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Industrial Relations Dispute Simulation System Prototype with Artificial Intelligence Approach

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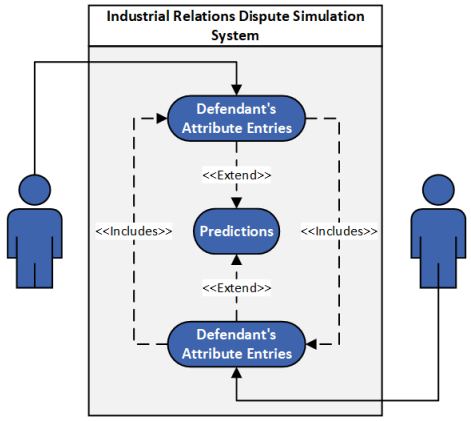
ABSTRACT



There are many cases of industrial relations disputes/IRD every year. IRD cases can be resolved by kinship or mediation to reduce the material burden of all parties, such as case costs other than time and energy. With this background, the researcher proposed developing a system for simulating the IRD judicial process with an AI approach. AI encourages faster and high-accuracy prediction results because AI works through the learning process against a set of training data to produce learning models. The research method used is an experimental laboratory to select AI algorithms with the highest accuracy. Meanwhile, for system development methods, research proposes prototyping methods with designing systems using UML. Prototyping is an option because it takes the intensity of communication between the developer and the end user to determine the prototype of the system being built. System development with platform website. UML provides a variety of diagrams that facilitate communication with developers to illustrate the system being built. System testing uses the black box methodology approach because at this stage, testing is carried out to ensure that the functional system has met the needs. From the experimental results, the decision tree algorithm provides the highest accuracy of 80% in training and testing a set of datasets in the form of cases and IRD court rulings from 2022. The accuracy score means that the learning model by the decision tree algorithm can correctly predict (TP / True positive) 75 % of all cases (test data). The accuracy score is obtained through a confusion matrix that shows the performance of the decision tree algorithm for classification. The results of this research help the process of simulating IRD cases before being taken to judicial line to minimize costs and other efforts that could potentially be incurred during judicial process.

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1. INTRODUCTION

One law problem that often occurs in Indonesia is industrial relations disputes (IRD). IRD can be done through judicial institutions (litigation) or outside judicial institutions (non-litigation). Workers and employers who have disputes can proceed to resolve them through legal channels or in judicial institutions if there is no agreement through mediation [1]. IRD distribution is a difference of opinion that causes conflict between employers or combinations of employers and workers/workers/workers because of disputes regarding rights, interests, termination of employment (PHK), and trade unions. The content of IRD court decisions globally consists of information about plaintiffs and defendants, the list of lawsuits, and information about court decisions [2]. There are quite many cases of industrial relations disputes that are raised at the Ministry of Manpower of the Republic of Indonesia every year.

Several previous studies have discussed the role of technology in the judicial process. The era of the industrial revolution 4.0 shows several technological developments, including internet of things (IoT) technology [3], augmented and virtual reality technology [4], Artificial Intelligence (AI) technology, and other technologies. Technology is no longer a device for automation alone. Instead, it increases its role so that the integration, interconnection, and interrelation of various sectors, including the joints of socio-economic life. A study was conducted in 2021 on how AI can help the judicial process or legal system. In the research article, it is hoped that AI can help increase the value related to human rights [5]. Another study was conducted in 2020 related to AI with the law. The research formulated 3 (three) points of AI and law: cost, singularity, and governance [6]. Likewise, research in 2021 is how AI can contribute to the judicial process. AI is expected to help accelerate the examination of cases so that there are no judicial delays and prevent the partiality of judges [7]. AI is also proposed in the process of inspecting encrypted devices entering ports in the US. It prevents the device from containing pornography content for children and others. Researchers hope AI helps without taking away everyone's rights [8]. The use of AI, specifically with machine learning techniques, has also been used to help with forecasting related to legal issues [9]. In the health sector, AI is applied to help trace cases of COVID-19 patients confirmed positive, in recovery, and cases of death. Thus it can detect new clusters of COVID-19 patients and predict new clusters [10]. In addition, AI in education has also been implemented, such as face recognition and speech for students/teachers, AI to help the assessment process, AI to create intelligent classes, and other AI applications [11]. The algorithm will study all the training data provided so that patterns are formed from the data. The resulting learning model will then validate the test data to generate the output as a class from each test data. AI can process data specifically so that it helps establish, describe or predict the future [12].

