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ABSTRACT

Recently natural disasters and man-made calamities happened very frequently in Taiwan, some of which caused hundreds of inhabitants died and injured. The most important thing that makes the emergency medical treatment system work effectively during these catastrophes is dependent on the accuracy and immediacy of the information among ambulances, hospitals, fire bureaus, public health bureaus or offices, and emergency executive centers. With this information, the medical system can arrange the resources efficiently.

Radio frequency identification (RFID) is a kind of wireless technology that it uses radio frequency (RF) to identify target objects. The characteristics of RFID are its identification and orientation. Through tracing electronic signals, RFID is able to identify, orientate and trace patients or medical materials directly and continuously. Thus, RFID can help managers of medical institutions to promote emergency medical treatment quality, reduce medical mistakes effectively, and increase efficiency and effectiveness in hospitals.

A series of emergency medical delivery applications that use 915MHz RFID rings is developed in this paper. Through the help of RFID, the paper integrates the information of the whole emergency medical supply chain, and establishes a new model of emergency medical activities to solve the problems of information blocking among different medical rescue units. By solving these problems, the new model can enhance the rescue quality, reduce the damage of the disaster and strengthen the patient-oriented emergency care system.

Keywords: Emergency medicine, RFID (Radio Frequency Identification), data exchange, patient reference. emergency care quality

1. INTRODUCTION

Natural disasters and man-made calamities happened very frequently in Taiwan in recent years. From the 921 earthquake in the middle of Taiwan and the typhoons from HERB, TORAJI to MINDULLE, these disasters had caused a lot of serious damages. After the accidents, we found several faults through the investigation of the emergency medical rescue system when facing these catastrophes. For example, the uninformed distribution of the patients, the lack of the concordance among the departments of the government, inappropriate allocation of resources, the unknown injured degrees of the patients, and the un-reach of the right and instant information to the officers of disaster rescue teams who have been recognized as major faults [3-6].

It is needed for the government to establish a more efficient system to handle such a situation when disasters happen. The system is useful in the processes of the crisis management, especially when the communication of messages is crucial and the integration of the related medical resource is needed. If the advantage of the information technology is suitably applied, it is expected that the rescue team can provide the health service in the first time and then reduce the damage of the major disasters.

RFID is known as the one of the top ten important technologies in this century [7], since of its identification and orientation characteristics. RFID, if applied in medicine, can provide the tracing of patients or medical materials directly and continuously. Thus, RFID can help the managers of medical institutions to enhance its emergency medical treatment quality, reduce medical mistakes, and increase efficiency and effectiveness in hospitals [1].

When crucial disasters take place, how to deliver information quickly and accurately among ambulances, hospitals, fire bureaus, public health bureaus, and emergency executive centers is a major key to save the lives. This paper is to design and apply RFID to the emergency medicine. The application of RFID in emergency medicine can be the process from the time when the patient in the ambulance to the time when the patient is moved to the emergency room. Through the whole process involved, the application of RFID can integrate the logistics of the emergency medicine and provide a solution for the questions that they can not be solved in the time that the information count not be shared and integrated.

The purpose of the paper is to aid rescue systems to

obtain the newest information for the different level of stages, namely, the operation stage (such as ambulances and hospitals), the management stage (such as fire bureaus and public health bureaus) and the strategic stage (such as control centers). In the operation stage, RFID system can utilize the medical resources according to the deployment of these resources and the injured degree of the patients that are classified before arrive the emergency room. In the management stage, RFID system can improve the coordination of data exchange and reduce the problems of disagreed information among the hospitals in responsibility, fire bureaus and public health bureaus. In the strategic stage, RFID system can help the directors of the government to get the condition of the casualties in disaster event, and help the directors to make adequate decisions to rescue victims of the disaster.

2.   RFID EMERGENCY MEDICAL SYSTEM DEVELOPMENT

2.1.   System development

The proposed RFID emergency medical system develops and designs based on the related technique specified in the white paper in EPC Network [8-10]. We designed the system with the method of prototyping. The users' satisfaction and demands were considered in the developing process. The emergency rescue process and its flow chart are showed in Figure 1.

