

# Implementation of a Web Based Automatic Public Complaint Classification System Using the Random Forest Algorithm at the Department of Population and Civil Registration of Pesisir Selatan Regency

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This study aims to implement a web based automatic complaint classification system using the Random Forest algorithm at the Department of Population and Civil Registration of Pesisir Selatan Regency. The research applied the Research and Development (R&D) method, including needs analysis, system design, prototyping, testing, evaluation, and refinement. Complaint data in text form were processed through preprocessing stages (case folding, tokenization, stopword removal, and stemming), followed by TF IDF feature extraction before classification using Random Forest. The model was evaluated using accuracy, precision, recall, and F1 score metrics. The results indicate that the system was successfully developed and is capable of classifying complaints automatically and in real time with good accuracy. The integration of Laravel and Flask API supports efficient classification, while the verification feature ensures category accuracy. The system improves efficiency, accelerates complaint grouping, and enhances public service quality.

**Keywords:** Automatic Classification, Random Forest, Public Complaints

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## 1. Introduction

In the era of governmental digitalization, the Department of Population and Civil Registration (Disdukcapil) faces significant challenges in managing public complaints that continue to increase in both volume and complexity. Complaints are generally submitted in unstructured free text formats, often containing varied spelling, regional languages, and mixed administrative terminology [1]. Recent research by [2] emphasizes that this issue leads to delays in analysis and response processes, as officers must manually categorize complaints, which is time consuming. Therefore, the implementation of an artificial intelligence based automatic classification system has become a strategic necessity to enhance the effectiveness of public service delivery [3].

Moreover, the imbalance of complaint categories introduces bias in analytical results. Certain categories, such as civil administration services, tend to dominate the dataset compared to more technical categories. [4] highlight the importance of data balancing approaches and evaluation metrics such as precision, recall, and F1 score to ensure that machine learning models produce more representative and equitable classification outcomes. This approach ensures that each complaint category has an equal opportunity to be accurately identified by the system [5].

The selection of an appropriate classification algorithm is also a critical aspect of modern complaint management systems. Based on the findings of [6] the Random Forest algorithm demonstrates high performance in text classification tasks, offering stable accuracy and a low risk of overfitting. Its strength lies in its ability to process complex textual features while maintaining interpretability of results, making it particularly suitable for public service systems that require transparency and reliability.

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The integration of artificial intelligence systems with web based public service platforms has also become a key focus of recent studies. [7] explain that implementing classification algorithms within web based systems significantly improves the efficiency of complaint handling, especially when machine learning models are directly connected to public complaint databases. Such integration not only accelerates the categorization process but also enables interactive data presentation for officers, facilitating further analysis and timely decision making.

However, technological integration must also address data security concerns. [8] stress the importance of implementing privacy policies and data encryption mechanisms in AI based complaint systems, given that the managed information often includes sensitive data such as National Identification Numbers (NIK) and personal addresses. Therefore, the development of automatic classification systems must adhere to government data governance principles to maintain public trust in digital systems.

Indonesia's digital government transformation policy further strengthens the relevance of implementing automatic complaint classification systems. The adoption of machine learning technologies such as the Random Forest algorithm within web platforms supports the acceleration of e government initiatives by enhancing service efficiency, transparency, and public accountability. Robust technological infrastructure enables the system to identify patterns and trends in public complaints, thereby supporting data driven policy formulation.

This study focuses on the implementation of the Random Forest algorithm in an automatic complaint classification system integrated with a web platform at the Department of Population and Civil Registration of Pesisir Selatan Regency. The research aims to improve the speed and accuracy of complaint classification processes while ensuring data security and ease of access for both officers and the public. The findings are expected to contribute to the development of responsive, transparent, and adaptive AI based public service innovations.