Some of the problems often occur whether by plaintiffs and defendants in resolving IRD cases through judicial line are related to costs and time. Not a few costs can be used during the court process. Details include case registration/case costs, compensation, and costs incurred due to the court decision. The plaintiff and defendant need to provide a lot of time during the court process. Even this long court process and much money cost require considerable mind and energy [13]. In particular, those with limited resources will experience difficulties or be burdened financially following the judicial process. In addition to limitations or inability to understand and access all legal/judicial instruments quickly and easily. In law, there is a fast and low-cost way of resolving disputes through informal procedures, such as arbitration [14]. However, this requires various efforts, such as assistance from legal institutions, lawyers, and legal mediators. As a result, legal uncertainty may occur due to protracted settlements with results not by the wishes of the disputing party [15].

Based on the problems above, the problem of this study is how to develop a web-based system that can simulate court process specifically for IRD cases. Thus, the purpose of this study is to develop the system so that it can be used by all parties to the dispute (both plaintiffs and defendants) to simulate the judicial process of IRD cases based on evidence and attributes to produce predictions of court decisions. This study hopes to contribute that the predicted results can be used as a basis for consideration for all parties to disputes related to IRD cases to decide whether to take the case to legal channels or resolve it through mediation/kinship. Thus, it can prevent or minimize the expenditure of case costs and other costs, the allocation of sufficient time, and the concentration level sufficiently distracts the mind.

This digital application of the IRD case simulation system was developed with a website platform using python programming by applying one method in an intelligence approach, namely the decision tree [16]. This system presents 3 main functions, namely the function to enter user roles (as plaintiffs or defendants either representing workers or employers), functions to include the value (instance) of each attribute both as a plaintiff and as a defendant, as well as a function to display the predicted results in the form of court decisions.

At this stage, the resulting research output will be tested with black box methodology to ensure that the system's functionality is following the needs [17]. Then the TAM (Technology Acceptance Model) testing technique is used to test acceptance and usability from the user side after the technology/software is ready for use [18].

2. METHODS

This section describes the object of research, research methods, including the algorithms used, and the stages of research.

2.1. Research Object

The object of this study is a collection of cases from the high court, state and highest courts, specifically only related to cases of industrial relations disputes (IRD). This study used 65 court decisions of IRD cases from 2022.

2.2. Research Methods

The data collection method used is the direct withdrawal of data through a website provided by a court institution in Indonesia that can be public accessed. The data on the website link is a collection of court decisions. Researchers do not choose IRD cases to be used but withdraw all court decisions provided which related to IRD cases on the website.

Furthermore, the data is analyzed to prepare datasets (training and testing data). At the analysis stage, a set of cases published by court decisions are then converted into datasets in excel format, consisting of several attributes/fields/columns, both dependent attributes and independent attributes. Court decision prediction represent class attributes (dependent attributes). This stage is done manually by involving experts in the legal field so that the conversion results are valid. The data conversion results produce a dataset that is then used for training and testing. Before training, preprocess the dataset to ensure no empty, biased or redundant data. Preprocessing is also done manually, considering that raw data is a little. The dataset obtained is then divided proportionally by a percentage of 70:30, namely 70% of the dataset will be used for the training process, and 30% will be used as testing data.

Once the dataset is available, the following method is to determine the right AI algorithm through laboratory experiments. Researchers will try several methods/algorithms in artificial intelligence to predict court decisions related to IRD, such as fuzzy logic [19], genetic algorithm [20], neural network [21],support vector machine (SVM), decision tree [22], naïve bayes [23], and more. Each method has different characteristics and ways of working: fuzzy logic related to uncertainty problems, genetic algorithms related to optimization problems, and neural networks working like the human brain works. In receiving and responding to stimuli, SVM works to place the most appropriate position of the hyperplane on the dimensions of the data set space. At the same time, the decision tree [24] produces a model in the form of a tree of Decisions based on the value of gain or entropy. Each method will then be tested for performance using accuracy indicators in predicting court decisions in IRD cases. Several methods will be identified from the experimental results that provide the best prediction accuracy. Accuracy means the percentage (%) predicted to be correct against the total of all predictions. Thus, the higher the accuracy value, the better the prediction results [25]. The algorithm with the highest accuracy is then selected to validate test data in IRD cases. To choose the best method/model, laboratory experiments are carried out on the raw data in the dataset. In this case, it is the initial 40 rows of data collected.

