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Designing an IT Service Management System with Naïve Bayes Method and Knowledge Base to Support IT Services

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ABSTRACT

SMK Pelita Alam is a health school that has been using IT systems rapidly in recent years to assist with various tasks. With the increased use of IT, new problems arise in IT service management, some of which are the increased volulme of data and information that must be managed. Therefore, the purpose of this research is to create a Helpdesk Ticketing application at SMK Pelita Alam that is equipped with a classification of the urgency level of complaints, and several other features such as a Knowledge Base that provides an updated knowledge base to improve responses to common questions and an AI Chatbot to ask various kinds of questions. This research uses the Waterfall research method while the algorithm used for complaint classification is Naive Bayes Classifier. This algorithm is implemented on the create ticket form, and this application is developed web-based. The results showed that the designed system can improve IT service quality, operational efficiency, and user satisfaction. The system can also provide useful information for future IT service planning and improvement. This research is expected to make a positive contribution to the development of assistance service systems at SMK Pellita Alam.

Introduction

The importance of efficient Helpdesk system management is increasing in the digital era, especially in educational environments such as SMK Pelita Alam. SMK Pelita Alam, established in 2008 in Bekasi City, is a pioneer health school. In recent years, they have rapidly adopted Information Technology (IT) systems to support various activities and tasks.

This research aims to create a Helpdesk Ticketing application at SMK Pelita Alam. The application adopts the Naive Bayes model for the ticketing process, and includes additional features such as a Knowledge Base to provide a continuously updated knowledge base to improve responses to common queries, and an AI Chatbot to respond to a wide range of queries. Naive Bayes Classifier is applied in handling the classification of complaints through the ticketing form. The use of this algorithm aims to improve accuracy in determining the urgency level of each complaint ticket.

This research is expected to make a positive contribution to the development of the assistance service system at SMK Pelita Alam. The results are also expected to be a reference for other educational institutions interested in using information technology to improve service quality and operational efficiency.

Therefore, the Design of Helpdesk Ticketing Application with Naive Bayes Method and Knowledge Base at SMK Pelita Alam is an important step to improve the quality of IT services, increase operational efficiency, and provide a better experience for IT service users in this school.

Knowledge Management System

Knowledge Management System is one of the right solutions for implementing work SOPs, processing knowledge both old and new in the form of experiences and modules, difficulties in sharing knowledge between teachers and limited storage space (Perdana et al., 2019). Knowledge Management System is a mechanism for storing, maintaining, and organizing business information as well as work related to the creation of various information that becomes a permanent organizational intellectual asset (Ishari et al., 2020).

Based on the two statements above, it can be concluded that the Knowledge Management System is an important solution for implementing Standard Operating Procedures (SOPs) for work and managing knowledge in organizations. Knowledge Management System helps organizations collect, store and organize information related to work and the creation of intellectual assets. This system helps organizations overcome challenges in sharing knowledge between team members and the problem of limited storage space for important information. Thus, the application of the Knowledge Management System can help organizations become more efficient.

Naive Bayes Algorithm

Naïve Bayes or multinomial naïve bayes is a method used to classify a set of documents. This algorithm utilizes probability and statistical methods proposed by British scientist Thomas Bayes. The NB method takes two stages in the text classification process, namely the training stage and the testing (classification) stage. In the training stage, the process of analyzing document samples is carried out in the form of vocabulary selection, which is a word that may appear in a collection of sample documents that can represent the document as much as possible. Next is the determination of priority probability for each category based on document samples. In the classification stage, the category value of a document is determined based on the terms that appear in the classified document (Wibisono et al., 2020).

- Naive Bayes Method Formula

$$P(H|X) = \frac{P(X|H).P(H)}{P(X)}$$

Where:

X	:	Data with unknown class
H	:	The data hypothesis is class specific.

