Naïve Bayes on Priority Queue Management

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Abstract. Queue management is one way to improve service quality at Polyclinic of Universitas Negeri Malang (UM). Based on the observations of the researchers, it was found that the management of the Polyclinic of UM queue could still be optimized again regarding the queue number information and service time so that patients could definitely know what number they were in the queue and what time they would get treatment. The results of this observation are supported by the statement of the administrative officer stating that the registrations procedure is still manual by filling out the form paper and waiting for the call in the waiting room without the queue number. Based on this background and looking at Indonesian rules and regulation that states special treatment can be given to people with certain conditions, researchers are inspired to make website queue development by implementing Bayes Theorem as an algorithm in priority decision support systems. In creating this development website, researchers used the waterfall development method. Data collection is done using a questionnaire. Validation questionnaires were used as website validation data by software engineering experts and algorithm experts. Participants’ questionnaires were used to determine user satisfaction with the website, and accuracy questionnaires were used by experts to assess the accuracy of the theorem in giving priority. Based on the results of research and data analysis, 100% validation was obtained by experts, 99.87% by users, and 75% by experts. These three percentages provide the conclusion that the research development website is valid and feasible to use.

Keywords: queue, priority, bayes theorem

1. Introduction

Based on general provisions, types, requirements, and permits written in Permenkes (Indonesian Minister of Health Regulation) No. 28 of 2011 concerning Clinics [1], the polyclinic is one of the health facilities that are expected to be a partner of the government in providing health services to the community to improve the health of the Indonesian people. It is appropriate for the Polyclinic to continue to improve the quality of its services. Polyclinic of Universitas Negeri Malang (UM) as the focus of research has good services and facilities. However, from the observation, the researcher assessed that the service could still be improved again related to queue management so that each patient knew the queue number and estimated service time that he would get.
In the health queue, the First Come First Served (FCFS) queue discipline does not always apply given the more severe patients require faster handling. This event will create a preemptive disciplined Priority Service (PS) queue. This is also a focus of researchers.

Looking at real conditions that exist and according to Law No. 39 of 1999 concerning Human Rights Article 41 [2] which clearly states that every person with a disability, the elderly, pregnant women, and children are entitled to special facilities and treatment, the researcher makes the development of a priority queue website.

Artificial intelligence that can imitate human thinking can be applied in giving priority to this development website. One algorithm that has been studied in the queue field is Bayesian [3]. Which is a simple probability statistical algorithm using Bayes Theorem, comparing old cases with new cases [4][5]. The existence of previous research on Bayes' Theorem in making decisions has led to its own inspiration for researchers to implement Bayes Theorem to improve queue management at the polyclinic with priority based on the patient's condition. The limitations in this development are: (1) the one-time duration of service in the general polyclinic is 15 minutes and 30 minutes in the dental and KIA poly, (2) the number exchange occurs because the higher priority is done by changing the number three-three, and (3) method comparison is not carried out.

2. Methods
The development method used in developing the research of queue website is the waterfall method. The steps of this method as shown in Figure 1 are (1) requirement and definition, (2) system and software design, (3) implementation and unit testing, (4) integration and system testing, and (5) operation and maintenance [6].

The reason for using this method is because the simple method and will make the product quickly made due to the revision is done at the end and it is flexible to return to any stage when an error is found [7]. In order for the design to be read by the machine, coding programs will be carried out using the PHP language with Sublime text editors and MySQL databases. Decision Support System(DSS) or Decision Support System will be done to give priority to the Bayes Theorem as the algorithm. Priority will be given to patients who are more susceptible/severe, so that patients will be served first, in accordance with the non-preemptive priority queue discipline [8]. Bayes theorem that is used to work to find a possibility occurs if an event occurs by looking for an event if a possibility occurs multiplied by all possibilities for all events [9]. In implementing this theorem, we use the weighted values that have been consulted with experts, which are presented in Table 1.

