A Design of IADSS with the Earthquake Detecting Function

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Abstract: - In previous research, we use the corresponding technologies of micro-computer peripheral interface control to design the Intelligent Anti-Disaster Security System (IADSS) [1]. While the disaster occurs, the proposed IADSS will execute the security protection. In the original IADSS, there don't have the ability to do some necessary facilitation while earthquake occurs. Furthermore, there don't have the Remote Monitoring System. In this paper, we combine the newly "NT&SD Transducer" [2], the peripheral interface control and some Network Transferring Techniques to enhance the function of the IADSS.

Key words: Anti-Disaster Security System, Security protection, Transducer.

1 Introduction

Recently, many huge buildings are built for people living. The practice of these buildings is complicate and the people are not often known each other. Once the unexpected disasters occur, how could these people assist themselves? In fact, those disasters can be reduced once there necessary methods are used properly in the beginning of the disaster. Such as, at the beginning two or three minutes are the key moment to wipe out the disasters. If some devices can work out before the disasters spreads, therefore, the disaster would decrease. In previous research, we use the corresponding technologies of micro-computer peripheral interface, and combines with the temperature combination sensor, the smoke inductor, the humidity sensor, the gas sensor, the infrared radiation sensor, and the A/D converter to design the Intelligent Anti-Disaster Security System (IADSS). The IADSS overcomes the traditional device defects, such as: the difficult of maintenance and the high expenses. Our Intelligent Anti-Disaster Security System would own the following advantages: i. Easy settlement and easy maintenance. ii. Completely functions, both of the Anti-disaster and Security. iii. Economy. We can use the IADSS to check all the situations of our home through the computer. And we also can use the evaluated data by the sensor of each device to examine whether the functions of the each device are normal or not. We have made numerous simulations in the IADSS and obtained some successful results [1].

The IADSS with the abilities to reduce the damage induced by the common disaster in building, such as the Fire, the Gas and the Thief and protects people avoid being fear. However there still have some natural disaster not been considered in the IADSS, such as the Earthquake. Furthermore, there don't have the Remote Monitoring System; in other words, we cannot check the whole situations in office or some other places not in home. In recent time, the earthquake disaster occurs frequently in the circum-Pacific channel areas, especially in Japan and Taiwan. According to the detected data of the past ninety years collected by the Central Weather Center [3], there are an average number of 2200 times of earthquake occurred in Taiwan each year (the Central Weather has estimated the ability of earthquake detecting shade that has been widely improvement in 1991, so the average numbers of the earthquake increases to 8217 times from 1991 to 1994.). Most of them can't be felt by people. But there are an average numbers of 214 times that can be felt by people. In 1951, there are about 858 times of earthquake (felt by human) occurred in Taiwan. This is the maximum times of the earthquake in history. Furthermore, according to the history records, there is one hazardous earthquake that brings tragedy to Taiwan per year. The earthquake may not bring direct harm to the human and animals; but the building build by people may break down after serious quivering, it may injure other people and animals, the status of harm would be very serious.

In resent paper, we have developed a newly "NT&SD Transducer" [2], this vibration detecting device will immediately shut down the dangerous device before the seismic wave arrives. In this paper, we combine this newly "NT&SD Transducer", the peripheral interface control [4]-[8] and some Network Transferring Techniques [9]-[12] to propose an advanced IADSS to enhance the function of the original one. We organize the paper

in the following manner. Section 2 presents the "NT&SD Transducer" [2]. In Section 3, we present the combinations of the "NT&SD Transducer" and some Network Transferring Techniques to enhance the function of the IADSS-**the advanced IADSS**. Finally, the simulations and brief conclusion are given in Section 4.