P(H|X)	:	The probability of hypothesis H based on condition X (a posteriori probability).
P(H)	:	The probability of hypothesis H (prior probability).
P(X|H)	:	Probability of X based on the conditions in hypothesis H
P(X)	:	X probability

To explain the Naive Bayes method, it is necessary to know that the classification process requires a number of clues to determine what class the analyzed sample belongs to. Therefore, the Naive Bayes method above is solved:

$$P(C|F1 \ \dots \ Fn) = \frac{P(C)P(F1 \ \dots \ Fn|C)}{P(F1 \ \dots \ Fn)}$$

Where the variable C represents the class, while the variables F1 ... Fn represent the characteristics of the clues needed for classification. The formula then explains that the probability of a sample of a particular characteristic belonging to class C (posterior) is the probability of class C occurring (prior to the sample's inclusion, often called prior), multiplied by the probability of occurrence of the sample's characteristics in class C (also called likelihood), divided by the probability of occurrence of the sample's characteristics globally (also called evidence). The Evidence value is always fixed for each class in a sample. The posterior value will later be compared with the posterior values of other classes to determine which class a sample will be classified into.

Understanding Laravel

Laravel is a PHP programming language framework. Laravel has many modern features that really help developers in making applications. Laravel also has several advantages, namely using the Artisan Command Linel Interface (CLI), using the PHP Composer package manager, writing shorter, easier to understand, and expansive program code (Bin Tahir et al., 2019).

In the website (M Ali Maksum, 2022)in the journal (Amarulloh, 2023)said, Laravel is a PHP programming language-based framework that can be used to help the process of developing a website to be maximized. By using Laravel, the resulting website will be more dynamic.

Based on the two statements above, it can be concluded that Laravel is a PHP programming language framework that has many model features that really help developers in making applications and developing websites. Some of Laravel's advantages include the use of the Artisan Command Line Interface (CLI), the use of the PHP Composer package manager, writing program code that is shorter, easier to understand, and expressive.

Understanding Livewire

Laravel Livewire is a php frame work, it has an interesting feature which is real-time. Livewire's input processing speed is different from other frameworks. To process input, usually after entering data, other frames will reload the browser to clear the previous data. And this means it is very useful for inputting large amounts of data and saving time.(Daru & Adhiwibowo, 2021)

Database

A database is a collection of information stored systematically in a computer so that it can be controlled by a computer program to retrieve information from the database. The term "database" originated in computer science. It was later expanded to include things other than electronics. Database-like records existed before the Industrial Revolution in the form of books, receipts, and business data sets. (Andaru, 2018)

A database is an arrangement or collection of data records stored in a computer. The relationship between entries in the database can be used as a source of information for the user. Until now, many database records are still displayed in text form as information to users. This is one of the vulnerabilities that cryptographic analysts have in accessing, manipulating or leaking and distributing database records.(Yanti et al., 2018)

Based on the above understanding, it can be concluded that a database is a set of data that is stored and organized in a systematic and controlled manner by a computer program. It can be used to store, organize, and retrieve data easily and efficiently. Databases can be used in various fields, such as business, education, government, and others to store information such as customer data, transactions, inventory, and others.

Helpdesk

Helpdesk is a system used to provide assistance, support, and solutions to various problems or questions that arise at SMK Pelita Alam. Customer helpdesk system plays an important role in assisting the end users or customers of the organization to get the resolutions for their service-related problems. (S.P. & K.S., 2021)In the Journal Article (S.P. & K.S., 2021), Paramesh and Shreedhara discuss automatic ticket classification using artificial intelligence concepts such as Text Document Classification and Natural Language Processing Technique. It is said that Helpdesk systems are successful if they can handle and resolve problems quickly and accurately for each complaint submitted to the relevant department in terms of IT (MIS).

Chatbot

Conversational Bot or Chatbot is a content that is visualized in chat format and users can interact with the system using text. (Yuniar & Purnomo, 2019)

According to Eka Yuniar and Heri Purnomo, Chatbot has been equipped with spherical intelligence and natural language processing or NLP which makes it an intelligent computer application and can answer questions given by humans, this Chatbot was built by implementing an expert system using the forward chaining method. The forward chaining method is used to find conclusions from the facts collected.

e-Ticketing

According to (Muda et al., 2021), e-Ticketing is a way to document the online sales process that can make it easier for prospective buyers to book tickets via a web application.