## 2. Literature Review

Consumer behavior toward high protein nutritional products is strongly influenced by cognitive and perceptual factors, as explained in the Theory of Planned Behavior, which emphasizes that attitudes, subjective norms, and perceived behavioral control shape behavioral intentions [9]. In this context, variables such as nutrition knowledge and health motivation are often associated with the formation of positive attitudes toward healthy consumption. Previous studies indicate that higher nutrition knowledge tends to improve individuals' awareness and preference for healthier food choices, while health motivation drives individuals to adopt preventive consumption behaviors. However, empirical findings remain inconsistent [10]. Some studies report that knowledge alone is insufficient to influence intention without strong affective drivers, suggesting that cognitive factors may not always translate into actual behavioral intentions. Additionally, external attributes such as price and brand have been widely discussed within the framework of Consumer Perceived Value Theory, where consumers evaluate trade offs between benefits and costs [11]. While certain studies confirm that price sensitivity and brand image significantly influence purchasing decisions, others find that these variables become less relevant when consumers prioritize health related benefits [12].

According to Health Belief Model, individuals are more likely to engage in health related behaviors when they perceive clear benefits and minimal barriers. Perceived healthiness reflects the expected functional benefits of a product, whereas perceived tastiness addresses hedonic satisfaction, both of which are critical in influencing food choices [13]. Prior research consistently shows that these two variables are strong predictors of healthy food consumption; however, contradictions still exist regarding the role of social

influence factors such as online reviews. Some studies highlight the growing importance of digital information in shaping consumer trust and intention, while others argue that online reviews have limited impact when intrinsic product attributes dominate decision making. These inconsistencies reveal a research gap, particularly in understanding the simultaneous influence of cognitive, economic, perceptual, and social variables on consumption intention within the context of high protein nutritional products [14]. Moreover, many previous studies examine these variables in isolation, leading to a lack of integrative models that capture their combined effects [15].

Based on these gaps, the present study addresses the following research problem: to what extent do nutrition knowledge, health motivation, price, brand, perceived healthiness, perceived tastiness, and online reviews influence the intention to consume high protein nutritional products, both partially and simultaneously? This study aims to provide a more comprehensive empirical model by integrating multiple determinants into a single analytical framework. Accordingly, the hypotheses proposed are: (H1) Nutrition knowledge has a positive effect on consumption intention; (H2) Health motivation has a positive effect on consumption intention; (H3) Price has a positive effect on consumption intention; (H4) Brand has a positive effect on consumption intention; (H5) Perceived healthiness has a positive effect on consumption intention; (H6) Perceived tastiness has a positive effect on consumption intention; and (H7) Online reviews have a positive effect on consumption intention.

### 3. Methods

This study employed the Research and Development (R&D) method to develop a web based automatic public complaint classification system at the Department of Population and Civil Registration (Disdukcapil), utilizing a supervised learning approach with the Random Forest algorithm. The development process encompassed needs analysis, system design, prototype development, testing, evaluation, and system refinement. Complaint data in textual form were processed through several preprocessing stages, including cleaning, tokenization, stopword removal, and stemming, followed by feature extraction using the TF IDF method. The data were then classified using the Random Forest algorithm through bootstrapping, random feature selection, multiple decision tree construction, and majority voting mechanisms. Model performance was evaluated using accuracy, precision, recall, and F1 score metrics. The resulting system is capable of automatically and in real time classifying complaints, providing a verification dashboard, complaint status management, and report generation in PDF or Excel formats. Through the application of the prototyping method, along with UML and database design, the system is expected to enhance efficiency, accuracy, and the overall quality of public services.

### 4. Result and Discussion

#### Implementation Results in the Web Based Complaint System

##### Main System Interface Display

The design of the main interface emphasizes user friendly principles and responsive design, enabling optimal access via both desktop and mobile devices. The presence of a direct complaint access button facilitates users in submitting reports without undergoing complicated procedures.



Figure 1. Main Interface of the Complaint System

### Public Complaint Form Interface

After users submit the complaint form, the system automatically validates the input data to ensure completeness and proper formatting. Subsequently, the complaint text is processed by the classification system using the Random Forest algorithm to automatically determine the complaint category. This process occurs within a short time frame, allowing users to receive immediate confirmation that their complaint has been successfully submitted and classified [16].