| Probability | Hypothesis |
|-------------|------------|
|             | $i = 1$    | $i = 2$ |
| $p(H)$      | 0.5        | 0.5     |
| $p(E_i|H)$  | 1          | 0.5     |
| $p(E_2|H)$  | 0.5        | 0.4     |
| $p(E_3|H)$  | 0.7        | 0.6     |
| $p(E_4|H)$  | 0.9        | 0.8     |
| $p(E_5|H)$  | 0.1        | 0       |
| $p(E_6|H)$  | 0.2        | 0.1     |
| $p(E_7|H)$  | 0.3        | 0.2     |
| $p(E_8|H)$  | 0.4        | 0.3     |
| $p(H)$      | 0.5        | 0.5     |
| $p(E_{i+1}|H)$ | 1        | 0.5     |
\[ i_1 = \text{precedence}; \quad i_2 = \text{according to schedule} \]

\[ E_1 = \text{tools}; \quad E_2 = \text{mild pain}; \quad E_3 = \text{moderate pain}; \quad E_4 = \text{seriously ill} \]

\[ E_5 = \text{age of child}; \quad E_6 = \text{teenage age}; \quad E_7 = \text{adult age}; \quad E_8 = \text{elderly age} \]

The testing of the researcher development website is divided into three stages, including: (1) validation test by software experts and algorithms, (2) field tests by users, and (3) accuracy testing by experts. These three tests were carried out using a questionnaire instrument, which validation test was used as a basis to find out whether the product was valid and feasible to be tested in the field. Field tests were used to determine user satisfaction, this test was conducted at the UM Polyclinic for 5 days with a total of 46 trial subjects. The third test, accuracy testing is used to determine the level of accuracy of the theorems used in giving priorities, tested by experts, namely doctors.

3. Result and discussion

From a series of trials that have been conducted, the following results are obtained

3.1. Validation result

Product validation was assessed by software engineers and algorithm experts, namely Mr. M. Zainal Arifin, S.Si, M.Kom. The results of product validation are presented in Table 2, Table 3, and Table 4.

| Table 2. Validation of Functionalities |
|---------------------------------------|
| **Descriptions** | **Values Range** |
| Account registration | 100 |
| Patients | 100 |
| Algorithm | 100 |
| Administrator | 100 |

with a validation percentage of 100%, obtained from 17 statements in all aspects.

| Table 3. Usability Validation |
|------------------------------|
| **Aspects** | **Percentage** |
| Efficiency | 100 |
| To learn and remember | 100 |
| Mistakes and security | 100 |
| Satisfaction | 100 |

with a validation percentage of 100%, obtained from 18 statements in all aspects.

| Table 4. Algorithm Validation |
|------------------------------|
| **Aspects** | **Percentage** |
| Compatibility | 100 |
| Reliability | 100 |
| Efficiency | 100 |

With a validation percentage of 100%, obtained from 3 statements in all aspects.
3.2. Trial result
Product trials in the field were carried out for 5 days at the UM Polyclinic with 46 trial subjects. The results of this trial are presented in Table 5.

| Aspects                        | Percentage |
|--------------------------------|------------|
| Efficiency                     | 100        |
| To learn and remember          | 100        |
| Mistakes and security          | 100        |
| Satisfaction                   | 99.76      |

With a validation percentage of 99.87%, obtained from 17 statements in all aspects.

3.3. Accuracy result
The accuracy of the theorem is assessed by experts, namely a doctor. The results of the accuracy test are presented in Table 6.

| Aspects      | Percentage |
|--------------|------------|
| Parameter    | 75         |
| Priority     | 75         |

With a validation percentage of 75%, obtained from 7 statements from all aspects.

From the validator's assessment, the percentage of validation assessment is 100% in each assessment, namely functionality, usability, and algorithm. By stating that this website is valid, this means the website is feasible and ready to be tested in the field. The results of the trial conducted for five days with a total of 46 subjects tried to give an overall percentage of 99.87%. In accordance with the criteria, thus the website developed is valid without the need for revision. The level of accuracy of the theorem used in giving priority is 75%, which is obtained from experts. Validity criteria are declared valid if not less than 70% [10].

4. Conclusion
The conclusion of the researchers' development website is that this website, both the functionality and usability of the website and the implementation of the queuing theorem has been valid and feasible to use with 100% validation value by experts, 99.87% by users, and 75% by experts.

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