Design and Development of GSM Based Concealed Alarm System

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Abstract: Consider the characteristics of bank and other financial institutions. This paper aims for reforming the conventional alarm system by the concealed GSM monitor and wireless alarm systems and meanwhile, SMS and voice alarm can be sends to the outer by multi-regional remote control for FM networks. It can be receiving the alarm, then the monitoring center can achieve real-time on site monitoring it provides the more efficient information for the incident handling.

Keywords: GSM, Wireless Alarm System, FM Networks, SMS.

I. INTRODUCTION

The financial transactions of branches banks are often more concentrated, it also threat of robbery, therefore how to improve the real-time alarm and the security is the pressing problem. While the GSM (Global System for Mobile Communications) technology's development, has provided the very good solution to this problem. So the concealed GSM monitor and alarm system for bank counter arises at the historic moment. This alarm system triggers alarm through the foot-button in a more concealed way. At the same time by multi-zone multi-directional remote control wireless FM network, messaging and voice alarms can be achieved. On receiving the alarm, monitoring center can monitor on-site voice in real-time, thus provide more efficient information for the incident handling.

The alarm system described in this paper is mainly used in banks, residential quarters, warehouses, hospitals and so on. These areas require remote alarm or emergency situation alarm very much. Especially banks are prone criminal area of cases, sometimes bank staff cannot alarm timely or cannot alarm, so that the property of our country may fall into the pocket of criminals, and the life and health of bank staff's may be hurt by the criminals. But this system solves these problems very well, in the event of criminal cases, once step the foot-button to trigger alarm in the main control area, or use the remote control wireless FM network to transmit a trigger signal to the microcontroller in other monitoring area can both achieve alarm and monitor of the criminal. This intellectualized GSM-based alarm system has the characteristics of diverse alarm way; easy concealment; and may realize alarm over mass, thus achieves the safeguard of the financial network security.

II. SYSTEMDESIGN

According to the overall layout of the distribution of bank counters, the schematic diagram of the overall monitoring is in Figure (1).
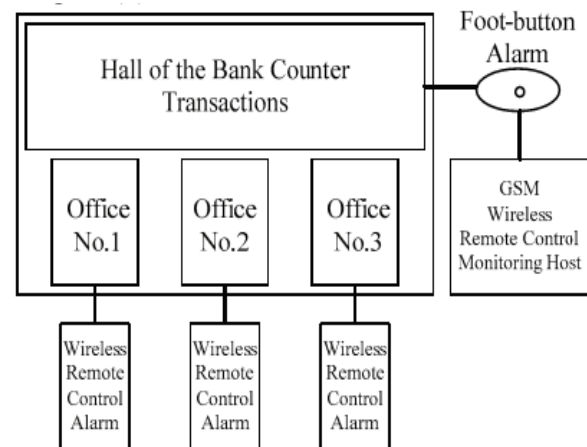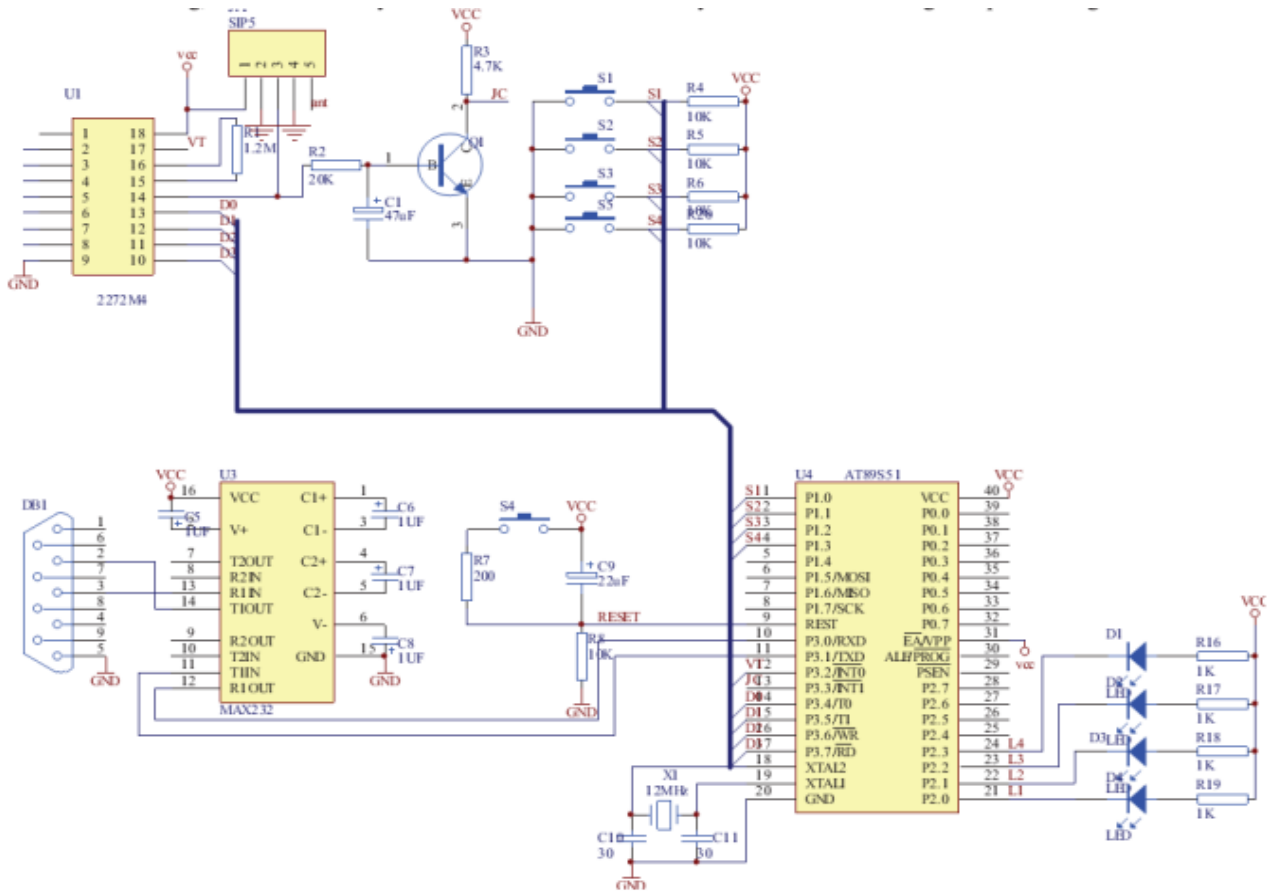

