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The STEP^2 Model for Designing Emergency Services

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Abstract: Nowadays, information technology is developing at a tremendous speed and cloud computing is trying to replace stand-alone system which can be used to store or transfer information and data on the Internet. This study uses several technologies to design a multi-function e-service system for emergency ambulance services and it also invents a STEP^2 model to illustrate the design of emergency services. The STEP^2 model composes several aspects, there are service, technology, environment, processes, and people. The e-service system updates the traditional handwritten process and is also adopted with smart device by ambulances in Taiwan, the e-service allows information to be stored and transferred to the hospital database. Therefore, this study uses a service design approach to design an e-service system for ambulance service processes, which can be installed on a smart device. This e-service system integrates various media (such as sound, pictures, and text) and helps hospital employees to prepare materials for the patient before the patient arrivals at the hospital. This study uses e-service on the ambulances in Taiwan and illustrates the process by using a service design methodology, and it also improves the efficiency of hospital's material management.

Key words: cloud computing; e-service; STEP^2 model; smart device; service design; emergency service
JEL codes: I1, L8, M1

1. Introduction

According to WHO's report, the ageing population is growing very fast in almost every country. Hence, the e health care system is also growing economy; it is for each national level growing of big economy. Taiwan's hospital information system (HIS) has been developed over the past few decades. Followed by progress of Information Technology (IT), operating from the hospital enhances the scale of clinical trials. The Taiwanese government has vigorously supported telemedicine or electronic medical records (EMR) in recent years, and the ambulance transfer service plays an important role in medical services. Taiwan has established a wide range of medical institutions and is hoping to build a quick and convenient medical network so that patients do not have to travel long distances to access health care. At the end of 2012, Taiwan had 21,433 hospitals. Table 1 shows the statistic of hospitals in Taiwan since 1995. From the 1995 to 2006, the quantity of hospital is increasing, but since 2010 the quantity of hospital is not starting to grow.

The Ministry of Health and Welfare also shows that Taiwan has more than 2,125 ambulances in serving the needs of 23 million people; therefore, on average, one ambulance is on standby for one million citizens. However, ambulances in Taiwan still record incidents and accidents on paper. Therefore, this study aims to develop an

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electronic service using 3G or the next Long Term Evolution (LTE, 4G) system to build a medical service network on a smart device. The e-service can be used to send the patient's data to the hospital automatically through the medical service network before the patient arrives at the hospital. For an explicit design process, this study applies the Unified Modeling Language (UML) to show the processes and planning, and promotes a service research model for the service process design. In the remainder of the paper we describe the implementation of this model, introduce a case study to illustrate the workflow, present conclusions, and summarize the next steps for future studies.

Table 1 Hospital in Taiwan 1995-2012

year	The # of hospitals	Hospital			Clinic			
		All	Western medicine	Traditional Chinese Medicine	All	Western medicine	Traditional Chinese Medicine	Dentists
2012	21,433	502	488	14	20,931	10,997	3,462	6,472
2011	21,135	507	491	16	20,628	10,815	3,411	6,402
2006	19,682	547	523	24	19,135	10,064	3,006	6,065
2001	18,265	637	593	44	17,628	9,425	2,544	5,659
1995	16,104	787	668	99	15,317	8,680	1,933	4,704

Source: Ministry of Health and Welfare.

2. Related Works

In order to understand the background to this study, the following paragraphs describe several aspects of medical developments, the ambulance process, and the service architecture.