2 The "NT&SD Transducer"

The "NT&SD Transducer" [2] is used to enchance the function of the original IADSS. In this Section, we briefly described the proposed vibration detection device- "NT&SD Transducer". The objective of this design is stated in the following: While the magnitudes of the strong earthquake reach 7 (M=7), the earthquake waves move through all direction at the mean value of 7km/sec. The speed of the network transfer is: About 400 times over the seismic waves. If we use the network transfer method to shut off the master safety switch of dangerous installation before the seismic waves arrive while the strong earthquake occurs, the disaster will be decreased. Therefore, the purpose of the "NT&SD Transducer" is to adapt the required methods before the seismic waves destroys the dangerous installations. There are three major units in "NT&SD Transducer": Detecting shaking degree unit, Network Transfer (NT) unit & Shut-Off Dangerous Installation (SD) unit. In the following, we will describe the attractive features of the "NT&SD Transducer". The block diagram of the "NT&SD Transducer" and the internal hardware structure are shown in Figs.1 and 2, respectively.

2.1 Detecting shaking degree Unit

There is a filter inside the "NT&SD Transducer" that can filter out the noise of the external shaking signals while the earthquake waveform signals detected by the "NT&SD Transducer". And the shaking degree of the rest of the signals will be going through the micro-chip processor analysis. The "NT&SD Transducer" uses the vibration sensor to detect the occurrence of the shaking. The characteristic of the vibration sensor is: while the shaking sensor stands stationary, the resistance of the vibration sensor is infinite, then it is at the "OFF" status; while the "NT&SD Transducer" is suffered by the external power, it reaches at the status of centrifugal force, the plane surface slants, the characteristic of the resistance of the vibration sensor has been changed to 0, then it is at the "ON" status. While the external power disappears, the vibration sensor turns back to the "OFF" status.

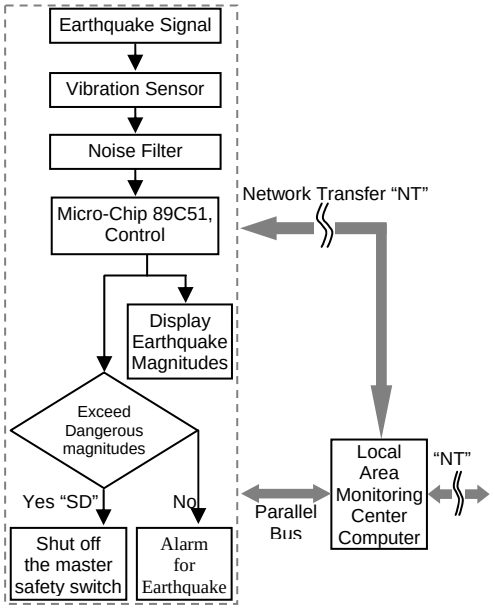

Fig. 1 Block Diagram of the "NT&SD

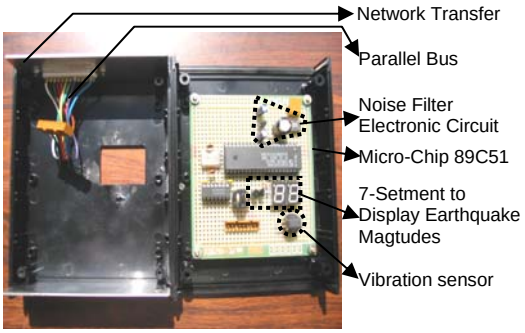

Fig.2 Internal Hardware Structure of the "NT&SD Transducer"

2.2 Network Transfer (NT) Unit

There are two ways in "NT&SD Transducer" to transfer the detected shaking data to the Local Area Monitoring Center computer [2]. (i) By using the Ethernet Wire Network Transfer (ii) By using the Parallel Bus and the 8255 interface card of the Local Area Monitoring Center computer.

The data of the shaking detected by Detecting shaking degree Unit will be analyzed through the micro chip 89C51 [13]; then judge the level of the shaking; through the detecting of the micro processor 89C51 and the calculation of the occurrence times of 'ON', 'OFF'. We have made numerous simulations corresponding the occurrence times of 'ON', 'OFF' of the "NT&SD Transducer" and the earthquake MAGNITUDE shown in [2], people who are interested in the decision of the earthquake MAGNITUDE should refer to [2]. Therefore we can decide the MAGNITUDE of the earthquake. Through the network communication, we can transfer the "shaking data", detected by the "NT&SD