Figure1. The schematic diagram of the overall monitoring

We may design one or more foot-buttons in the master monitoring area, in the event of criminal cases, anyone of the staff can send out alarm message by these foot-buttons, then the alarm system will send mass short messages to the leaders of relevant department and other staff, report the on-site situation. So the relevant departments can also monitor the internal situation by mobile phone, which can allow security personnel to take effective measures to ensure staff and national property. For other assistance monitoring area, the system uses wireless transmission means, as long as there is a button is pressed, the alarm system will immediately send mass short messages to the preset phone numbers.

A. Hardware Circuit Design

The hardware circuit is mainly composed of six parts: MCU (Micro Controller Unit) unit, alarm indicating circuit signal input interface circuit, GSM communication module interface circuit, wireless transmitter and receiver circuit and power supply. The schematic diagram of hardware circuit is shown in Figure (2).

The alarm system's major function includes: (1) carry on the judgment to the alarm signal and then determine the kinds of the criminal cases; (2) establish communications with the GSM module, complete the initialization of the GSM module and the personalization of the alarm system; (3) complete the data protocol conversion between the MCU and the GSM module, transform the alarm information into the data format in accordance with the SMS protocol and passed it to the GSM module for transmitting, simultaneously dial a fixed-line

Figure2. The schematic diagram of hardware circuit

B. Design of Alarm Indicating Circuit

This alarm system uses four LED to indicate the working status of entire system: one for indicating online status of the GSM module; one for indicating signal strength; one for indicating the criminal cases; and one for indicating the power supply.

C. Design of Alarm Signal Input Interface Circuit

In this alarm system we designed four foot-buttons in the master monitoring area. This alarm button triggers alarm through the foot-button in a more concealed way, therefore it may greatly improve the success rate of the alarm. In other

assistance monitoring area, the system uses wireless transmission means for alarm.

D. Design of GSM Module Interface Circuit

The entire alarm system is mainly designed in accordance with the 3.3V interface circuit level, while the RS232 circuit telephone and transmit the on-site scene sound to the monitor for easy real-time monitoring and processing. Requires 5V input and output level, and GSM terminal needs to provide users with TTL level serial output. Therefore we may need level conversion circuit for 5V~3.3V or 3.3V~5V, here we used MAX232 to achieve the inter conversion.