- The development of medical hospitals in Taiwan

Taiwan has been promoting its telemedicine service since 1980. Telemedicine is an information exchange service, allowing patients, who do not need to go to the hospital, to get professional advice regarding treatment. In the 1980s, Taiwan had not developed any Internet or networking hardware facilities because of the high cost of installation. In 1995, when IT became more widely available, computers were adopted to improve medical services, and hospitals rapidly developed their health model, using the Internet to cope with data-oriented design, multimedia delivery, self-help, Decision Support Systems, and EMR (Taiwan's Department of Health, 2001). In 2000, hospitals saw the rapid development of handheld systems through wireless networks, Internet media, Global Positioning Systems (GPS) and Radio Frequency Identification (RFID). In recent years, as provision of care for the growing elderly population has increased, the medical services have integrated positioning and remote home health care into EMR and transfer patient information to the hospital immediately. With the start of the smart device era in 2010, Taiwan's smart phone market share reached 47.2% in 2011 (Digital Convergence Development Association, Taiwan, 2011). These mobile devices integrate diverse functions such as cameras, sound recordings, flashlights and communications, and use Information and Communication Technology (ICT) to coordinate with external facilities. Figure 1 shows the development of the medical service since the 1980s.

- The process and development of ambulance services

In 1988, Taiwan's executive Yuan promoted the emergency medical service (EMS) and is found EMS by the medical development in Taiwan, ambulance service was also included in the medical service. A dedicated line was set up so that, in an emergency, people could dial 119 to free call the nearest fire station or hospital. The operators notified to the scene after the query map, and the paramedic can perform emergency operations in the ambulance.

However, in an emergency, it is hard to explain the situation, and if the paramedic wants to take a photo or record sound, they would need to use a camera and/or a recording device. The patient needs to confirm the situation by signing the form completed by the paramedic (Figure 2). When the patient arrives at the hospital, the hospital will review the information recorded by the paramedic ambulance. However, if the hospital does not have the resources to care for the patient, the ambulance will be redirected to another hospital.

