APPLICATION DESIGN OF THE MEDICINES USAGE PREDICTION BASED ON BACKPROPAGATION NEURAL NETWORK METHOD AND PHP

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Abstract—**The development of information technology makes many organizations utilizing it in their business process. For example, hospitals use certain information systems in medicine management. We observe that most medicines applications do not provide the drug usage prediction feature so that this situation causes the hospital staff being difficult in providing enough medicines. Therefore, in this experimental research, we developed an application in the form of a simple design for helping the hospitals in predicting daily medicine usage. This application also provides medicines stock management and doctor diagnosis features. The Brainy library is used to facilitate implementing the backpropagation neural network method in PHP programming language. We choose PHP because this server script is widely used in information system development. We demonstrated that the mock-up as the result of this development is able to work properly. For further study, we suggest expanding this mock-up become a full hospital information system that covers many functions in medical centers.**

Keywords: **Medicine usage prediction; Neural network; PHP.**

I. INTRODUCTION

In this decade, most hospitals use certain information systems in managing their resources, such as finance, medicines, and staff [1]. Medicines management is one of the most critical sectors in the medical center because it is directly related to the patient's recovery. If it is out of stock, definitely the treatment of the patients will be chaotic. To avoid the risk of running out of stock of medicines and consumables, hospitals generally make simple predictions themselves about their usage for medical materials for the next few days. In addition to being inaccurate, this method is very troublesome because there are so many types of drugs and medical materials in which the needs of each type of drug are certainly different. Thus, a complete information system is needed with a system that is able to predict the usage of drugs and medical materials.

At present several studies have developed prediction systems to be applied in numerous cases with various method approaches or algorithms. From several well-known artificial intelligence methods, Backpropagation Neural Network is the best because it has been proven to have a high degree of accuracy. This method must be trained repeatedly with the

appropriate input and output examples so that it can recognize patterns and obtain the weight and bias of each node with the smallest error [2]. Several studies have successfully applied the Backpropagation Neural Network model to produce an accurate prediction system. For instance, [3] researched the car sales forecasting system using artificial neural networks and certainty factor which will be utilized as an effective way to increase company profits. From the test results, the error results obtained from the accuracy of the prediction system built by 4.205%. Another example, [4] developed a system that predicts foreign tourist arrivals using recurrent neural network backpropagation through time method.

Because of its accuracy, this research will propose a medicine usage prediction system using Backpropagation Neural Network that is implemented in PHP programming language. By utilizing this prediction system, institutions providing health facilities will receive a warning when the stock of drugs and medical materials will run out the next few days so that examination and treatment of patients will not be disrupted.

II. BACKPROPAGATION NEURAL NETWORK

Neural Network is a mathematical model that works following the way of the brain where the model must be trained with certain patterns before it can be used [5]. The main purpose of the neural network computing is to develop mathematical algorithms that enable to learn by imitating information processing and knowledge acquisition in the human brain. The simple model of the neural network is as follows.
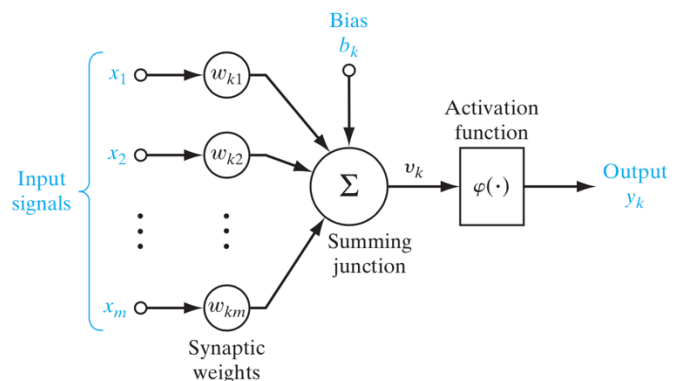

Fig. 1. The illustration of the neural network that captured from [6]

In the figure above, we can see that the neural network model consists of several input signals that will be multiplied with their respective weights. Then the multiplication results and the bias value are added up and calculated based on the activation function. For more detail, the illustration in figure 1 can be formulated as follow.

$$y_k = \varphi \left(\sum_{i=0}^{m} w_{ki} x_i \right)$$

(1)

Generally, in order to give an accurate prediction, the weight values in the neural network must be trained with a training algorithm, such as the Backpropagation algorithm. In this algorithm, there are two steps in training the model, namely [7]:

1. The forward phase is the step when the output value is calculated based on the formulation (1) above with previous weight values. The weight values are set to random when initializing step.
2. The backward phase is the step when the weight values are adjusted based on how much difference (error) between the training value and the output value from the forward phase.