According to (Tarigan et al., 2022), e-Ticketing allows users to see in real time the progress status of the handling of the problems they face. R. Tarigan, Dkk also explained that the e-ticketing system can facilitate electronic ticketing and reporting can also be done electronically.

Definition of Laragon

Laragon is free software that includes many operating systems as locahost or standalone servers. Laragon provides many services, tools, and features consisting of Apache, PHP Server, PHPMyAdmin, MySQL, Memchaced, Redis, Composer, Xdebug, Cmder and Laravel (Putra et al., 2019).

UML (Unified Model Language)

UML or Unified Model Language is a standard language for documentation, specification, and development in software development, which uses an Object Oriented Programming approach (Kurniawan et al., 2021).

Method

This research methodology uses a mixed-method approach, which combines qualitative and quantitative research methods. The research location was carried out at SMK Pelita Alam Bekasi City. The data used in this study are primary data and secondary data, primary data obtained through interviews and direct observation, and secondary data derived from documentation and references to literature studies, journals, and articles.

Results and Discuss

a. Current System Analysis

This library still uses a manual system, so member services cannot run effectively and efficiently. In addition, the library also does not have a handbook to help members find book collections, so it becomes difficult for members to find books that they want to borrow or search for. The library needs a system that can computerize and re-implement the process so that information can be obtained quickly, accurately, and precisely. Information obtained for members in the form of library book collections. This system is also useful for maintaining basic information such as book lists, member login access, member data, and reports on borrowing and returning books for the admin.

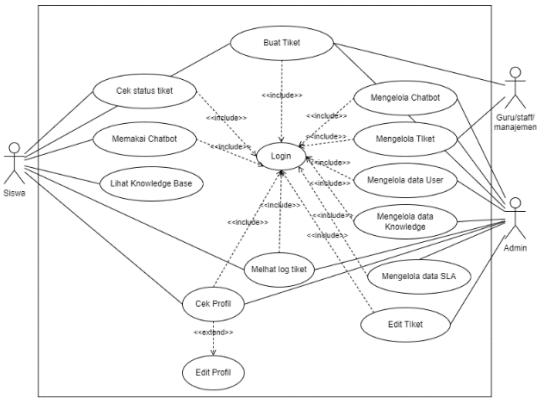

Figure 1. Usl Case Helpdesk Ticketing Application

b. Database Design

Table 1. Database

Table	Total rows
categories	5
chatbot_settings	4
dataset_tickets	8
knowledge_bases	7
message	8
priorities	6
roles	4
statuses	5
tickets	19
users	11

c. User Interface

Figure 2 is the first page when the website is accessed. On this home page, users do not need to log in to get information from the questions they want to find, users only need to click on the search column, users can also access the knowledge page. To access the Chatbot feature, users are required to log in. And if the user wants to create a ticket, the user must be registered by Admin / IT Staff.

Figure 2. Home Page

Figure 3 displays the login page. The user logs in using E-mail and Password. The login page is used to restrict user access rights to the Application. On this login page the user can use the forgot password feature and also register, there is also a checkbox see Password.

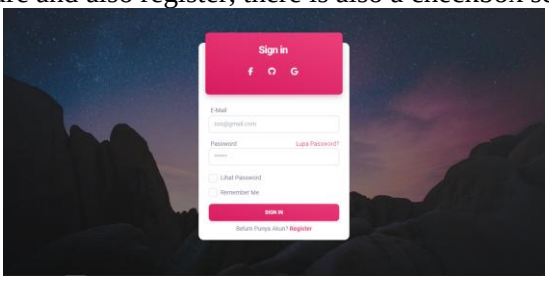

Figure 3. Login Page

Figure 4 displays the Admin / IT Staff Dashboard page. The Helpdesk Ticketing Admin dashboard page has several menus on the left sidebar, including: Knowledge Base, Chatbot, Tickets, Manage Users, and Settings.