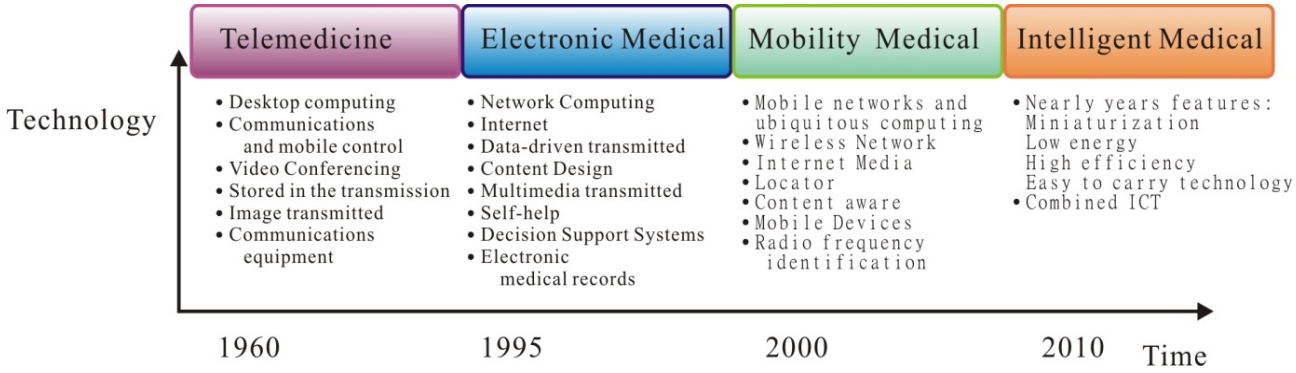

Figure 1 Recent Medical Developments

Source: Ministry of Health and Welfare

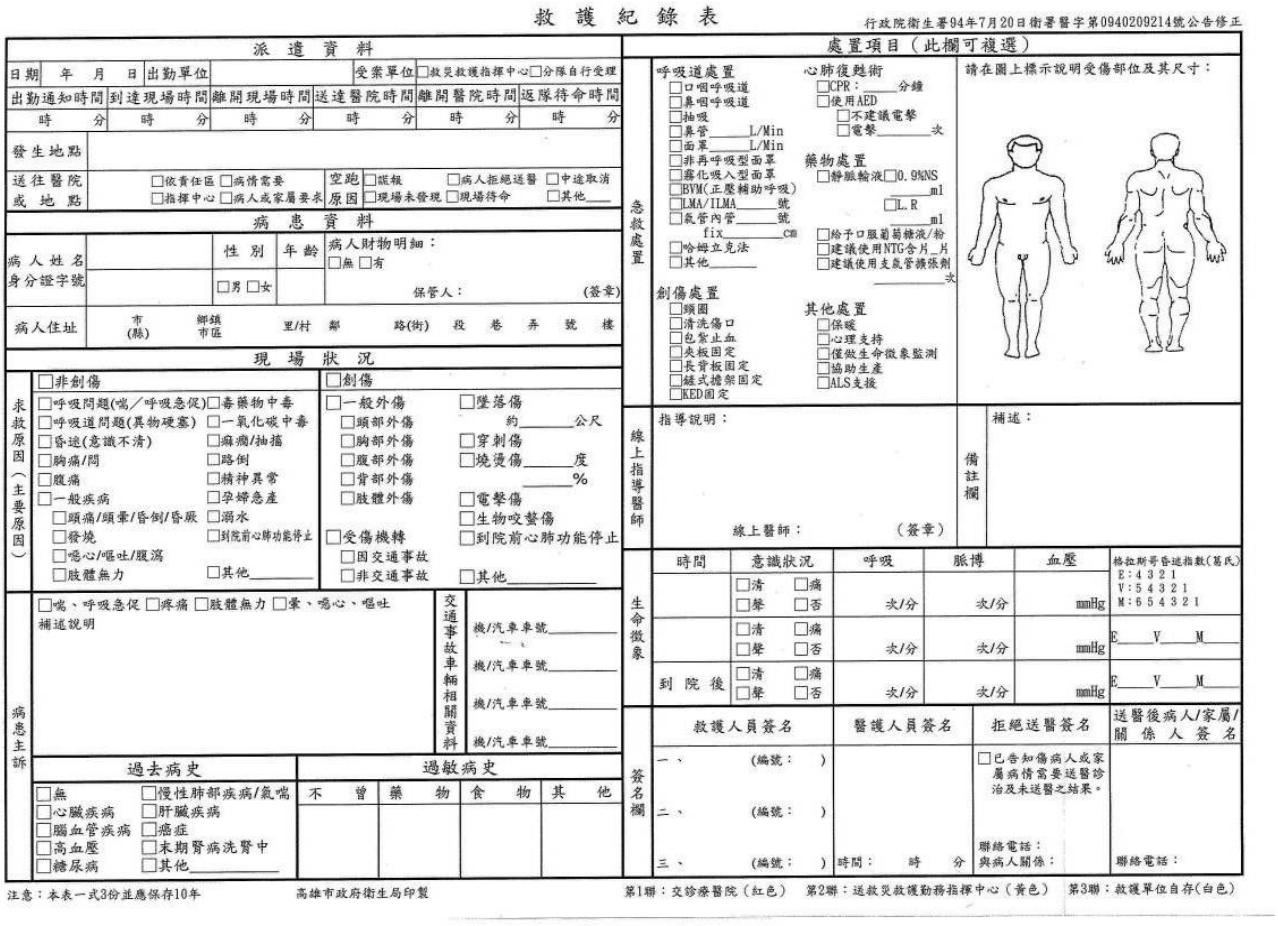

Figure 2 Injury/Illness Record Completed by the Paramedic

- The services blueprint

A service design aims to create a valuable service for customers; hence, research of a service design should follow a standardized structure to create a source of service value. A service design requires a services blueprint and a services flowchart, which detail the work processes, policy decisions, resource flows, customers, staff, and order of services process. Creating a services blueprint can help designers to understand the logical process of the service and identify possible bottlenecks in the service procedures.

A services blueprint is an important tool for the service flowchart; it is used in the construction of architectural blueprints to render a specific concept and detailed design specifications (Rao & Kakis, 2003). When the services blueprint is designed, the service providers must understand that interactive services in producing process first. By establishing the difference between core services and supportive services, we can concatenate the various processes and integrate the activities listed above to create a prototype. After this integration, we can invent a basic service to improve the service.

