Transactions of Real-Time Medical Services Using Smart Card to Support the Role of Smart Campus

Dewiani¹, Elyas Palante², Misa Amira Azwar³, Sitti Wahyuni Artini⁴
1,2,3,4Electrical Engineering Department, University of Hasanuddin, Indonesia
¹dewiani@unhas.ac.id ²e_palantei@yahoo.com ³misaazwar13@gmail.com ⁴artiniwa@gmail.com

Abstract. To improve health service, we can do by using new technology. One example of technology development in health is telemedicine. In this case, the patient data management integrated with electronic checks payments with one card. For that, in this final project is made using smart card system integrated with Unhas Clinic Website. Smart cards that are used by researchers are based on the Consortium Smart Card Indonesia iRFC v 1.0, while the PHP programming language is used to design the website. The creation of MySQL databases and Apache web server responsible for the request-response HTTP are combined in an application called XAMPP. This forms a system that uses a smart card which can save patients’ medical records and perform electronic payment transactions (e-payment). There are 10 people who have been registered as patients on the Website System of Unhas Clinic where 2 of them are insurance patients and have successfully completed the examination. In addition, the examination process at the Website of Unhas Clinic can be done on short distance (0 Km) and long distance (20.3 Km) by using Wireless Fidelity (Wi-fi) network operating system (uplink: 2.94 Mbps; downlink: 20.37 Mbps) and cellular networks such as Provider 1 and Provider 2 (average uplink: 7.1 Mbps; downlink: 5.15 Mbps) with fast connectivity.

Keywords. Smart card, Website, Medical Record, e-Payment.

1. Introduction

According to the World Health Organization (WHO), health is defined as a state of physical, mental, and social well-being and not just the absence of disease or weakness. Excellent health can support humans to engage in productive activities. To provide early detection of the disease, one must undergo a medical examination at the hospital. However, some patients have difficulty. For example, the hospital and the patient's residence are far enough away.

Limitations of health services can be overcome with technology, one of which is Information and Communication Technology (ICT) based on wireless technology, and has become a necessity in various aspects of life. With this ICT, information can be presented in real time, fast and certainly very accessible to interested parties [1]. In the field of health, ICT is needed to monitor the health condition of patients so that the combination of ICT and medical science is what creates biomedical techniques.

With the development of increasingly sophisticated biomedical techniques today, many studies design long-term treatment. For example, medical personnel can monitor vital signs of a patient's health condition without requiring direct interaction in the same room so that medical
personnel problems can be minimized. Indoor interactions differ from medical personnel and patients known as telemedicine.

In the implementation of science and technology development, especially in healthcare overview with advanced vision and prioritization of convenience, many researchers develop Health Service Applications based on smart cards [2].

Research [3]; [4]; and [5] have developed the process of recording medical data using Java Card cards and access cards Unified Medical Record Access and Analytics (UMRAA) so that clinics or hospitals no longer need to store patient data in paper form. The methods used are different, some use the Integrated Electronic System Recorder System (IEHRS) as a patient medical record storage database and some use the US Health Care System database associated with the UMRAA card. In this regard, it would be more sophisticated if a smart card containing data or information of patients who can be input online can also make electronic payment transactions so that the work of hospital staff or clinics can be easier in providing services to patients. Therefore, this research designs an integrated web-based payment service system using one smart card, so students can check their health at campus clinic and can use it in canteen and library. In other words a smart card can support the role of smart campus.

2. System design
As result of development of information technology, various approaches have made to improve health services by integrating both telemedicine and electronic patient data management. As for the benefits to be obtained from this system are if in an emergency, the patient does not need to come to the hospital for treatment, medical record is no longer written manually, and patients can interact online with the doctor. In this regard, the main concentrations of this research are: first, the telemedical system that has been designed consists a website which is a storage of patient medical records database, various types of medical examination and communication links between doctors and patients. Second, in facilitating patients to seek treatment, the web server is integrated with a smart card that is useful for storing patient data and facilitate in making payments electronically by top up the card balance first. Third, the mechanism of long-distance communication relationship between doctor and patient is implemented through chatting mode. This system is systematically designed as shown below:

![Diagram of System Design](image)

**Figure 1. Stages of Medical Service Transaction System Design**

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The initial stage of the design process begins with a theoretical and practical review to be tailored to the needs of the technical specifications of the desired Unhas Clinic Website System. In order to meet the first stage well, more intensive and extensive literature review activities should be undertaken to obtain the formulation of the Medical Service Transactions System that are different from previous studies and perform more robust. The next step is to analyze the needs of Medical Service Transaction System. At this stage the researchers perform analysis of the system, what are the needs of the system to be designed, such as software, hardware, or operating systems and so on. Based on the results of the two stages, then the next process information system design can be more effective and accurate. The next stage is the design of the Website System where in the website the patient will conduct health checked transactions such as the selection page of the types of examination. There are types of examinations that patients can choose such as body temperature, blood tension, general blood check-up, urine, headache, stomachache, asthma, cough, vomiting, diarrhea, chest pain, allergies, and emergency checks. In this type of emergency check, it can be selected if the patient is in an emergency condition that requires immediate relief. Patients can pay for medical expenses after they are handled by medical staffs or doctors. In addition, it can store patient medical records in database that can only be filled by admins and doctors and visible for the patient but cannot be changed by the patient. Furthermore, to facilitate the patient to communicate with the doctor then the researchers made a chat application so that patients can consult a doctor easily without having to go to the clinic especially if there is an emergency situation. This stage is very important to establish the desired medical service transaction system by writing the code of the program (coding) and system testing. In this research, program code is built using PHP programming language with MySQL database creation and Apache web server which is responsible for HTTP request-response where to make it easier for researchers to use XAMPP application. To link the clinic website that has been created, then it will be integrated with the smart card in accordance with the Consortium of Smart Card Indonesia Version 1.0. The use of the Smart Card itself is to store patient data and facilitate in making payments electronically (by top-up the card balance, first). While the functional testing of medical service transaction system conducted intensively to determine the overall system performance whether the resulting output is in accordance with the input data. In general, a schematic diagram of a medical service transaction system that has been designed can be seen on Figure 2.