Figure 4. Admin Dashboard Page

Figure 5 displays the Knowledge Base page. On this Knowledge Base page there are several forms and buttons. First, there is a search form to search for knowledge with the desired keywords. Second, there are two buttons to add new knowledge and upload knowledge via Microsoft excel as a template. To edit, Admin / IT Staff, can click on one of the knowledge that you want to edit. Finally, to delete it, Admin / IT Staff can select the checkbox to the left of the knowledge title, then click the delete button.

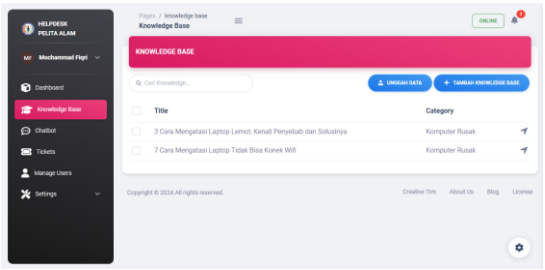

Figure 5. Knowledge Base page

Figure 6 displays the Chatbot page. Users can access this Chatbot page as long as they are logged in. In this Chatbot page there is a form to ask a question, and several buttons, including a send question button, and a delete button to clean the conversation.

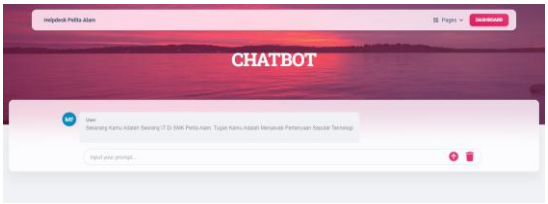

Figure 6. Chatbot page

Figure 7 displays the Tickets page. On this Tickets Admin page there are Import, Export, and re-delete dataset buttons. Admin can also delete and import the ticket data into the dataset. Admins can also conduct discussions with users who submit tickets.

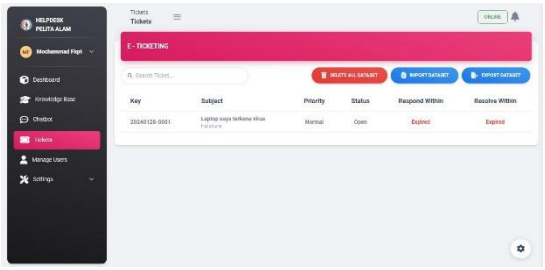

Figure 7. Tickets page

Figure 8 displays the Manage Users page. On this page there is a button to add new Users. Then there is the Import Users button, this method uses Microsoft excel templates to add Users data in bulk. And there is a filter button to classify the data that you want to appear. The edit

button is to the right of the "Three Dots". For delete next to the photo of Users, Admin / IT Staff can select one or all Users that they want to delete.

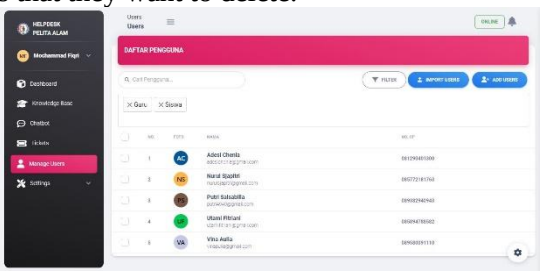

Figure 8. Manage Users page

This Setting menu is located on the left sidebar of the Admin / IT Staff page view. There are several menus in this Setting dropdown, namely, Categories Menu (Figure 9), Priorities Menu (Figure 10), and Statuses Menu (Figure 11). in each menu there are add, edit, and delete buttons. Priorities and statuses cannot be added or deleted.