Medical staff must understand the processes undertaken at medical facilities. Thus, this study will first define the service process of all the work, activities, and resource flows of the medical service. The service design plans to understand the original service structure, find the blind spots, and develop a more fluent service process.

3. Research Model

In this research, we try to understand how to design a service for paramedics and to concern the service should be coped with information systems in the hospital. This research proposes a model for using the Service, Technology, Environment, Process, and People (STEP^2) for the service design framework. STEP^2 is chosen to be our model, because the service being developed addresses processes within a people-based environment that incorporates technology especially when the medical service is occurring in the hospital. Therefore, the STEP^2 can be illustrated as follows:

- Service: To get experience opportunity from another group and under some conditions, the requester can obtain some benefits from the experience opportunity.
- Technology: To use hardware, software, and techniques integrate service intention through the Internet and develop some methods to solve the problem.
- Environment: Service is occurring in a specific environment or among various things.
- People: Humans always operate a lot of actions in a real location and there are many participants to join with services provider.
- Process: The service provides a solution to people for solving their problems, which are occurring in the environment.

Figure 3 depicts the relationship among these parts of this research model. There are five elements in this model, each of them plays different role for designing various services for specific purpose. People require service to satisfy their requirements and People try to execute some activities based on processes. The technology plays an assistant helping people to use service and integrates diverse processes. These elements are occurring in a specific environment.