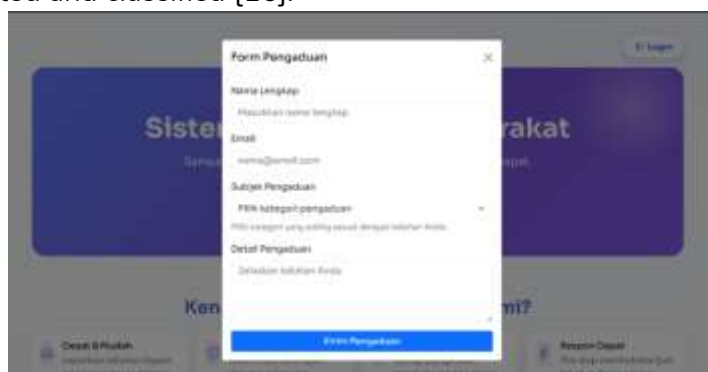


Figure 2. Public Complaint Submission Form

### Admin and Officer Dashboard Interface

The dashboard presents summary information in statistical form, including the total number of complaints, complaints not yet processed, currently in process, and completed cases [17]. Additionally, a complaint table provides detailed information for each report, including the classification category, complainant identity, and submission time. The dashboard is designed intuitively to enable officers to quickly assess complaint conditions and take necessary follow up actions [18].



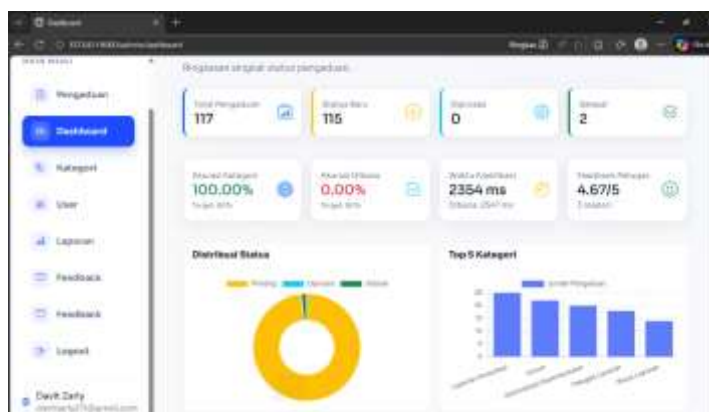


Figure 3. Admin and Officer Dashboard

### Integration of the Random Forest Algorithm into the System

The predicted category along with its confidence score is returned to the web system and stored in the database. This information serves as a reference for officers in verifying and processing public complaints [19]. The integration enables real time system performance, eliminating the need for manual classification. Overall, the implementation results indicate that the developed web based complaint system operates according to its design. The system not only facilitates public complaint submission but also assists officers in managing and classifying complaints in a fast, structured, and efficient manner with the support of the Random Forest algorithm [20].

### System Testing Results

System testing was conducted to ensure that all functions and features of the web based complaint system operate in accordance with the designed requirements and specifications. The objective of this testing phase was to identify functional errors, verify proper integration among system components, and ensure system readiness for use by both the public and officers of the Department of Population and Civil Registration [21].

The testing method employed in this study was Grey Box Testing. This method was selected because it evaluates not only system outputs but also internal processes, including input validation, machine learning API integration, data processing, database storage, and fallback mechanisms during category prediction [22]. This approach provides a more comprehensive evaluation compared to solely applying Black Box Testing.

### Functional Testing Results

Functional testing was performed on all core system features, including access to the main page, login processes, complaint submission, automatic classification using the Random Forest algorithm, and data management by administrators and officers [23]. Each feature was tested using multiple test scenarios to ensure that the system produced outputs consistent with expected results.