Currently, engineers of our country have begun to use the GSM module such as Falcom's A2D Series, Wave come's WMO2 series, Siemens's TC35 series, Ericsson's

DM10/DM20 series, ZTE's ZXGM18 series and so on, moreover the function and usage of these modules is not very different. Among these modules the performance-to-price ratio of Simens's TC35 series module is very high, and they already have the domestic wireless apparatus network card, therefore, we selected in this design is TC35i of the Siemens's TC35 series.

The TC35i module is the latest Siemens wireless module, small, compact design, function compatible with the TC35, and easy to upgrade to the GPRS module. The module combines RF (Radio Frequency) circuit and baseband in one, and can provide users with a standard AT command interface for data, voice, short messages and fax. Furthermore it can provide convenient, fast, reliable and secure data transmission for the user's application development and design.

E. Wireless Transmitter and Receiver Circuit Design

This system uses PT2262/2272 for wireless transmitter. It has the characteristics of far transmission range, more stable and reliable. PT2262 may have up to six (D0-D5) data pins, and it can output the address codes and data codes from the 17 pin serial port, therefore it can be used for wireless remote control transmitter. In this system, the transmission circuit uses the general 315M Hz frequency remote control. The receiver circuit must transmit the information to the MCU for processing and starting alarm soon after receiving the alarm signal.

In view of the 315M Hz band's interference problem, this system added an interference detection circuit specially. If it detects the same frequency signal more than 10 seconds, the alarm system will immediately send the short message: There is interference in the monitoring area, please rapidly process. And this way solves the problem that the alarm system being interfered cannot report to the police normally very well.

III. SYSTEMSOFTWAREDESIGN

The core of the system software is the communication between MCU and GSM module, and the technical difficulty is how to set and use the AT commands. The AT commands are modem control commands, the establishment of wireless channel, data transmission and other operations are all done through it. The flow chart of main program is shown in Figure (3). We should setup the user's parameters first, mainly includes setting the user's alarm phone, personalization alarm message and so on. We can either set it by computer through the serial port or via mobile phone through the short message.

One important task of system software is to complete protocol conversion. GSM module and mobile phone supports the GSM protocol, in order to control the GSM module for short messages sending and receiving, we should transform the control commands, alarm status and other data from the MCU into relevant format, such as PDU or Unicode format which is supported by short messages of mobile phone.
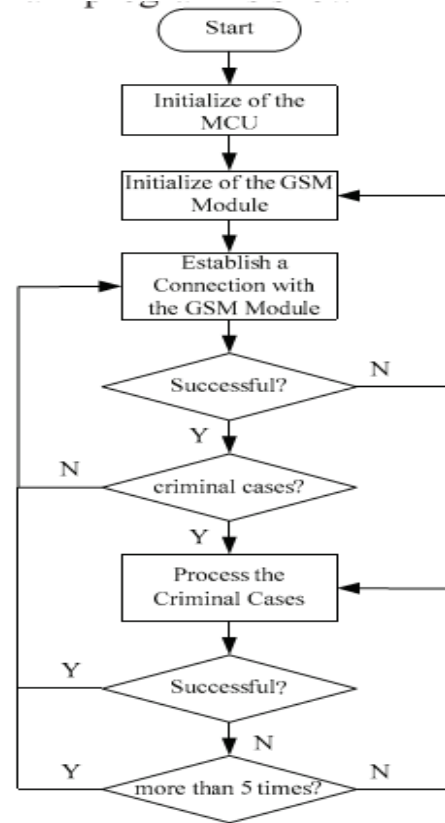

Figure3. The flow chart of main program

The core of terminal system design is the wireless communication between MCU and the GSM module, and the serial port communication together with the setting and using of the AT commands is the programming difficulty. The system software design uses the modular design concept, which is mainly divided into initialization module of MCU; initialization module of communication; data acquisition module; data transmission modules and other components.

IV.GSM

GSM is a standard sets it is developed by the European Telecommunications Standards Institute to describe the protocols for second generation of digital cellular networks used by the mobile phones. It becomes the facto global standard for the mobile communications with 80% market share. The GSM standard for developed as a replacement of first generation and analog cellular networks, and its originally described a digital circuits switched network optimized by full duplex voice telephony. This is expanded over time to include data communications, which first by circuit packet data transport via GPRS .

Further improvements we were made when the 3GPP developed 3rd generation of UMTS standards followed by the fourth generation of LTE Advanced standards.

"GSM" is a trademark of this Association.