The testing method is carried out by measuring the performance of the selected method in the form of accuracy to predict all cases in the testing data, which is 4.0% of all datasets obtained. The test results produce an accuracy value from the selected method based on the calculation results on the confusion matrix, which compares the correct prediction results against the overall prediction.

In the prototype design process, researchers use steps in the software development life cycle (SDLC) [26]. The SDLC method proposed in this study is a prototyping method [25] considering that the system built is simple (the features presented are few) and requires fast execution. Repeated communication with developers is needed with prototypes at the analysis and design stages. This communication aims to ensure the prototype of the most suitable system and meet the needs of all parties.

2.3. Research Phase

Following the background of the research above, the research was carried out through several stages in Figure 1. Figure 1 is the flow of research conducted:

1. Identify the Problem

   Identification of problems is carried out through interviews with parties representing employees and parties representing LBH (Legal Aid Institute). From the interview results, various problems that occurred in the IRD case between employees and entrepreneurs were obtained.

2. Formulating The Problems

With the information obtained from the parties above, the researcher then analyzes the formulation of the problem in accordance with the problem above. The analysis process still involves the above parties.

3. Literature Review

With the formulation of this problem, the researcher explores literacy from previous research related to technological approaches in IRD cases. The literature review is done by publishing scientific articles in several journals and proceedings.

4. Collecting Data

Researchers access minutes and court decisions on publicly dependent web pages.

5. Prepare the Dataset

The case judgments are then converted into a dataset consisting of several columns to represent the attributes of both dependent attributes and independent attributes. The results of the dataset conversion have obtained a total of 65 raw data with 22 (twenty-two) columns/fields/attributes. The 22 columns represent 4 (four) major classifications, namely plaintiff Positas, plaintiff petite, defendant Positas, defendant petite, and the result of the judgment. The group attribute of the verdict is an attribute that acts as a class attribute. Then these 70 raw data represent the cases identified by case registration number.

6. Laboratory Experiments

After the dataset is obtained, the next stage is to try several AI algorithms through laboratory experiments to obtain the algorithm that provides the best accuracy. The algorithms tested were decision tree, naïve Bayes, support vector machine, and k-NN. These four algorithms were chosen because of their simple way of working and based on the amount of raw data that is not too much. The algorithm that provides the highest accuracy was chosen to help simulate court decisions in this study. The dataset used during laboratory experiments is 38 rows with 22 columns/fields. These 38 rows of data are the initial data obtained by the team.

7. System/Application Development

With the selection of the algorithm with the highest accuracy based on existing datasets, the next thing is to start building a system with a website platform equipped with a simple graphical interface (user interface) so that the system is dependent and easy to use. System development in this study uses prototyping methods in SDLC with stages of analysis, design, implementation, testing [27]. During analysis and design, there is repeated communication with developers in deciding on prototypes of the system. System implementation using PHP programming language.

8. Testing

Testing was carried out 2 (two) times, namely testing the algorithm with accuracy indicators and the functional system using black box methodology. Testing algorithms/methods use 65 rows of data with a division of 70:30 for training and testing data. Functional testing of the system involves developers and end users. This testing ensures that a system's functions follow the needs.