Transducer" to the PC computers of the Local Area Monitoring Center. We can also transfer the detected "shaking data" by the parallel bus, then the data reaches the 8255 interface card [11], then transfer to the PC Computer of the Local Area Monitoring Center finally. The Local Area Monitoring Center collected all the shaking data of the "NT&SD Transducer", then through the TCP/IP communication protocol [12], the data transfers to the Central Area Monitoring Center. The Central Area Monitoring Center will judge whether it is the earthquake or not. At that moment, the Central Area Monitoring Center will judge whethere the earthquake magnitude exceeds the some crieria level or not. If the reliability of the harmful earthquake is ensured,, the Control Instruction will be send out immediately. The UPS will be turned on. And by using of the TCP/IP protocol, the Control Instruction will be transferred to the Local Area Monitoring Center. The Local Area Monitoring Center will execute the mission to shut off the master safety switch of the dangerous installation finally.

2.3 Shut Down Dangerous Installation (SD) Unit

The Central Monitoring Center will detect the transferred shaking signal analysis, and judge the shaking magnitude. If there are 70% of the "NT&SD Transducer" in the Local Area has detected the magnitude exceeds the safety range, a Control Instruction will be sent to the Local Area Monitoring Center. The Local Area Monitoring Computer will execute the "SD" action through the "NT&SD Transducer" and shut down the master safety switch of the dangerous equipment that could reflect the secondary disaster easily, such as the master power switch and the master natural gas switch.

In order to forbid to bring people the loss of Economics and the inconvenient of Life by executing incorrect "SD" action of the incorrect earthquake magnitudes detected by the "NT&SD Transducer". The most important part before we actually apply the "NT&SD Transducer" is to establish the calibration table. The distinction of the magnitudes of the earthquake is based on the *ON-OFF* times of the vibration sensor that is detected by the inner "micro-chip" of the "NT&SD Transducer". During the same period of time, if the *ON-OFF* times of the vibration sensor are higher, then the magnitudes of the earthquake is stronger, and vice versa.

The proposed "NT&SD Transducer" have been calibrated, and we have a detaile description of the calibration experiments presented in [2].

3 The IADSS with the Earthquake Detecting Function

In the original IADSS [1], there don't have the ability to do some necessary facilitation while earthquake occurs. Furthermore, there don't have the Remote Monitoring System; in other words, we cannot check the whole situations in office or some other places not in home In this Section, we present the combinations of the "NT&SD Transducer" and some the Network Transferring Techniques to enhance the function of the original IADSS. The complete System Structure of the Advanced IADSS is shown in Figure 3. The Advanced IADSS owns the following special features:

i. Automatic Security and Anti-Thief System;
ii. Automatic Gas Detecting System;
iii. Automatic Fire Detecting System;
iv. Automatic Humidity Detecting System;
v Automatic Earthquake Detecting System;
vi Automatic Remote Monitoring System;

Furthermore, there are two different versions of control processes in the Advanced IADSS; 'Analog Signal Control & Digital Signal Control' in order to prevent the breakdown of the computer. The Rule of the Analog Signal Control is to transfer the system control authority to the interface control. We set up the critical value (safety value) of the Temperature, Gas, Humidity, and Earthquake degree into the pre-set reference voltage. While the sensor detects the value of voltage is higher than the critical value, the reaction process enables. There are four control systems in the Analog Signal Control Function: the Automatic Fire Detecting System, the Automatic Security, Anti-Thief System and the Automatic Gas Detecting System and Automatic Earthquake Detecting System. Except the computer auto-redial function, the rest functions of the Analog Signal Control is the same as the Digital Signal Control. In Digital Signal Control, we use the A/D0804 Analog Digital Transform Device to process the digital signal control method.

3.1 Automatic Security and Anti- Thief System

We design two devices in the Automatic Anti-Thief Detecting System. These are: Infrared Detecting Device and Heat Detecting Device. There are two steps instructions: Alarm Buzzing and Auto-Redial.

3.1.1 Alarm Buzzing

While someone (thief, robber) breaks into the house, the guy would enable the infrared, the alarm of the Advanced IADSS rings to remind people to take protection process.