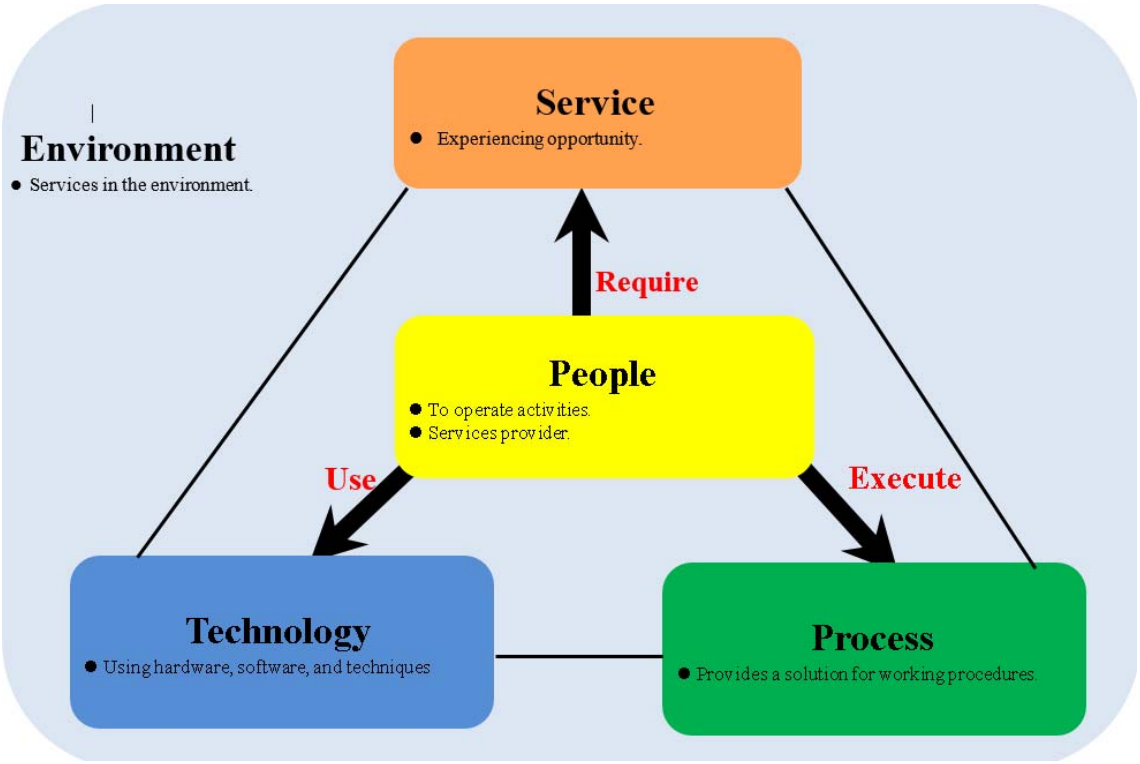

Figure 3 The Research Model

4. System Implementation

In order to understand the operations of STEP^2 model, this research adopts emergency services to design a system for ambulance in a rescue environment by using emergency service architecture. The emergency service management needs to be able to record voice, write text, create drawings, accept signatures, and use other functions of a mobile device. In addition to transferring the collected information, this service requires two databases to record information: (1) for the information collected by the paramedics in the ambulance, and (2) to integrate patient data from the hospital databases. To ensure that the information for each patient is unique, the service has to assign a random number without duplication. The data is transferred to the hospital through a mobile network. When the patient arrives at the hospital, the doctor can scan the barcode on the patient's bracelet to access the patient's data in the system. Figure 4 shows the scenario of the emergency service.

There are two situations occurring in the scenario of Taiwan's rescuing environment. At the first line environment, when the emergency center receives calling from the patient, the center dispatches the ambulance to serve patient immediately and the medical employee uses smart device (or Tablet PC) to record the situation of patient. And then, the emergency services transmit these information to hospital through the Internet or mobile network. Once the hospital staff receives the patient's information, the medical employee prepares medical materials for the patient before he/she arriving at hospital. Hence, the medical employee can be known more situation about the patient and to prepare more things for the patient in the hospital environment. The process of rescuing scenario also provides in the Figure 4.

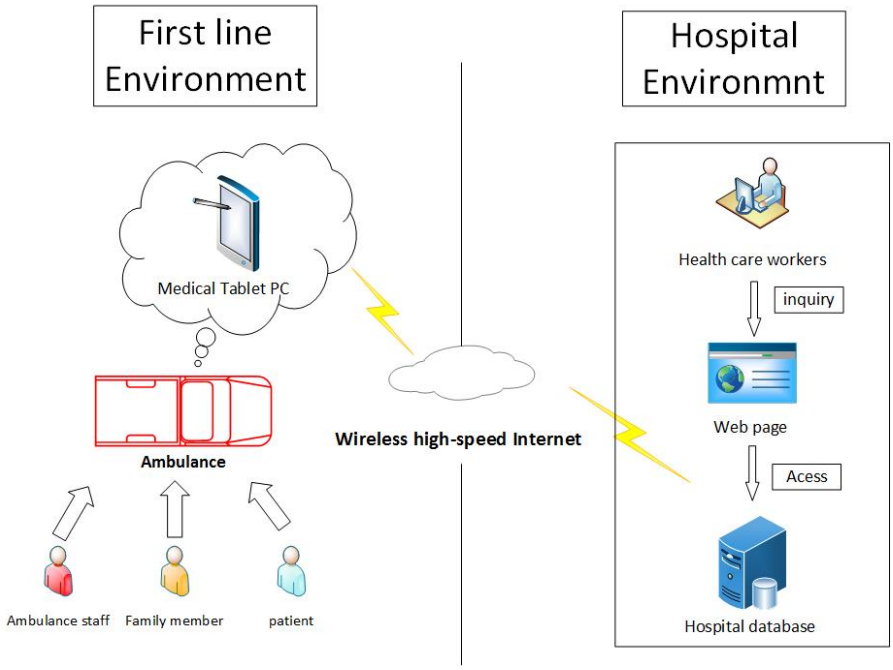

Figure 4 Scenario of the Emergency Service

Based on Figure 4, this research designs a software framework for an emergency service. The framework can be divided into two parts: one for mobile devices (or smart device, Tablet PC), and the other for using service in the HIS. Currently, each HIS is designed for using different architectures, but most have a database facility. This research adopts a Web service for communication between heterogeneous systems and uses a browser interface to display the patients' records. Different layouts can be designed to correspond with different hospitals. Figure 5 shows the software framework to operation with various facilities.