The rescue process contains six steps, as is discussed in the fallowing:

1.   The people who witness or encounter the disaster event call or inform the local fire bureau whatever they have seen;
2.   The commander of the fire bureau dispatches fire-fighting trucks immediately and notifies the related hospitals to send ambulances to the spots to offer emergency medical treatment;

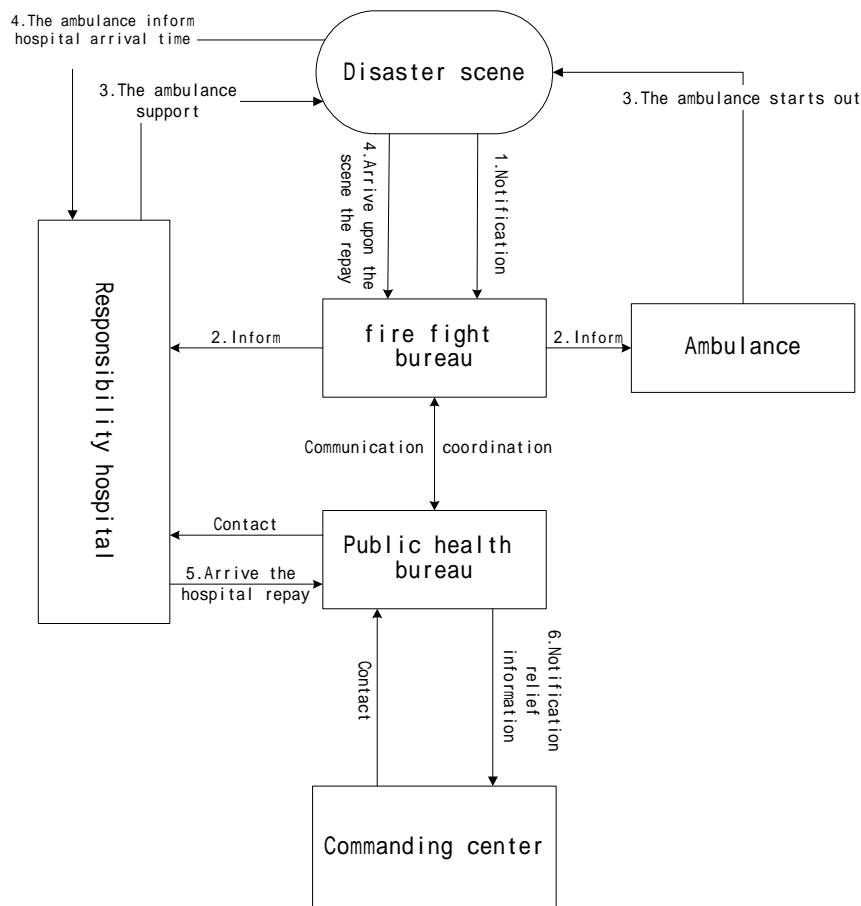3.   The ambulances arrive at the spots to salvage the victims and pick them up to these ambulances;

Figure 1.The flow of emergency medical rescue.

4.   Before arriving the hospital, the rescue team notifies the hospital in the ambulances about their arrival time and the preparation of the treatment;

5.   When the ambulance arrives to the hospital emergency room, the hospital will notify the public health bureau of the patient's information. If the public health bureau doesn't receive the information, it can inquire the hospital. The information between the public health bureau and the hospital must be coordinated with each other;

6. The commander in the public health bureau notifies the command center about the information of the disaster. The commander in the command center arranges the relative units to deploy the resources to the injured patients.