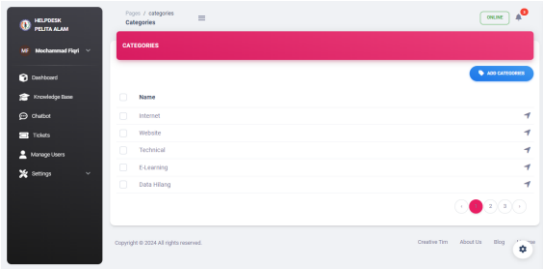

Figure 9. Categories Menu Page

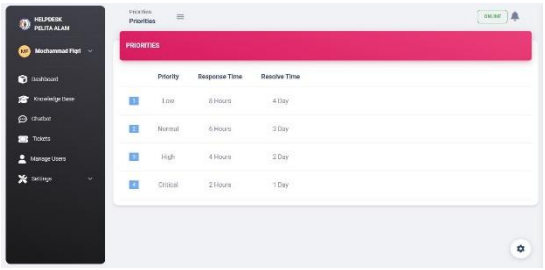

Figure 10. Priorities Menu Page

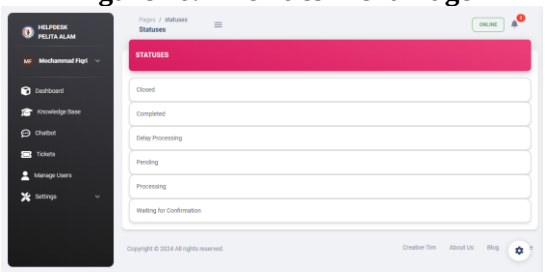

Figure 11. Statuses Menu Page

Testing

Testing the Helpdesk Ticketing Application developed for SMK Pelita Alam Bekasi City aims to determine whether the application can function in accordance with predetermined specifications and meet user needs.

a. Testing Method

One of the most widely used algorithms in classification techniques is the Naive Bayes algorithm. In this way, each attribute will contribute to the decision making, with equal weighting of attributes and each attribute is independent of each other.

In the implementation of the Naive Bayes algorithm, I used the library from yooper/php-telxt-analysis, this library is made specifically for the PHP programming language.
The application of Naïve Bayes Algorithm in this application is in the ticket creation process. In the ticket creation process there are 2 attributes and target labels, namely, Priority and Category. The Naïve Bayes algorithm is applied when creating a new ticket through several stages, including:

1. Data Collection

Data Collection Stage, the data used is the complaint data given by the User to the Admin / IT Staff. The data is collected from tickets that have been created. Figure 4.25 is a model for importing existing ticket data into training data.

```php
public function importToDataset() {
        try {
            $this->validate([
                'subject' => 'required|unique:dataset_tickets',
                'details' => 'required|unique:dataset_tickets',
            ]);

            DatasetTickets::create([
                'subject' => $this->subject,
                'details' => $this->details,
                'priority_id' => $this->priority_id,
                'department_id' => $this->department_id,
                'type_id' => $this->type_id,
                'category_id' => $this->category_id,
            ]);
            return redirect()->to('/tickets')->with([
                'toast_type' => 'success',
                'toast_message' => 'Berhasil Import Ticket ke Dataset',
            ]);
        } catch (\Throwable $th) {
            return redirect()->to('/tickets')->with([
                'toast_type' => 'error',
                'toast_message' => 'Gagal Import Ticket ke Dataset',
            ]);
        }
    }
```

Figure 12. Code Import Dataset

2. Data Preprocessing

At this stage there are several processes that are carried out, including: Lower Case Filter, Stopword, Punctulation Filter and Stemming.

- Lower Casel Filter

```php
use TextAnalysis\Filters\LowerCaseFilter;

// Lower Case Filter
$transformer = new LowerCaseFilter();
$lowerText = $transformer->transform($this->details);
```

Figure 13. Code Lower Case Filter

- Stopword

```php
use TextAnalysis\Filters\StopWordsFilter;

//Stopword
$stopWord = new StopWordsFilter($this->loadStopwords());
$stopWordText = $stopWord->transform($lowerText);
```

Figure 14. Code Stopword Filter

- Punctuation Filter

```php
use TextAnalysis\Filters\PunctuationFilter;

//filter
$filter = new PunctuationFilter();
$textFilter = $filter->transform($stopWordText);
```

Figure 15. Code Punctuation Filter

- Stemming

Figure 16. Code Stemming

3. Split Data

In this process, the division of training and testing data from existing data sets is carried out with a division of 80% for training data and 20% for testing data.