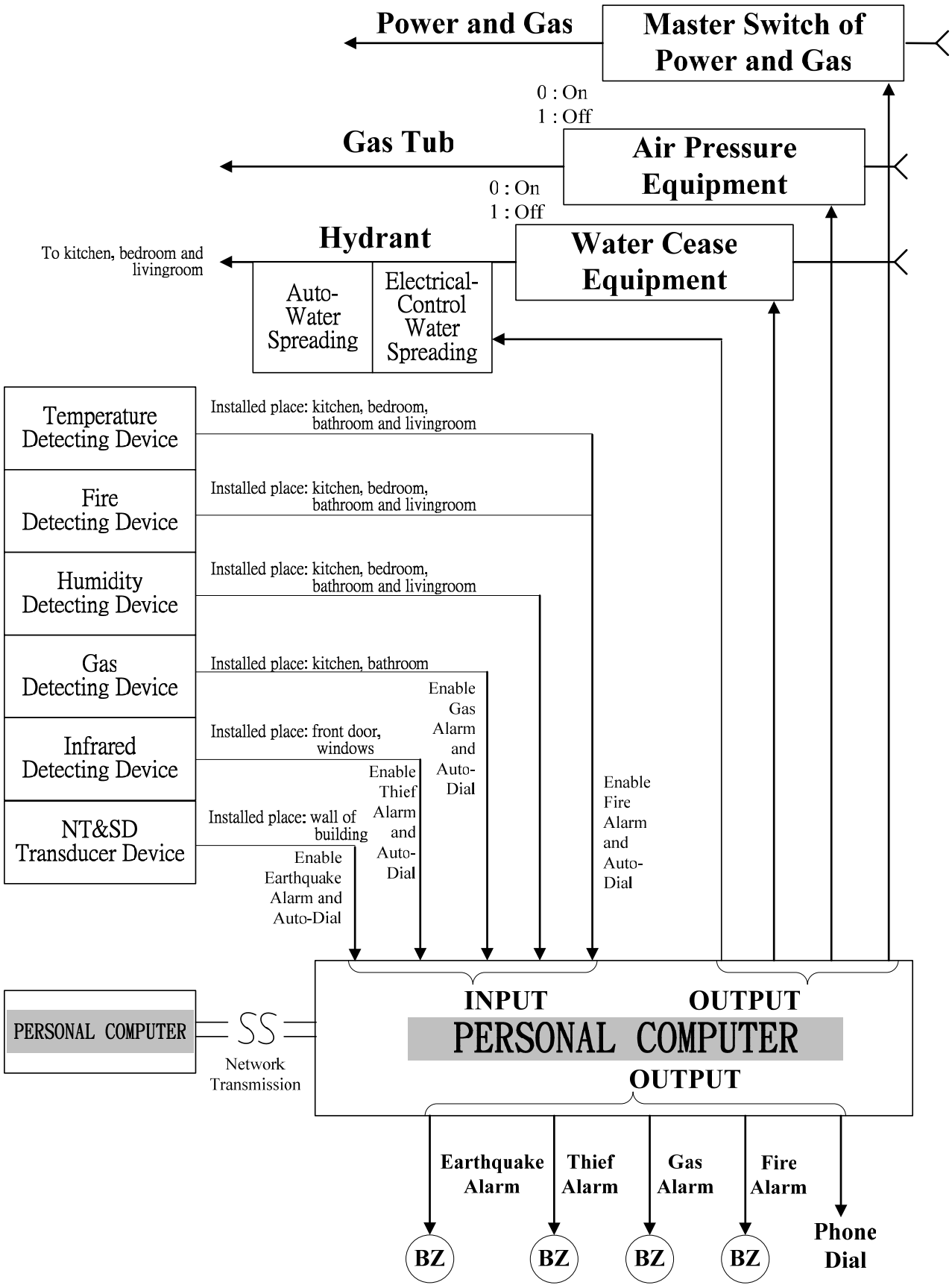

Fig. 3 The complete System Structure of the Advanced IADSS

3.1.2 Auto-Redial

While someone (thief, robber) breaks into the house, the computer would enable Auto-Redial function and transmit the voice-mail to notify the help requirement message.