Table 1. System Testing Results Using Grey Box Testing

No	Feature/Module	Test Scenario	Input/Condition	Greybox Aspect	Expected Output
1	Landing Page	Access main page	URL/	Laravel route (web.php) runs normally	Welcome page displayed completely

No	Feature/Module	Test Scenario	Input/Condition	Greybox Aspect	Expected Output
2	Admin/Staff Login	Successful login	Valid email & password	Session created + redirect based on role	Redirected to dashboard according to role
3	Failed Login	Login fails	Incorrect email/password	Laravel authentication fails, no session created	Error message "Login failed" appears
4	Role Middleware	Admin accesses staff page	Admin accesses /admin/kategori	role:petugas middleware blocks access	Access denied / redirected / forbidden
5	Complaint Form	Valid complaint submission	Complete data	Insert into pengaduans table with pending status	Success notification + data stored
6	Form Validation	Empty submission	Empty fields	Laravel required validation triggered	Validation error message appears
7	Category Prediction API	API prediction successful	Flask API ON	POST /predict/kategori → JSON response stored	Category & score displayed, source=api
8	ML Script Prediction	API down, fallback script	API OFF	Call predict_kategori.py	Prediction successful, source=ml
9	Rule Based Prediction	API & script fail	API OFF + script error	Retrieve keywords from config/kategori.php	Category based on keyword, source=rules
10	Default Prediction	No matching keyword	Random input	Default fallback category "General"	Category = General, source=default
11	Read Status Prediction	Read status prediction	New complaint	Random Forest + predict_proba()	Y/N prediction stored with score
12	AI Accuracy Validation	User selects AI matched category	Score $\geq 70\%$	Validate AI score	Message: category is accurate
13	AI Accuracy Validation	User selects different category	Score $\geq 70\%$	Compare user vs AI category	Message: category mismatch
14	Database Storage	Verify prediction storage	Submit complaint	Prediction columns filled completely	All data stored completely
15	WhatsApp Notification	Send WA notification to admin	New complaint	WA service triggered, failure logged	Failure does not interrupt process

No	Feature/ Module	Test Scenario	Input/Condition	Greybox Aspect	Expected Output
16	Auto Training	ML Automatic training after submission	New complaint	MachineLearningService triggered	Training runs / failure logged
17	Admin Dashboard	Load dashboard	/admin/dashboard	Query statistics + chart dataset	Statistical widgets displayed correctly
18	Complaint List	View complaint list	/pengaduan	DB query for complaints + predictions	All data displayed correctly
19	Complaint Details	View complaint details	Click view	Retrieve details + RF voting tree	Complete details displayed
20	Edit Complaint	Update complaint data	Edit title/description	Recalculate category & read prediction	Data updated + prediction recalculated
21	Delete Complaint	Delete complaint	Click delete	Delete DB record	Data removed from list
22	Staff Category CRUD	Staff accesses category management	/admin/kategori	Middleware passes + category query	CRUD operations successful
23	User CRUD	Staff manages users	/admin/users	Insert/update/delete user in DB	User data updated accordingly
24	Export PDF	Export PDF report	Click export	Generate PDF from filtered query	PDF file downloaded
25	Export Excel	Export Excel report	Click export	Generate Excel from filtered query	Excel file downloaded
26	Satisfaction Survey	Guest submits survey	Submit survey	Insert survey data into table	Survey stored successfully
27	Usability Feedback	Submit feedback	Rating + comment	Insert DB + calculate average rating	Feedback appears on dashboard
28	Session Management	Access admin without login	/admin/dashboard	Auth middleware redirects to login	Redirect to login + intended URL stored
29	404 Handling	Error Access invalid URL	/abcd	Fallback route triggered	Custom 404 page displayed
30	Responsive Layout	Access via mobile device	Small screen	Bootstrap responsive grid	Layout adapts to mobile view

Based on Table 1, all testing scenarios conducted produced results consistent with the expected outputs. No critical functional errors were identified during the testing process. This indicates that the system is capable of executing all primary functions effectively.