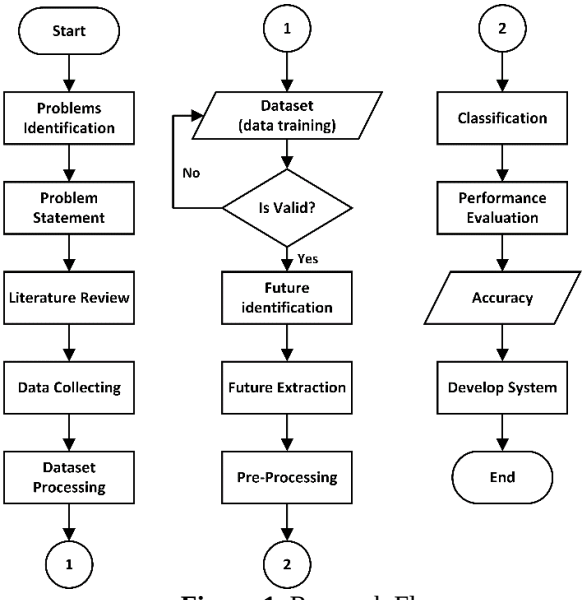

Figure 1. Research Flow

2.4. Algorithm

Based on the results of testing of all algorithms used to show that the decision tree provides the highest accuracy. Thus, the method or algorithm chosen to conduct training and testing of IRD case datasets is a decision tree.

3. RESULTS AND DISCUSSIONS

The results and discussion section explains the results obtained along with their explanations from the steps at the research stage.

3.1. Formula the Dataset

The development of an application prototype to simulate the prediction of IRD case court decisions begins with the analysis stage of a set of minutes or court decisions of IRD cases, both high court decisions, district courts, and supreme courts, to form datasets. The results of the analysis of court decisions are converted into row and column formats in Excel form. The column shows the list of attributes of both dependent attributes and independent attributes. At the same time, the row shows each attribute's record or set of values (instances). This set of rows and columns is used as a dataset for methods used to carry out the training or learning process. Minutes or court messengers in text format contain information about the plaintiff, the defendant, the plaintiff's Positas and petite, the defendant's posit and petite, and court decisions. This court decision is then converted into columns representing attributes/fields/variables from the training data. From the dataset preparation process results, 65 raw data with 22 columns/fields/attributes were presented. The court decision prediction is an attribute that acts as a class Table 1 lists attributes and instances of training data.

Table 1. List of Attributes and Instances from Training Data

Dependent and Independent Attributes	Instance/Value					
Plaintiff's Positas	Plaintiff laid off?	Plaintiff mutated?	Plaintiff temporarily dismissed?	Plaintiff Status PKWTT?	Wage provision during the case	-
Plaintiff's Petition	Pay	Mutation Revocation	Stay Employed	-	-	-
Positas Defendant	Compliance of Law/PKB	Compatibility of Mutation Decree to PKB	PKWTT Plaintiff Status?	Plaintiff Committed Infringement	-	-
Defendant Petite	Laying Off Plaintiffs	Decline Payment	Plaintiff Pays Case Costs	Stay Employed	-	-
Court Decision Prediction	Granting Plaintiff's claim	Plaintiff makes payment	Plaintiffs remain laid off	Requesting Payment of Process Wages?	Plaintiff compensation pay company	Rehired

3.2. Algorithm Experiment Results

The next stage is to test through laboratory experiments on several AI methods/models to produce methods that provide the highest accuracy. This laboratory experiment was applied to 38 raw data, a set of initial data obtained by researchers. The method with the best accuracy is then used to make predictions. Table 2 lists AI-based learning methods/algorithms with proposed machine learning approaches for experiments and their accuracy.

Table 2. Accuracy from Some AI Methods

Algorithm	Accuracy
Decision Tree	75%
Naïve Bayes	60%
Support Vector Machine	56%
K-Nearest Neighbor	58%

Based on the experiment results in Table 2, the method chosen to test the dataset (data testing) in this study is the decision tree method. In mathematical formulation, the calculation begins by finding the entropy value of the class attribute and then continues with calculating the gain value of each attribute against the class attribute. Equation (1) is the formula for calculating the entropy value.

$$Entropy\ (S) = \sum_{i=1}^{n} -\pi \times \log_2 \pi \quad (1)$$

Based on the review literature, no scientific articles related to the industrial relations dispute court (IRD) have been published. Most of the previous research has been related to law in general. Thus, as a comparison, the previous research was related to machine learning for legal problems in general. Table 3 shows the accuracy of machine learning methods used in previous studies.