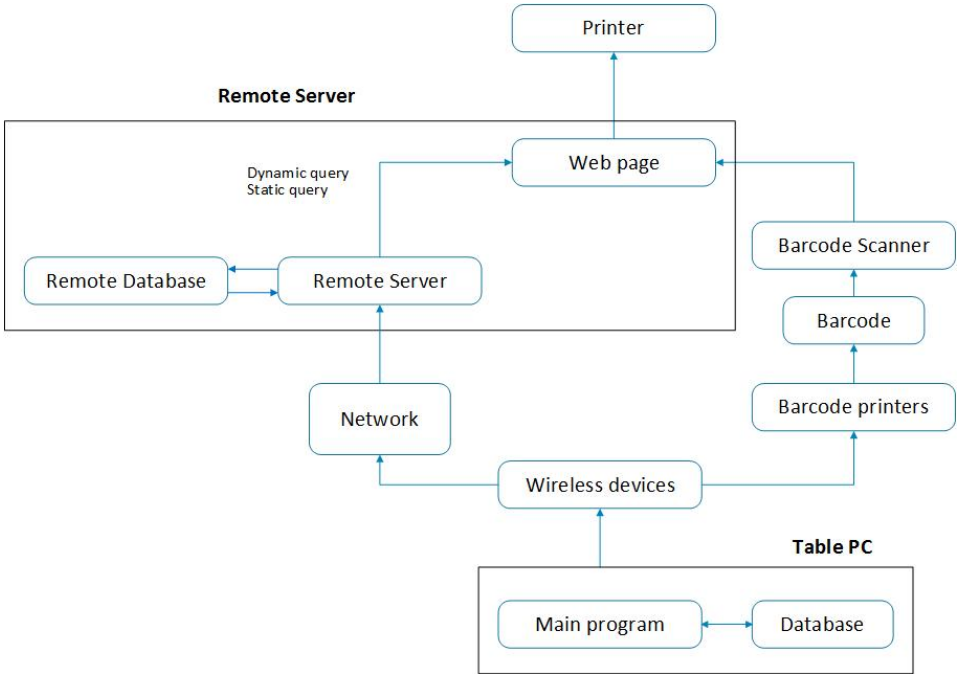

Figure 5 Software Framework for an Emergency Service

5. Conclusion

In this research, we invents a STEP^2 model to analyze the emergency services and to design a system for using in ambulances which could digit immediately, reduce mistakes, and send data to the hospital. The system speeds up the time taken to record data, and this data can be used for statistics or review. Owing to our system that data be digit immediately. As almost 81,000 people take medical treatment each year, and if each rescue procedure takes about eight minutes, this system could save considerable time completing paperwork, and thus decrease human capital costs. Furthermore, hospitals can send messages and advice regarding medical treatment to aid the rescue team.

However, to use the system, it is necessary to have a tablet PC and a reliable network. Some remote districts might have limited reception, which could pose a problem. This system could also decrease the several service mistakes that occur when making handwritten documents and allow the paramedics to concentrate on providing medical care without losing data, thus providing the patient with better treatment. In the future, we hope this system will be available for all ambulances and that it will be developed into an application (APP) to ensure the injured/sick persons receive quality first aid treatment. Our system will continue to develop the system with human-based services and add mobile Internet such as GPS PC to phone biometric verification. We also aim to develop interactive information transmission; for example, patient medical records, commonly used methods, or connecting to a doctor online to provide higher quality medical treatment.

In the future, this research will try to combine the toolkits of business process management with service design and to discuss more operations of STEP^2 model. We hope the innovative service model can bring more benefits for the aspect of service design in the future.

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