III. SYSTEM DESIGN

In this chapter, we design the medicine usage prediction system that consists of two applications that are connected through a cloud server.

A. System Overview

The system to be designed is a combination of 2 applications, namely medical record application and prediction application. The medical record application is filled in by the doctor to store data on patient complaints, disease diagnoses, and prescription drugs and medical materials provided. The patient data is stored and then will be processed by the application of prediction of drug needs and medical materials to predict drug needs for the next day based on its prior week usage.
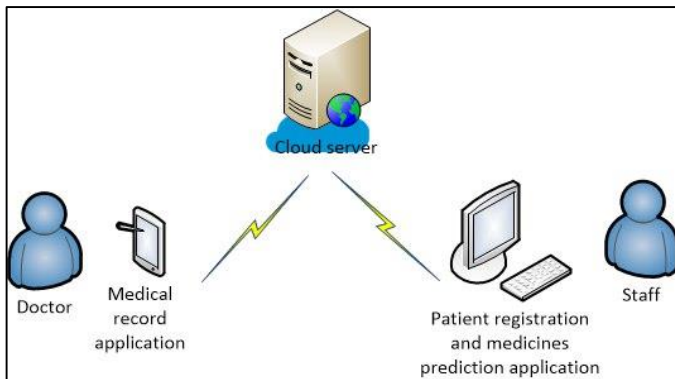

Fig. 2. The system overview

Applications built in the form of a combination of web-based applications and android-based applications. The web application is used by hospital employees or operators to record new patients and see predictions of drug needs. While the android application is used by doctors to record the results of medical recordings. Before use, employees and doctors must register with the administrator and log in to enter the system.

B. System Workflow

The flow of using this system is as follows. When the patient arrives at the restaurant, the operator of the hospital or clinic will receive him and record the patient's identity. Furthermore, the system will store personal data and complaints to the cloud server, and will automatically send notifications to the doctor's application using Firebase push notification technology. The doctor who receives the notification will then examine the patient and enter the examination results into an Android application that has been connected to the system. Finally, patients take the drug at the pharmacy in accordance with the prescription written by the doctor. With all the data that has been recorded, the operator can see the number of drug transactions and the status of drug requirements for tomorrow.

IV. RESULT

Based on the system design, we succeed to build two applications as below. We use PHP programming language [8], Brainy library [9], and MySQL database [10] for the server implementation. Please note, because they are aimed at Indonesian users, the applications use Indonesian in the entire user interface.

A. Patient Registration

When the user successfully enters the system as an operator, the application will load the homepage that displays the main information in the form of a patient waiting list and a list of patients that have been handled by the doctor. Patients who are still on the waiting list can make a change of doctor. To add a patient, either a new patient or a patient who has been treated before, the operator presses the green '+ Rekam Medis' button.
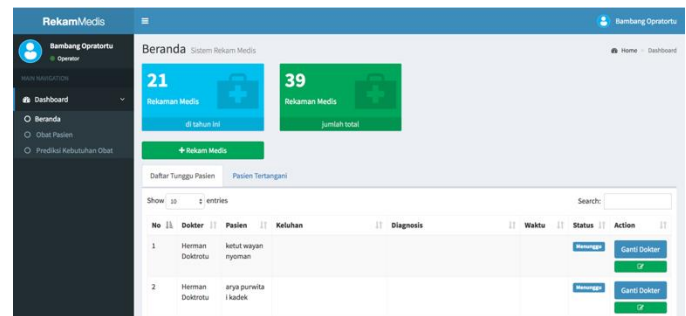

Fig. 3. The homepage

B. Medical Record

Doctors in this system have a role to conduct examinations, diagnose diseases, and prescribe medication for patients. To begin using this application, the doctor logs in to the Android application. If successful in logging in, the doctor will see a