Table 3. Accuracy From Other Research Using AI Methods

Case	Method	Accuracy
Judicial Case Decision [28]	Hybrid CNN and BILTSM	91.52%
Prediction Court Judgement [29]	LSTM and CNN	92.5%
Predicting Outcome Legal Case (New Delhi) [30]	LR (Logistic Regression)	88.37%
	KNN	88.37%
	CART	91.86%
	Naïve Bayes	84.88%
	SVM	86.05%
	Random Forest	90.70%
Spanish Legal Judgement [31]	Decision Tree (Multi Class transformation strategy)	56.96%
	Random Forest (Multi Class transformation strategy)	74.08%

3.3. System Development Results

By the prototyping stages, the next is the analysis of the functional needs of the IRD judicial decision prediction simulation system. Based on the problems and datasets collected earlier, the following are the functional requirements presented in the system.

1. Value entry function of the attribute with the role as an individual or company representing the defendant.
2. Value entry function of the attribute with the role as the individual or company representing the claimant.
3. Function for prediction of court rulings.

The next stage is to compile the design of the proposed system, including system design, system architecture design, navigation structure design, and graphical interface design. Following the platform used for the system is the website. The system architecture design is described in detail in that the user accesses the system (makes requests) to the Web Server Gateway Interface (WGSI). Then the WGSI server responds according to the request from the client (in this case, the user) through the Application Programming Interface (API). The WGSI and API communicate with the IRD Court Decision Prediction Simulation System to present requests from the client.

The following design is a design that represents a set of functions or features presented by the system. This functional design is presented in the form of a use case diagram. Use case diagrams are one of the diagrams in UML (unified modelling language) in addition to activity diagrams, class diagrams, sequence diagrams, and others [32]. A use case diagram is a diagram that represents how the user interacts with the system. Use case diagrams also represent what functions are presented in the system or what functions (features) users can access. The features offered by the system to users can be known by looking at the use case diagram. Figure 1 is a draft use case diagram of the proposed system.

In system modelling with use case diagrams, there are 2 (two) people, namely the defendant and the plaintiff. These two actors can represent individuals as well as companies. Then there are 3 (three) use cases, namely attribute value entry as a defendant, value entry as a plaintiff, and prediction. Considering that the proposed system is a simulation system, both a plaintiff and a defendant must perform both roles at once or enter the value of each attribute of both roles at once so that the type of association used in both entry function use cases is included. Whereas if all values of each attribute, both as defendant and defendant, are included, then for the prediction use case, the association used is extended.

In addition to the system architecture design and system modelling, the following design is the navigation structure. The type of navigation structure proposed for simulation systems is hierarchical or nested [33] because menus are executed in order or tier. The selection of this type follows the results of the analysis in the previous stage, namely that during simulation, the menu is presented based on the user's role. With this role-based concept, the initial menu is a menu to ask about the user's role, whether as an individual or representing the company. Then proceed with the choice of role as defendant or plaintiff. Thus, it is carried out in stages. If each of these roles has filled in or selected a value/instance from all attributes, the following menu is a menu to make predictions and display the results of court decision predictions.

The final design is the design of the system's graphical interface (user interface / UI). This UI design is in the form of a menu display on the website that shows the functions (features) of the simulation system as well

as the use case diagram design. Based on the design of the use case diagram, the UI consists of 2 (two) major features, namely features for entry or providing values for each attribute and features for making predictions. In the feature for entry of the value of each attribute, a property is used as a drop box so that the user only selects the available instances on the drop box or, in other words, the user does not type in the instance of each attribute. While in the court decision prediction feature, the UI is presented by providing a prediction button. If the user press the button, the simulation system will display a prediction of the court decision.

The previous stage's results translate into a prototype of the system with PHP programming language because the proposed system is web-based, so the system is publicly dependent. Database utilization is used only to store the master data of all cases in the dataset if needed again for other research purposes. Figure 2 is a prototype view of the system for inserting user roles. The initial view of the system is that the user selects the role type as defendant or plaintiff, either representing an individual user or a company.

After the user enters both roles Figure 3, the user is presented with a menu that must be filled according to his or her role (individual or company as well as plaintiff or defendant). The list the user must fill in is a drop box so that the user only chooses from the list of fields given. Alternatively, in other words, the user (user) does not type in a textbox. Figure 4 is a form view that the user must fill in to see the prediction results.