According to the analyses of emergency rescue process, we designed the emergency medical treatment with the introduction of RFID. The modified rescue system flow represented in a sequence diagram is showed in Figure 2. Then we program the framework for the RFID emergency medical rescue system, which is divided into the operation, management and strategic stages, as is shown in Figure 3.
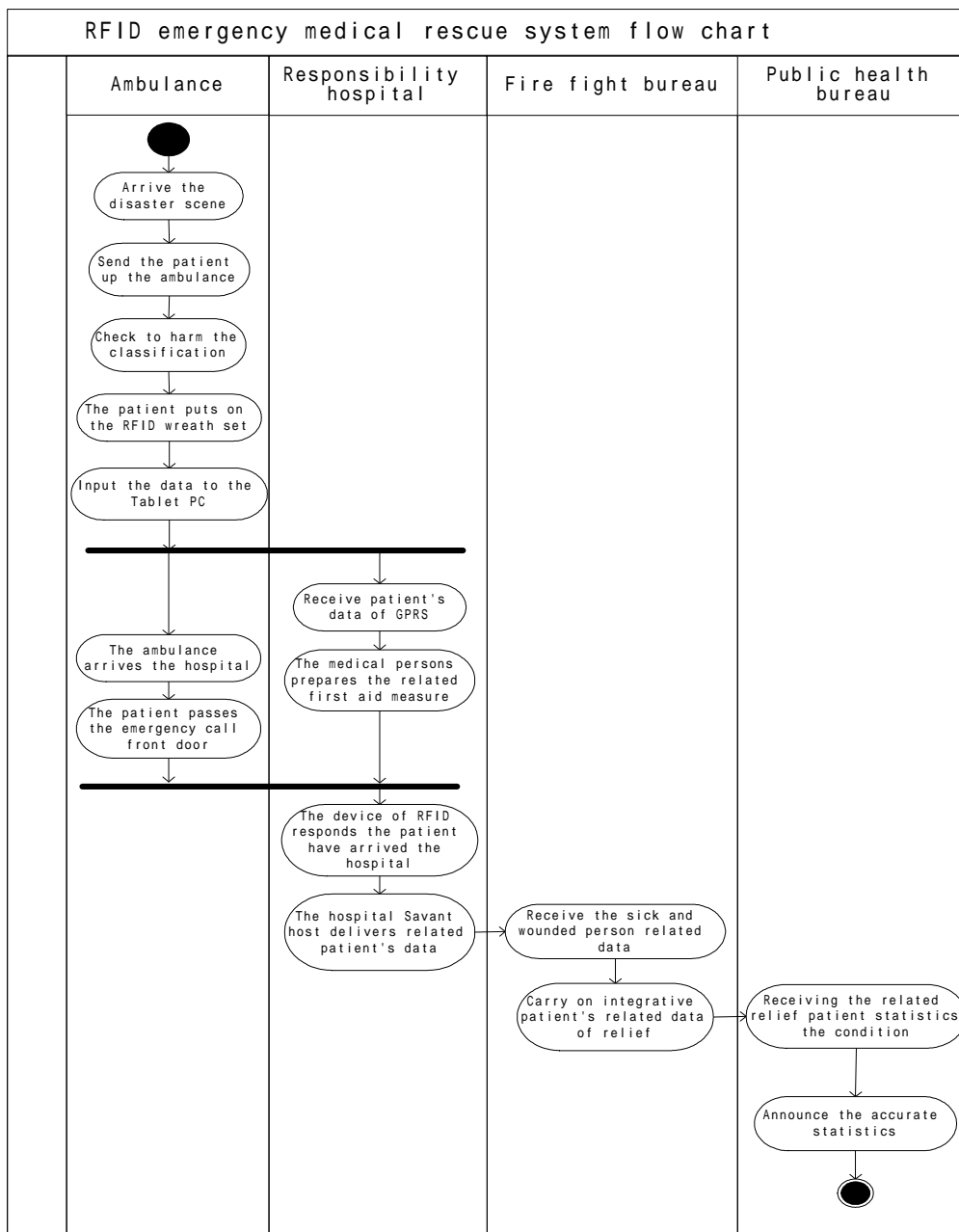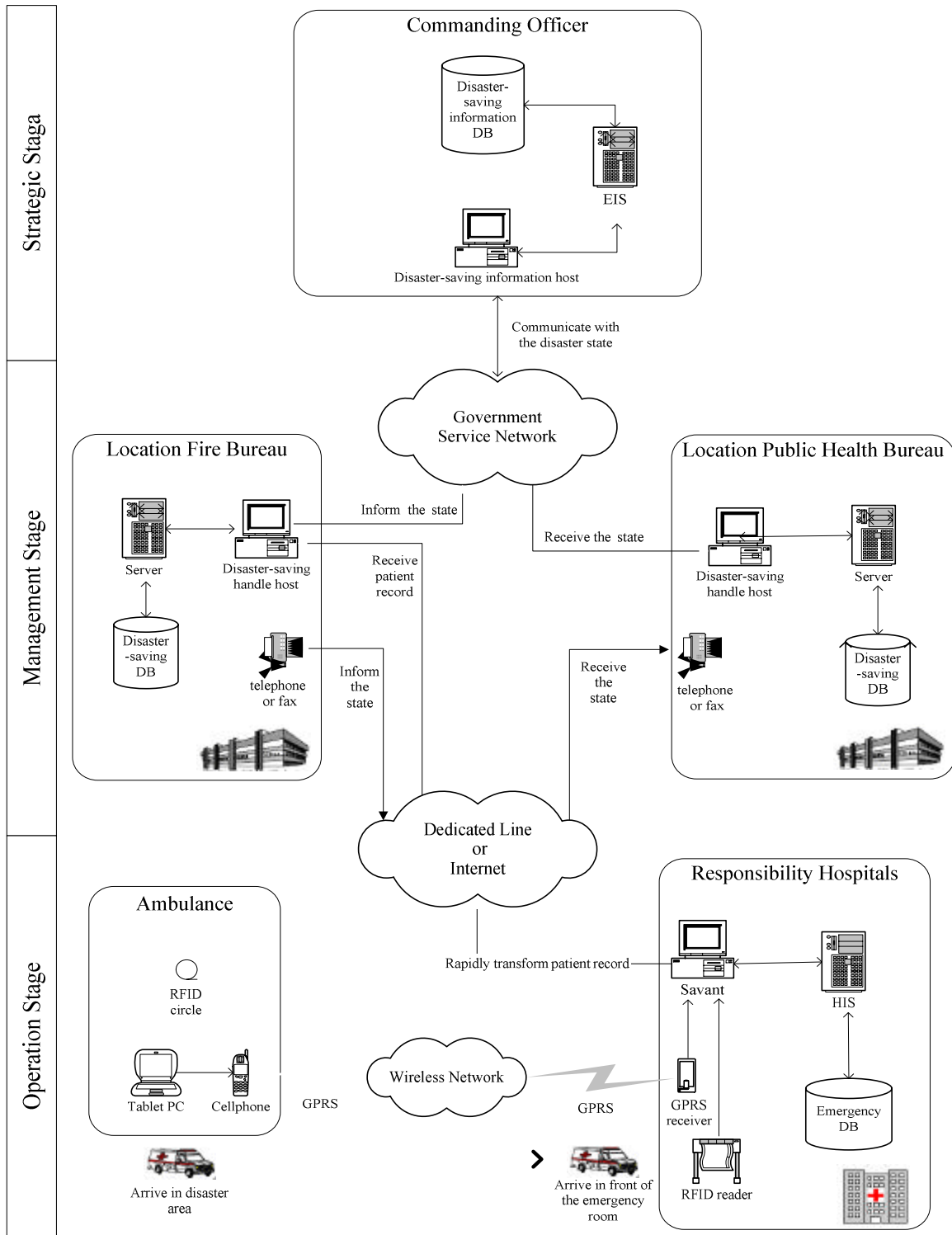
Figure 2: RFID emergency medical rescue system flow chart