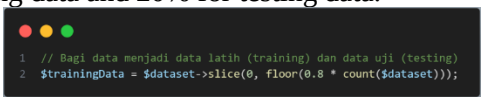

Figure 17. Code Split Data

After splitting the data, train the model data with the training data.

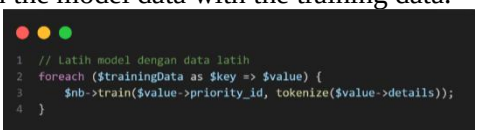

Figure 18. Code Train Data

4. Probability

Finally, calculate the probability of the prlprocelssing and split data results, here is the code:

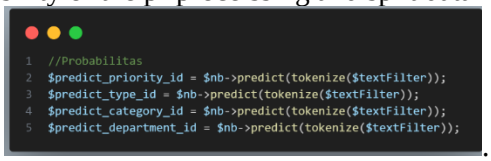

Figure 19. Code Calculate Probability

b. Testing Results

The test result stage is the result of what the program code runs.

1. Data Collection

In this stage, researchers implemented the data collection process for the Dataset. This process was carried out using the Microsoft Excel application. Researchers created training data from the original dataset. Which consists of 4 variables and 1 label. These variables include subject, details, department, and category, and the label is priority. The target that will be the testing material is part of the ticket.

Table 2. Example Dataset

Subject	details	department	category	Priority
Microsoft Word Problems	Microsoft word cannot be typed	IT Staff	Low	Software
Internet connection problems	I had a hard time connecting to the internet in classroom A. The Wi-Fi signal was very weak, and often cut off.	IT Staff	High	Internet
Unable to access the e-learning platform	I cannot access the e-learning platform. Every time I try to log in, the webpage does not respond.	Administrator	High	Website

2. Data Preprocessing
   - Lower Case Filter

In the Lower Case Filter stage, all characters in the text are converted to lower case. By doing this, it helps standardize the text, so that differences in capital letters have no impact on the overall text analysis.

Table 3 Lower Case Filter Results

Subject	details
laptop not turning on	The laptop does not turn on when turned on, the power indicator light is on but the screen does not display an image.

   - Stopwords Filter

The Stop Words Filter is part of the functionality to perform text processing, specifically to remove words that are considered as "stop words" from a text.

Table 4. Stopword Filter Results

Subject	deltails
laptop does not turn on	laptop does not turn on when turned on, the power indicator lamp lights up but the screen does not display the image.

   - Punctuation Filter

Punctuation Filter is part of the text processing feature to clean or remove punctuation from a text. It helps process and clean up the text by removing punctuation, thus allowing the analysis of the text to focus more on the words.

Table 5. Punctuation Filter Results

Subject	details
laptop not turning on	the laptop does not turn on when turned on the power indicator light is on but the screen does not display an image.

   - Stemming

Stemmer Factory is a class in Literature that is responsible for rounding the instances of the stemmer. Stemmers are the main component in the stemming process that performs the truncation of words with affixes from words to produce base words.

Table 6. Stemming Results

Subject	details
laptop not turning on	laptop turns on power indicator light turns on screen displays image

3. Split Data

In this process, training and testing data is divided from the existing data set with 80% for training data and 20% for testing data. After splitting the data, then train the model data with the training data.

4. Probability

Finally, calculate the probability of the results of preprocessing data and split data using the model in Figure 19. Researchers calculate the probability for the Priority column. So that the prediction results according to the details provided are as follows:

Table 7. Probability Results

id	name	probability
2	Normal	0.4304983865911
4	Critical	5.8441958917639EL-11

3	High	3.6496262803146EL-13
1	Low	5.6707305799158EL-15

Conclusion

Based on the research that has been described in the previous chapters, it can be concluded that: 1) The Helpdesk Ticketing application developed for SMK Pelita Alam Bekasi City has successfully passed the main functionality testing, namely the login system, adding tickets, adding a knowledge base, adding users, and using chatbots. The system has been able to run normally and in accordance with predetermined specifications. 2) The Naïve Bayes method utilizes training data to generate the probability of each target label, so that the probability values of the target label can be optimized to predict the highest probability of the target label based on the classification process performed by the Naïve Bayes method itself.

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