is used search and follow up GPS satellite signals, Users to coordinate and speed is available according to the information. It is a high performance, low-power intelligent satellite receiver module or called satellite engine, is a complete GPS receiver.

C. Message Transmission Module

Message transmission module is TC35i module of the German Siemens TC35 module series. This is the latest Siemens wireless modules, compatible with the TC35 functionally. TC35i supports dual-band 900MHz and 1800MHz and supports for voice, data, short message and fax service, low power, is a highly integrated GSM module. Module and the microprocessor interface circuit shown in Figure 2.

ODBC:

Microsoft Open Database Connectivity (ODBC) is a standard programming interface for application developers and database systems providers. Before ODBC became a de facto standard for Windows programs to interface with database systems, programmers had to use proprietary languages for each database they wanted to connect to. Now, ODBC has made the choice of the database system almost irrelevant from a coding perspective, which is as it should be. Application developers have much more important things to worry about than the syntax that is needed to port their program from one database to another when business needs suddenly change.

The advantages of the scheme are so numerous that are probably thinking there must be some catch. The only disadvantage of ODBC is that it isn't as efficient as talking directly to the native database interface. ODBC has had many detractors make the charge that it is too slow. Microsoft has always claimed that the critical factor in performance is the quality of the driver software that is used. In our humble opinion, this is true. The availability of good ODBC drivers has improved a great deal recently. And anyway, the criticism about performance is somewhat analogous to those who said that compilers would never match the speed of pure assembly language. Maybe not, but the compiler (or ODBC) gives the opportunity to write cleaner programs, which means finish sooner.

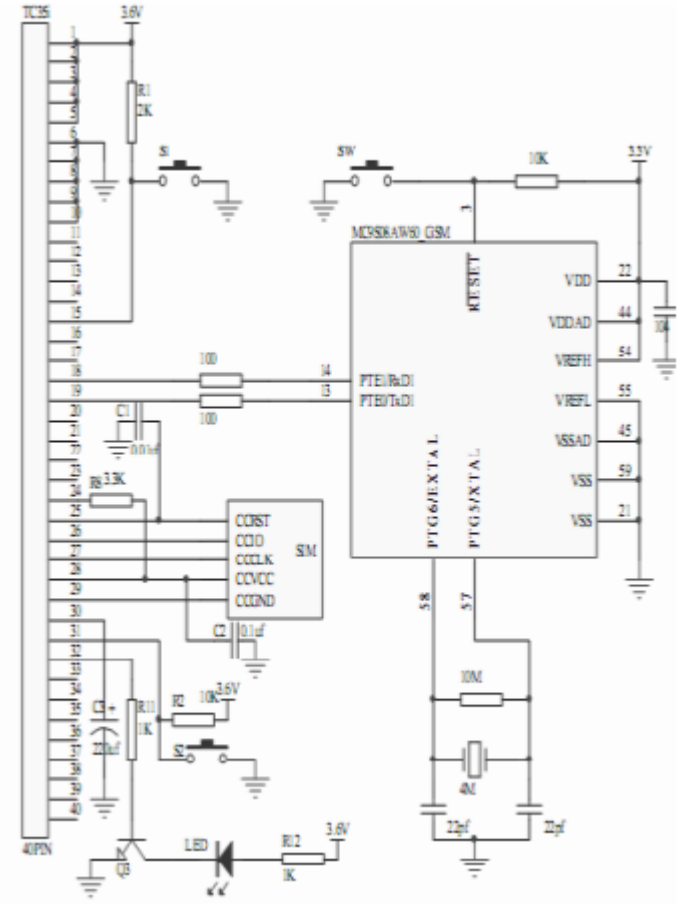

Figure.2: TC35i module connected with the microprocessor circuit

The 1-5,6-10 pins of TC35i are power supply pins, are connected to 3.6V power supply "+" and "-" .The 15-pin of ZIF socket is the module enable pin. The serial port pins 18,19 are connected to microprocessor serial communication pins. 24-29 pins are connected to SIM card. 32-pin SYNC is connected to LED to indicate system status. LED light can indicate that TC35i is off or sleeping, SIM card is not inserted or the network login and TC35i being logged into the network is holding machine status signals.

IV. SYSTEM SOFTWARE DESIGN

The development environment for the system software is CodeWarrior 6.1 with the C program language been used. Flow chart of the program is presented in Fig.3. It is shows that the system includes the features as motorcycle accident information

detection, GPS satellite positioning and alarm information sending. After the system initialized by powered-on, it runs the sensor calibration program and system self-test program. Sending alarm information when the system is abnormal. It is to determine to send "false alarm", “Emergency for help "and "reported safety" information by scanning keyboard signal. It is confirmed that the motorcycle accident occurred when data abnormal detected by information detection module. Position information searched by the GPS and then sent by GSM. X˙Y of MMA621010EG and Z-axis of MMA7260QT connected to the AD conversion interface of the microprocessor after a RC low-pass filter. The analog signal converted to digital by the 8-bit AD. It enables the microprocessor to detect the rollover or collision accident information effectively by calculating the different roll angle and set collision acceleration threshold.

According to NMEA-0183 protocol standard specifications, GPS receiver transmits the position and speed information to the PC and PDA etc. via the serial port. NMEA-0183 is a standard protocol which GPS receiver complied with. It is the most widely GPS receiver used protocol currently. According to NMEA - 0183, data is sent in statements. The receiver send multiple types of statements, only a few of letters in certain statements is valid, so it needs to parse the received data, separating out the required information.GS-87 module provides a serial communication interface, this design chooses 9600bps, serial communication parameters: Baud Rate: 9600, Data bits: 8 bits, stop bit: 1 bit, no parity. The SCI communication interface of MC9S08AW60 can read data sent by GS-87, the processing program can extract the effective geographic coordinates and time information. TC35i module data input/output interface is compliant with ITU-T RS232 interface standard. Fixed parameters: 8 data bits and 1 stop bit, no parity, baud rate 300bps ~ 115kbps, hardware control signal RTS0/CTS0, software flow control XON / XOFF, CMOS level, support the standard AT command set. Because instruction content is the ASCII code and short message in Chinese is encoded UNICODE code, the transmitting data must be encoded when microprocessor control TC35i module via AT commands. For the number of Chinese characters is large and the microprocessor resources are limited, the UNICODE code must put into the microprocessor memory which related to the Chinese characters involved in the message.