## **Analysis of System Testing Results**

The testing results demonstrate that the integration between the web system and the machine learning module operates optimally. The category prediction mechanism using the Random Forest algorithm functions properly, including in situations where the primary service experiences failure, as the system automatically activates a fallback mechanism without disrupting the complaint submission process [24]

Furthermore, the implementation of role based access control operates effectively, ensuring that each user can only access features in accordance with their respective authorization levels [25]. This is essential for maintaining data security and system integrity. Overall, the Grey Box Testing results confirm that the developed web based public complaint system fulfills functional requirements, operates reliably, and is ready to be utilized as an effective and structured platform for submitting and managing public complaints.

## **Discussion**

### **The Capability of the Random Forest Algorithm in Classifying Complaints**

The Random Forest algorithm demonstrates strong capability in classifying public complaints based on the submitted textual content. The model evaluation results indicate a very high level of accuracy, confirming that Random Forest is able to learn the relationship patterns between complaint texts and predefined categories. The primary strength of this algorithm lies in its ensemble learning mechanism, where the final prediction is determined by aggregating multiple decision trees. This approach enhances model stability and reduces the risk of prediction errors commonly found in single tree models [26].

Furthermore, the implementation of Random Forest in this study proved effective in handling textual data processed through TF IDF feature extraction. The combination of text preprocessing and TF IDF generated a cleaner and more structured data representation, thereby improving classification accuracy. The confusion matrix results, which show accurate predictions across categories, suggest that Random Forest is highly suitable for classifying public complaints characterized by distinct keyword patterns within each category [27].

### **Reliability of the Multi Layer Prediction Architecture**

The developed system employs a multi layer prediction architecture that separates the web application module from the machine learning module [28]. This architecture is considered reliable, as the classification process is executed through communication between Laravel as the primary backend and the Flask API as the prediction service. Such separation enhances system modularity, allowing individual components to be improved or updated without disrupting the entire system. Additionally, the system automatically performs classification immediately after a complaint is submitted, enabling rapid category prediction [29].

The reliability of this architecture is further demonstrated by its ability to process complaints in real time, with classification results instantly stored in the database. This mechanism enables officers to directly view complaint categories on the dashboard without waiting for manual processing. The machine learning model operates on a separate server, preventing performance overload on the Laravel application. This design improves system efficiency and ensures application stability even when handling a high volume of simultaneous complaints [30].

### **Real Time Category Validation as a Data Quality Enhancement**

The real time category validation feature represents a critical component of the developed system. After the system generates automatic classification results, officers are provided with the opportunity to verify the assigned category before further processing. This mechanism functions as a quality control measure to ensure that the predicted category accurately reflects the complaint content. Through this validation

process, misclassification errors can be minimized, thereby improving the overall accuracy of stored complaint data [31].

Moreover, officer validation has the potential to enhance dataset quality for future system development. Corrections made by officers can be recorded as feedback for model evaluation and refinement. In this way, the system not only delivers automated predictions but also supports continuous improvement [32]. This is particularly important because public complaints often contain linguistic variations, abbreviations, or local terms that may not always be immediately recognized by the model.

### **Comparison with Manual Classification Processes**

Prior to the implementation of this system, complaint management was conducted manually, requiring officers to read each complaint individually and determine its category. This manual process was time consuming, particularly when complaint volumes increased. Additionally, manual classification was susceptible to errors due to differences in interpretation among officers, potentially resulting in inaccurate categorization and delayed case handling.

With the implementation of the Random Forest based automatic classification system, the categorization process has become faster and more consistent. The system provides immediate category predictions based on learned data patterns, eliminating the need for officers to classify complaints from scratch. Officers now serve primarily as verifiers to ensure classification accuracy. Compared to manual procedures, this approach significantly reduces workload and enhances overall categorization accuracy.