Network structure

- The Base Station of Subsystem.
- The Network and Switching of Subsystem .
- This is sometimes just called the core networks.
- The GPRS Core Network .
- The Operations support system for the maintenance of network.

A. Base Station subsystem

GSM is a calculator network, which means that cell phones were connect to searching for cells in the immediate vicinity. There are five different cell sizes in this network. Then the coverage area of each cell varies according to the implementation environments. Macro cells can be regarded to the network cells. where the base station can antenna is installed on a building above average roof top level. Micro cells are whose antenna height is under roof top level; it is typically used in urban areas. Pico cells are small cells coverage diameter is a few dozen meters'; they were mainly used indoors. Fenton cells are designed for use in residential business environments and its connect to the service provider's network via a broadband connection. Umbrella cells are used to cover shadowed regions and fill in gaps between those cells.

Cell horizontal radius can be varies depending on antenna height, this antenna gain and propagation conditions from a couple of hundred m to several km. The longest distance of GSM specification is supports in practical use it is 35 kilo m .There are several implementations an extended cell, where the cell radius could be double depending on the antenna systems, then the type of train and the timing advance. Indoor coverage is supported by the GSM and may be achieved by using the indoor Pico cell base station, through power splitters, to deliver the radio signals from the antenna outdoors to the separate indoor distributed system. These are typically deployed by a lot of call capacity is needed indoors in shopping centers, this is not a pre requisite, since indoor coverage is provided by the building penetration of the radio signals .

GSM carrier frequencies: GSM frequency bands networks operate in the number of different carrier frequency's with most 2G networks operating in the 900 MHz. Where these bands already allocated, the 850 MHz bands ,it is used instead .In rare cases 450 MHz frequency bands are assigned in the some countries because they were previously used first generation systems.

B. Subscriber Identity Module (SIM)

Subscriber Identity Module is One of the key features GSM is the Subscribers Identity Module, it known as a SIM card. Then the SIM is a detachable smart card containing that user information and phone book. This is also allows the user to retain information after switching the handsets. the user can change the operators while retaining the handset simply by changing the SIM card. Some operators will block this phone to use only a single SIM, this practice is known as locking.

Phone locking: In Sometimes mobile networks can operate restrict handsets that they will use for own network. This is called locking and is implemented by the software feature of the phone. A subscriber usually contact with the provider to remove the lock for a fee, utilizes the private services to remove the lock, and websites to unlock the handset were themselves. Unlocking a phone without any operator's consent it should be an international right after the termination of any postpaid contract.

In some countries all phones can be sold unlocked. it is operators to offer any form of subsidy by a phone's price.

C.GSM service security

GSM was designed with the moderate level of service security. Then system was designed to authenticate which subscriber using key the and challenge response. Communication between the subscriber and base station can be encrypted. Then the development of UMTS introduces optional Universal Subscriber Module that uses a longer authentication key to give security, as well as mutually authenticating network and the user GSM only authenticates the user to the network .The security model offers confidentiality, but limited authorization capabilities.

New attacks have been observed to take an advantage of poor security implementations, these architecture and development of smart phone applications. The wiretapping and eavesdropping the audio input and output providing an opportunity 3rd party to listen in to the conversation. GSM uses General Packet of Radio Service for data transmissions like as browsing the web. Then the most commonly deployed GPRS were publicly broken. The researchers revealed flaws in the commonly used as GEA/1 and GEA/2 ciphers and published by the open source software for sniffing networks.

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They also noted that some carriers encrypt the data in order to detect the use of traffic, protocols they don't like, leaving their customers unprotected. GEA/3 seems to remain the relatively hard to break and it is said to be in the use of some more modern networks. It is used with prevent connections to fake base stations and downgrade with attacks, users will be protected by the medium term, though the migration to 128-bit is still recommended.

V.SMS

Short Message Service is the text messaging service component of phone, the web mobile communication systems, using for the standardized communications protocols will that allow the exchange of text messages between mobile phone devices. SMS is the most widely used for data application in the world, with 3.5 billion active users of 78% all mobiles of subscribers. Then the term is used as an acronym for all types of short text messaging to the user activity itself in many parts of world. SMS is also employed by directly marketing.

SMS as used for modern handsets originated by radio telegraphy in radio memo pagers using standardized phone protocols. These were defined a part of the Global System for Mobile Communications of series of standards as a means of sending to the messages of up to 160 characters to and from GSM mobile of handsets. Though the most SMS messages are mobile to mobile text messages, support for the service it has expanded to include other mobile technologies as ANSI CDMA networks and Digital AMPS, as well as satellite networks.