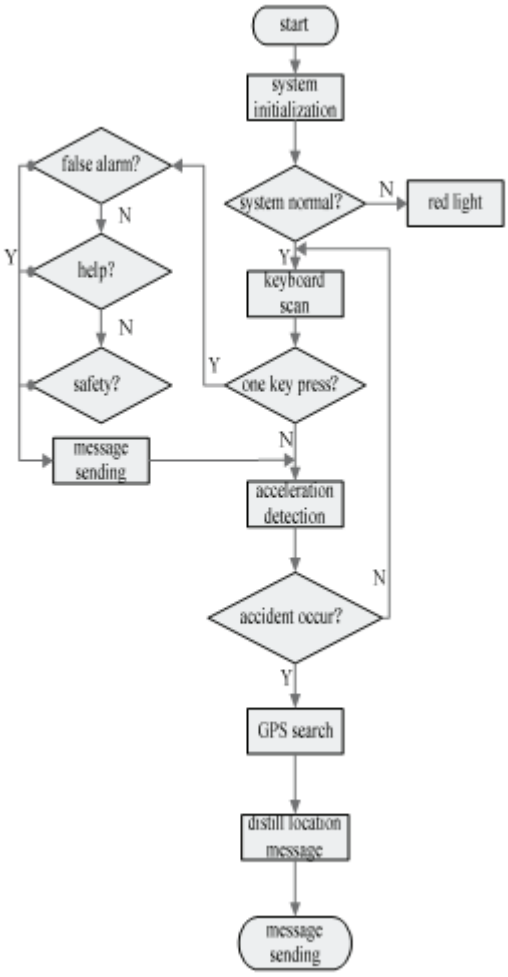

Figure.3: System software flow chart

ALGORITHM:

1. KNN Algorithm Description:

The K-nearest-neighbor measures the distance between a query scenario and a set of scenarios in the data set. The *k*-nearest neighbor algorithm (*K*NN) is a method for classifying objects based on closest training examples in the feature space. *K*NN is a type of instance-based learning, or lazy learning where the function is only approximated locally and all computation is deferred until classification. The *k*-nearest neighbor algorithm is amongst the simplest of all machine learning algorithms: an object is classified by a majority vote of its neighbors, with the object being assigned to the class most common amongst its *k* nearest neighbors (*k* is a positive integer typically small). If $k = 1$, then the object is simply assigned to the class of its nearest neighbor.

In pattern recognition, the k-nearest neighbor algorithm (k-NN) is a method for classifying objects based on closest training examples in the feature space. K-NN is a type of instance-based learning, or lazy learning where the function is only approximated locally and all computation is deferred until classification. The k-nearest neighbor algorithm is amongst the simplest of all machine learning algorithms: an object is classified by a majority vote of its neighbors, with the object being assigned to the class most common amongst its k nearest

neighbors (k is a positive integer, typically small). If k = 1, then the object is simply assigned to the class of its nearest neighbor.

The neighbors are taken from a set of objects for which the correct classification (or, in the case of regression, the value of the property) is known. This can be thought of as the training set for the algorithm, though no explicit training step is required. The *k*-nearest neighbor algorithm is sensitive to the local structure of the data. Nearest neighbor rules in effect compute the decision boundary in an implicit manner. It is also possible to compute the decision boundary itself explicitly, and to do so in an efficient manner so that the computational complexity is a function of the boundary complexity.

Usually Euclidean distance is used as the distance metric; however this is only applicable to continuous variables. In cases such as text classification, another metric such as the overlap metric (or Hamming distance) can be used. Often, the classification accuracy of "k"-NN can be improved significantly if the distance metric is learned with specialized algorithms such as Large Margin Nearest Neighbor or Neighborhood components analysis.

DISTANCE

The distance between two scenario using some distance function is d(x,y) where scenarios are composed of features suchthat $x = \{x_1, \dots, x_N\}, y = \{y_1, \dots, y_N\}$.

Two Distance functions are discussed in this summary:

1. Absolute distance measuring:

$$d_A(x,y) = \sum_{i=1}^{N} |x_i - y_i|$$

2. Euclidean distance measuring:

$$d_E(x,y) = \sum_{i=1}^{N} \sqrt{x_1^2 - y_1^2}$$

KNN Algorithm:

The algorithm on how to compute the K-nearest neighbors is as follows:

1. Determine the parameter K = number of nearest neighbors beforehand.
2. Calculate the distance between the query-instance and all the training samples. It can use any distance algorithm.
3. Sort the distances for all the training samples and determine the nearest neighbor based on the K-th minimum distance.
4. Since it is supervised learning, get all the Categories of training data for the sorted value which fall under K.
5. Use the majority of nearest neighbors as the prediction value.

V. CONCLUSION

An automatic alarm device for traffic accidents is designed in this paper. It can shorten the alarm time greatly and locate the accident spot accurately, realizing the automation of accident detection and information transmission. Consequently, it will save the rescuers form wasting their time in search. The experiments of model car's collision and rollover proved that this system can automatically detect corresponding accident and sent related information. Such functions can be achieved by buttons representing "false alarm", "help" and "safety", respectively.

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