![Diagram](image)

Figure 2. Overview of Medical Service Transaction System

3. **Trial test of medical transaction system**

Examination system at Unhas Clinic that located on Gowa Engineering Campus can be seen in figure 2. When the patients come to check their health, they must bring smart card to the clinic. The Smart Card is inserted into the reader to access patient information, perform the types of check-ups and to facilitate health payment transactions.

After the information about the patient has been read, then the patient is assisted by the medical staff to check or choose what examinations are desired, then the patient pays the examinations using
the smart card. If the patient does not have sufficient balance to payment transaction, then the patient must top up the smart card balance first by paying cash to the medical staff, then officers will top up through the system.

When the payment process is complete, then the patient will be checked by a medical staff at the clinic according to selected examination before. Then the medical staff will fill the examination parameters and examination conclusions are inputted through the Unhas Clinic Website System so that doctors that deal with the disease can see the results of examination from the medical staff and provide diagnosis even though the doctor is not in the Unhas Clinic. The medical staff or admin can print all patient examination results and receipt of payment after receiving the diagnosis result from a specialist doctor, then the examinations process is done. The flowcharts of patient examination flow system at Unhas Gowa Clinic can be seen below.

![Flowchart of System Flow](image-url)

**Figure 3. Flowchart of System Flow**
Figure 4 shows the front page of the Unhas Clinic website that can be accessed on the web browser by typing the web page [www.klinik-unhas.com](http://www.klinik-unhas.com). There are 10 patients have been registered on the Unhas Clinic website where the example of patients’ medical records is shown in figure 5. The web page view of the medical record website is intended to see the patient's examinations. In the web page view, it contains the check code, name, check-up date, status, and detail. Status column serves to see the status of the examination of the patient whether it is paid off, has not been paid or is finished. While the detail column is to continue the examination.
Figure 6 shows the action page. There are types of examinations that patients can choose such as body temperature, blood pressure, general blood check-up, urine examination, headache, stomachache, asthma, cough, sore throat, vomiting, diarrhea, chest pain, allergies, and emergency checks. In this type of emergency check, it can be selected if the patient is in an emergency situation requiring immediate relief. And the patient can pay for medical treatment after they handled by medical staffs or doctor.

![Figure 6. Action Page](image)

**Figure 7. Top-Up Page**

Figure 7 shows a Top Up page that is ready to add balance to the card as desired by the smart card holder. For now, if the patient wants to top up the balance of the smart card then they must pay using cash to the medical staff or admin at the Unhas Gowa Clinic. After making a payment it will open an Invoice page like Figure 8 which is a Payment Check of the type of examination that has been done. This invoice can be printing out or not, depend on the patient needs.

![Figure 8. Transaction Invoice Page](image)
Figure 9. Examinations Parameter and Checkup Results on Admin Side

Figure 10. Examination Parameters and Examination Results on the Doctor Side

Figure 11. Chat Feature on Admin or Medical Staff Side
Figure 12. Chat Feature on Patient Side

Figure 9 is the display of parameters and examination results that have been filled by medical staffs who are in Unhas Gowa Clinic. This page displays several options of medical check-up such as body temperature and blood pressure, general blood check-up, urine examination, physical examination, conclusions of the examinations and prescriptions which aims to fill out the examination results along with its parameters. While for Figure 10, it contains a conclusion column where the doctor will fill out the diagnosis result after reading the examinations result from Unhas Gowa Clinic and fill the doctor's prescription column if patient needs medicine for the illness. To fill the conclusion and prescription, all the doctors should be careful because after the results of examinations and prescriptions have been typed and stored it cannot be changed again. Figure 11 and 12 illustrates consultations between patients and medical staffs or admins who are at the Unhas Gowa Clinic through chat. In addition, it also works if the patient is in an emergency situation in which case the patient is unable to perform a medical examination at the clinic, then can send an emergency message to this chat page.

4. Conclusion
By integrating smart card with Unhas Clinic Website it can facilitate the patient to do the examinations without having to queue for waiting for medical record to be found which mostly still written using paper because in smart card there is patient information and can make payment transaction easily. In addition, health monitoring can be done by looking at the parameters of patient examination results that its directly inputted by the admins or medical staffs in the Unhas Clinic Website System. Doctors can also provide diagnosis and prescribe medication through the system according to the parameters and examination results of the patient. Consultation between the medical staffs or the admins in the clinic with the patient can be done through the chat feature of the Unhas Clinic so if the patient has an emergency that is not possible to visit the clinic, they can send emergency messages to this chat feature.

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