A. Early development

The technical development of SMS is a multinational collaboration of supporting the framework of standards bodies. Through these organizations of technology was made freely available to the world. SMS was considered in main GSM group as a possible service for the new digital cellular system. In GSM document Facilities to be provided in the GSM System, both mobile originated and mobile short messages appear on the table of GSM services.

The discussions of the GSM services is concluded in the recommendation GSM Tele Services supported by the GSM PLMN. Here a rudimentary of the three services as

1. Short message of Mobile Terminated Point-to-Point: then the ability of a network to transmit a Short Message to a mobile phones. Then the message can be sent by phone software application.
2. Short message of Mobile Originated Point-to-Point: the ability to a network transmits a Short Message sent by the mobile phone. Then the messages can be send to the phone to a software application.
3. Short message of Cell Broadcast.

The material elaborated in the GSM and its WP1 subgroup was handed over in Spring to a new GSM body called IDEG which had kickoff in May under the chairmanship of Fried helm Hille brand . Then the technical standard known today was largely created by IDEG as the two recommendations. The work on the draft specification in the follow in years, where Kevin Holley of Cell played a leading role. It Besides that completion of main specification GSM, then the detailed protocol of specifications on their system interfaces also needed to completed.

B. Support in other architectures

The Mobile Application Part of the protocol included support for the transport of Short Messages through the Core Networks from its inception. To expanded support for SMS by introducing the separate operation code for Mobile Terminated Short Message for transport. Since Phase 2, there have changes to the Short Message of operation packages in MAP, although the other operation packages have enhanced to support CAMEL SMS control.

C. Early implementations

The first SMS message was sent to over the Vodafone GSM network in the United Kingdom on 3 December, from Neil Pap worth of Sema Group using the personal computer to Richard Jarvis of Vodafone using the Orbital handset. The text of the message Merry Christmas. All first installations of SMS was gateways were for network notifications sent to the mobile phones, it is usually to inform of the voice mail messages. Then the first commercially sold SMS service was offered to the consumers, as a person to person text messaging services. The Most early GSM mobile phone handsets did not support to ability and send SMS text messages, and then Nokia was the only handset manufacturer whose total GSM phone line can be supported by user sending of SMS messages.

Initial growth was slower with customers sending on the average only 0.4 messages per GSM customer must be per month. One factor in the slow take up SMS was that operators were slow to set the charging systems, especially for prepaid the subscribers, and eliminate the billing fraud which was possible by changing the SMSC settings on individual handsets to use the SMSCs. networks in the UK only allowed by the customers to send the messages to other users on the same network, the usefulness of the service. Over time, this is the issue was eliminated by switch billing instead of the billing at the SMSC and by new features within SMSCs to allow the blocking of foreign mobile users sending a messages through it. Then the average number of messages reached 35 per month, and by the million messages was sent in the UK alone. It is also alleged that the fact roaming for customers, in early days, rarely received bills by their SMSs after holidays abroad which gave some boost to text messaging as an alternative to the voice calls.

D. Text messaging outside GSM

SMS is originally designed by the part of GSM, but it is now available on wide ranges of networks, including the 3G networks. However, not all the text message systems use SMS, and some notable alternatives by the implementations of the concept include Sky Mail and NTT Docomo to Short Mail, and both in Japan. Email messaging from the phones also, it is popularized by the NTT Docomo i-mode and the Black Berry, it is also typically uses standard mail protocols such as the SMTP & TCP/IP.

E.SMS today

In SMS text messages were sent translates into 193000 SMS per one second. SMS has become a massive to commercial industry, earning billion globally. Then the global average price for the SMS message, while mobile networks charge to each other interconnect fees of at least when connecting between the different networks. While SMS is still to growing market, traditional SMS are becoming to increasingly challenged by the alternative messaging services there available on smart phones with the data connections, especially in Western countries there services are growing in an popularity.

VI. CONCLUSION

Along with the wireless communication technology's unceasing progress, the use of mobile network operators to offer remote monitoring and data transmission has been widely used in various fields. Especially the GSM data transmission plan based on MCU such as the GSM alarm system, automatic meter reading system and soon has gained more and more people's attention. This article introduced the concealed GSM monitor and alarm system for bank counter, which has the characteristics of easy installation, alarm security and quickly, adapted to the needs of the market well.

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