middleware, which handles the RFID events, carrying out the extraction and summary of data and translating the information such that the information can be processed by other computer systems;

3. The middleware also integrates the Savant server and the HIS's database. The middleware transfers data in XML format to call other system components that is encapsulated in the Web Service. Using SOAP standard, the system integration is done.

3. BENEFIT ANALYSIS

The development of RFID emergency medical rescue system follows the guideline to establish an information system. The process of system analysis, system design, the hardware installation and the system construction can be easily achieved. In addition, we need to evaluate the system from four dimensions, namely, practicability, accuracy, efficiency and completeness:

1. Practicability

The feasibility, affordability and the future extension of the proposed system can be validated by the three facts: (1) the wider and wider coverage as well as the good quality of the mobile telecommunication and wireless Internet access system, (2) the appearance of the acceptable handwriting input system such as tablet PC and (3) the maturity of EPC Network, system have been developed maturely

2. Accuracy

The RFID tags are independent with each other. All rescue units can receive the messages sent from the tags accurately and automatically. Compared to human-entry system, the automatic operation system can reduce the risk of mistakes and malpractice;

3. Efficiency

The efficiency of the RFID emergency medical rescue system can be discussed in three viewpoints:

(1) The viewpoint of healthcare providers:

The system can directly connect to the HIS of hospitals. The system provides an easier and faster way to key in and recognize the patient in arranging the process of medical treatment. With this system, the healthcare providers can alleviate the stuffs and focus on saving the lives;
(2). the viewpoint of fire bureaus and public health bureaus:

Through the system, the local fire bureaus and public health bureaus can correctly and immediately allocate the available medical resources to the patients. In addition, the communications between them will be smoother than ever;

(3). the viewpoint of the governments:

By the precise information, the leaders of the government can promptly make decisions to rescue lives. Even when the local salvage resources are run out in a big casualty, the leaders can be aware the condition immediately and then ask the aids from adjacent areas or countries to provide the sufficient medical treatments;

4. Completeness

As a result of implementing the RFID emergency medical rescue system, the county government can get over integrated information about emergency healthcare demand quantity and the number of casualties whenever catastrophes happen.

4. CONCLUSION

We have designed and implemented the RFID emergency medical system for the emergency medical rescue system. The motivation is to design a complete process from the time when the patients are taken into ambulances to the time when they arrive to the emergency rooms. The primary characteristics of RFID can provide the function of identification, orientation and traceability of patients. The communication of information at anytime and anywhere will make the emergency medical rescue more efficient. The proposed system offers a chance to integrate the whole medical supply chains and solve the medical information flow problems that can't be effectively shared and integrated before.

Through the development of the RFID emergency medical rescue system, we establish a better model of emergency medical rescue system. With the successful experience of a pilot experiment in Nantou, Taiwan, we established the relative performance indexes, models and standard operating procedures, and will transfer the successful paradigm to the other seventeen local emergency medical rescue networks. Through the integration of the object (i.e., patient) flows traced by the RFID and the information flows exchanged in HL7 standard, we can connect each local medical network and establish an emergency medical information integration network. The system can promote rescue quality, decrease medical mistakes, diminish the damage of disasters and finally build a patient-oriented healthcare environment.

5. ACKNOWLEDGEMENT

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