### **Impact of the System on Complaint Management Efficiency**

The implementation of the automatic classification system has had a substantial impact on the efficiency of complaint management at the Department of Population and Civil Registration of Pesisir Selatan Regency. Through automated classification, officers can immediately identify the type of incoming complaint without manually reviewing the entire report. This accelerates complaint grouping and facilitates quicker follow up actions. Additionally, the dashboard system enables officers to monitor complaint statuses—such as new, in process, and completed in a structured manner [33].

Efficiency improvements are also evident in reporting and data recapitulation processes. The system automatically organizes complaint data by category, allowing monthly reports to be generated quickly through the export feature. This reduces administrative workload and minimizes documentation errors typically associated with manual reporting. Consequently, the system not only accelerates classification processes but also enhances the overall effectiveness of complaint management [34].

### **System Limitations and Challenges**

Although the system demonstrates very strong performance, several limitations and challenges remain in its implementation. One of the primary limitations is the model's dependence on the dataset used during the training process. If the available dataset contains highly specific linguistic patterns, the model tends to perform exceptionally well on similar data but may experience performance degradation when encountering new textual variations that differ from the training data. This situation may arise when citizens use regional languages, uncommon abbreviations, or more informal writing styles [35].

Another challenge concerns the need for periodic system maintenance, both in terms of the web application and the machine learning model. The system requires updates to the training dataset and model retraining whenever new categories are introduced or when complaint patterns evolve over time. From a technical perspective, the integration of Laravel with the Flask API also requires a stable server environment to ensure

seamless communication between modules. If server connectivity is disrupted, the automatic classification process may be delayed, preventing the system from delivering real time predictions.

### Relevance to the Research Objectives

The findings of this study are closely aligned with the research objectives formulated in Chapter I. The primary objective to develop an automatic web based public complaint classification system using the Random Forest algorithm has been successfully achieved, as evidenced by the system's ability to generate automatic category predictions with a very high level of accuracy. Furthermore, the integration of the machine learning model into the web based system was successfully implemented through a Laravel and Flask API architecture, enabling classification results to be displayed in real time on the officers' dashboard.

Beyond the technical achievements, this research has also fulfilled its objective of improving the efficiency of public complaint management. The developed system streamlines the classification process, making it faster and more structured, thereby reducing the time required for manual analysis by officers. In addition, the system supports automated complaint reporting through data export features, enhancing the overall effectiveness of public service delivery. Therefore, the developed system represents a practical solution to support the improvement of public complaint services at the Department of Population and Civil Registration of Pesisir Selatan Regency.

## 5. Conclusion

Based on the results of this study, the following conclusions can be drawn:

1. The web based automatic public complaint classification system was successfully developed and implemented at the Department of Population and Civil Registration of Pesisir Selatan Regency using the Random Forest algorithm.
2. The Random Forest algorithm is capable of automatically classifying textual public complaints with a satisfactory level of accuracy, thereby facilitating faster complaint grouping compared to manual methods.
3. The application of text preprocessing stages including case folding, tokenization, stopword removal, and stemming proved effective in improving data quality prior to the classification process.
4. The integration of the classification model with the Laravel based web system through a Flask API service enables real time complaint classification that can be directly accessed by officers.
5. The developed system enhances the efficiency of public complaint management by reducing officers' workload and accelerating the identification of complaint categories.
6. The verification feature for classification results by officers plays a crucial role in ensuring the accuracy of complaint categories before further follow up actions are taken.

Considering the findings and limitations, several recommendations are proposed. First, future research should apply more advanced models such as LSTM or transformer-based approaches and expand the dataset to improve accuracy, robustness, and generalizability. Second, integrating semantic and contextual analysis (e.g., sentiment analysis or topic modeling) is recommended to better capture the nuance of public complaints, while improving preprocessing to handle slang and language variations. Third, system development should focus on enhancing user experience, scalability, and performance through comprehensive testing under high-traffic conditions. Finally, future studies may explore semi-supervised or active learning to reduce manual validation and conduct comparative analyses across different institutions to assess system adaptability.

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