3.2 Automatic Gas-Detecting System

The new model Gas Detecting TGS800 that owns high sensibility is used in the Advanced IADSS design. The rule is to use 5V voltage to add on the sensor end of the Sensor. The heating sensor circles of the detecting device become hot. The anti-degree of the circles decreases and then sends to the OP and then amplifies the signal. We control the Sensor's sensitivity to adjust the OP Amplify device. The TGS800 detecting device can detect the 100PPM of the carbon monoxide. There are three steps instructions: Alarm buzzing, Shut down Gas and Auto-Redial.

3.2.1 Alarm Buzzing

While the gas or carbon monoxide spreads out, the density of the poisoned-air increases in the air. Then, the alarm of the Advanced IADSS rings to inform people to take protection process and fresh the air immediately.

3.2.2 Shut down Gas Switch

While the gas spreads, the computer monitoring gas master switch would be turned-off to forbid huge disaster.

3.2.3 Auto-Redial

While the gas spreads, the computer would enable auto-redial function and transmit the voice-mail to notify the help requirement message.

3.3 Automatic Fire-Detecting System

We design two devices in the Automatic Fire Detecting System. These are: Temperature Detecting Device and Smoke Detecting Device. There are three steps instructions: Alarm Ringing, Auto-Water-Spreading and Auto-Redial.

3.3.1 Alarm Buzzing

While there is a fire disaster, the temperature of the house increases and the smoke occurs. Then, the alarm of the Advanced IADSS rings to inform people to take protection process.

3.3.2 Auto-Water-Spreading

While the fire disaster occurs, the computer monitor center will spread the water immediately.

3.3.3 Auto-Redial

While there is a fire disaster, the computer would enable auto-redial function and transmit the voice-mail to notify the help requirement message.

3.4 Automatic Humidity-Detecting System

We design two devices in the Automatic Humidity Detecting System. These are: Humidity Detecting Device and Enabling Humidity Detecting Device. There are two steps instructions: humidity display and auto-humidity equipment.

3.4.1 Humidity Display

The auto-humidity detecting device will display the humidity data through the computer monitoring system of each room in the house.

3.4.2 Auto-Humidity Equipment

While the detected humidity data is higher than the standard data, the humidity functions will be enabled to main the normal environment for the precious goods in the room.

3.5 Automatic Earthquake Detecting System

There are four steps instructions: Alarm Buzzing, Shut down master Gas switch, Shut down master Power switch and Auto-Redial.

3.5.1 Alarm Buzzing

While the "NT&SD Transducer" detects the earthquake signals, then the Advanced IADSS rings to inform people to take protection process.

3.5.2 Shut down Master safety Gas Switch

While the degree of earthquake detected by "NT&SD Transducer" obtained some criteria level, the computer monitoring master safety gas switch would be turned-off to forbid huge disaster.

3.5.3 Shut down Master safety Power Switch

While the degree of earthquake detected by "NT&SD Transducer" obtained some criteria level, the computer monitoring master safety main power switch would be turned-off to forbid huge disaster.

3.5.4 Auto-Redial

While the "NT&SD Transducer" detects the earthquake signals, then the Advanced IADSS would enable auto-redial function and transmit the voice-mail to notify the help requirement message.

3.6 Automatic Remote Monitoring System

We use the corresponding technology of network to set up the Remote Monitoring System shown in fig. 3.; in other words, through the network, we can use

computer to check the whole situations in office or some other places not in home.

4 Simulations and Conclusion

We have a detailed description of the diagnostic experiment corresponding to the Analog Signal Testing (Shut-Down Computer) and the Digital Signal Testing (Enabling Computer) of the following Device Function Testing: Temperature Detecting Device, Smoke Detecting Device, Gas Detecting Device, and Infrared Detecting Device of the IADSS in [1]. We will build an eight areas diorama house to simulate the eight-floor building as the testing environment. We will use one Pentium-IV Computer to simulate the Central Control Center in the basement of the building and we also install the Peripheral Interface corresponding to the Hardware and Software [1] of the Advanced IADSS in the Pentium-IV Computer. We will set six "NT&SD Transducers" in each area, the total amount are 48 "NT&SD Transducers". We will make several simulations to demonstrate the efficiency of the proposed Advanced IADSS with the Earthquake Detecting Function.

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