page that contains a list of patients he must handle. The doctor also will get a notification when a new patient is registered by the staff and is waiting for treatment.
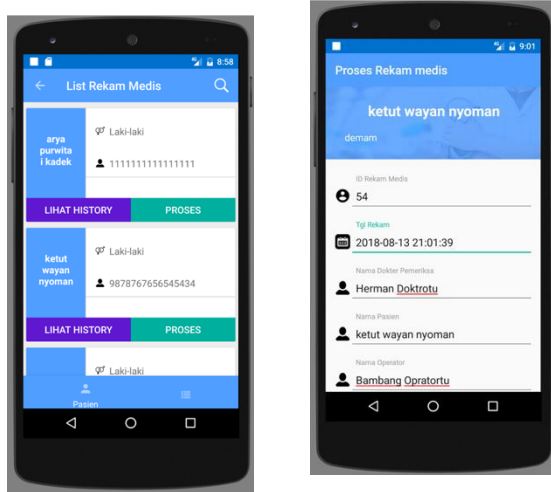
(a)   (b)
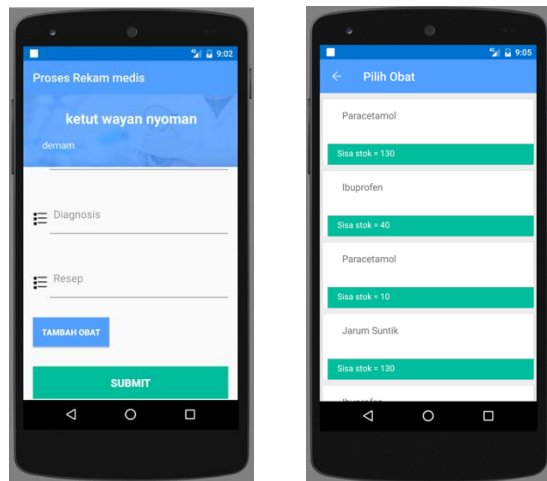
(c)   (d)

Fig. 4. The doctor page

From the patient's waiting list (figure 4.a), the doctor presses the 'Proses' button to begin the examination of the patient. The doctor examines the patient and fills in temperature, weight, height, blood pressure, diagnosis of disease, and prescription medication. To enter details of the drug to be given, the doctor presses the 'Tambah Obat' button and selects what medication to be given, along with the amount of the drug.

C. Usage Prediction

To see how the prediction of drug needs and medical materials tomorrow at the health center, the operator can select the 'Prediksi Kebutuhan Obat' menu located on the left side of the screen. Then a list of drugs and medical materials will appear which is owned by the health center, but the prediction shown is still empty. To run the prediction calculation process, the operator presses the 'Jalankan Perhitungan Prediksi' button in blue. This process only needs to be run once a day, so when

the operator opens this page again, the prediction data will already be filled. However, when the day changes, the data will again be displayed blank so the operator needs to press the button again so that the calculation process runs to predict the need for the next day.
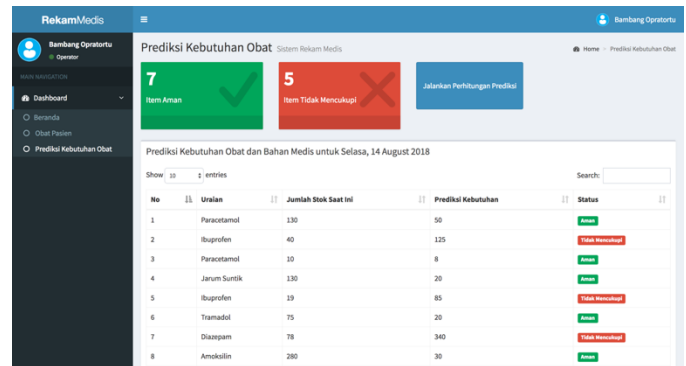

Fig. 5. The usage prediction page

D. System Testing

System testing is a stage to find errors or bugs in software that has been built before the system is widely used [11]. At this stage, the prediction system will be evaluated by means of a functionality test. This test aims to check whether the overall functionality or menus on the system can work well or not. The following are the results of system testing on a 2015 MacBook Pro laptop with the macOS High Sierra operating system, a 2.9 GHz Intel Core i5 processor, and 8 GB of 1867 MHz DDR3 memory.

TABLE I
Test results for functionality

No	Function	Result
1	Login	Running
2	Logout	Running
3	Patient registration	Running
4	Sending notification into Medical Record Application	Running
5	Saving patient diagnosis	Running
6	Medicines Need Prediction	Running

V. CONCLUSION

Based on the results and discussion that has been presented in section IV above, we conclude that this study succeeded in developing a prediction system in a hospital that is able to integrate the several business processes at the hospital or clinic, starting from the patient registration process, the process of recording disease diagnoses and until the process of predicting drug needs. For further study, we recommend expanding this mock-up application become a full hospital information system that covers entire functions in the medical center.

VI. Acknowledgment

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