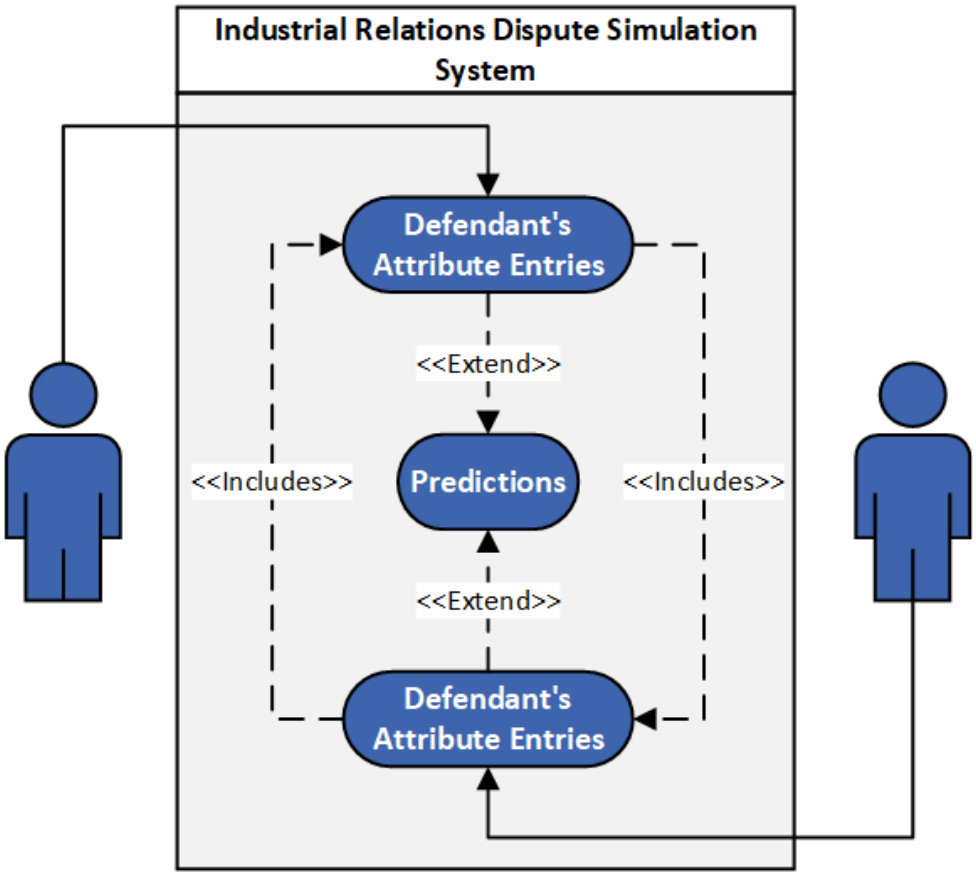

Figure 2. Use case System Diagram

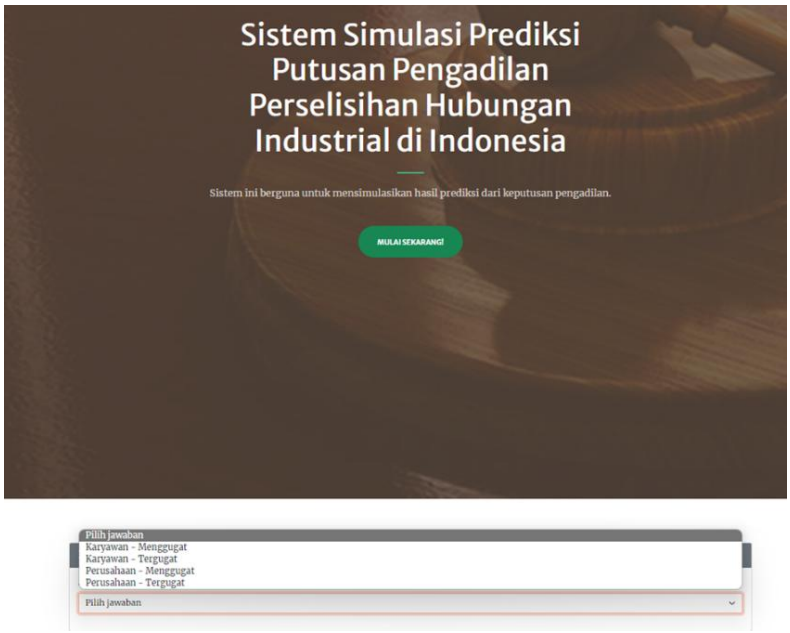

Figure 3. System Prototype for Entering User Roles

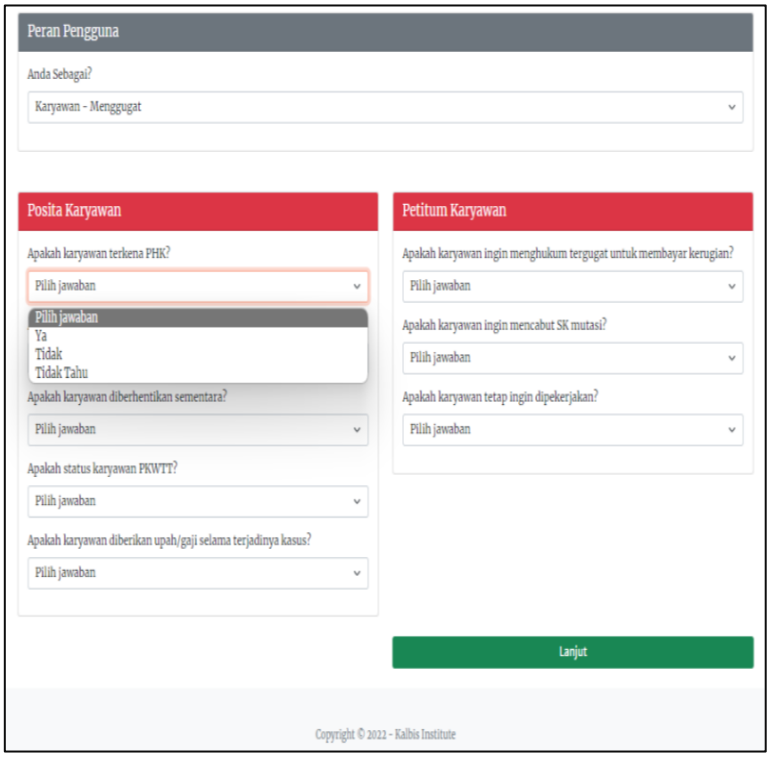

Figure 4. System Prototype for Value Entry of Each Attribute as Per Role

Following the working principle of the AI approach, the prototype is built by involving two parts, namely the menu for training (training) and the testing menu (testing). The training menu will be carried out in backend development by training the algorithm used to study all training data, a collection of IRD cases in the form of court decisions from several years earlier. The training results form a learning model, which is then used to test new data entered by users through the testing menu. In the testing menu, users provide answers to each question given. The answer from the user is the choice provided by the system. All questions presented in the system are a list of independent variables that become attributes in forming learning models. In the end, after the user enters all the values of each variable (question/statement), the next is the user can see the results of the prediction of the court decision by pressing the prediction button presented. The list of predictions for IRD judicial decisions is as follows:

1. Plaintiff's Claim Fully Granted
2. Plaintiff Makes Payment
3. Plaintiff Remains on Layoffs
4. The Company Pays Plaintiff Compensation
5. Company Hires Another Plaintiff

3.4. Method Performance

Testing to determine the performance or performance of the decision tree algorithm immature simulates the prediction of IRD court decisions using accuracy indicators. The test results of all testing data show an accuracy of 80%. That is, the prediction results in the form of correct court decisions are 80% of the total prediction results. Then the F-1 score is 62%. The F-1 score shows a weighted average comparison harmonic mean) of precision and recall. Better indicates that our model has good precision and recall. Here, 45 raw data were used as data training and 20 raw data as data testing (proportion 70:30 for 65 raw data).

3.5. System Test Results

The first stage of testing this research is using Blackbox Methodology conducted by the development team and the end user. According to the previous explanation that there are 3 (three) main functions presented in the system, the black box test is carried out to ensure all features in the three functions are available and running as needed. In the early stages of system development, as a result of the analysis, it is determined what functions can be performed by the system and how the detailed process of each function of these. Therefore, each feature in each function will be checked individually when testing. Table 4 represents the results of functional testing of the system with black box methodology [34]. The researcher proposed testing using TAM in the following research stage, namely applying the system to end users in organizations such as LBH and lawyer offices.

Table 4. System Functional Testing Results with Blackbox Methodology

Testing Items	Detail	Test Results
User Role Entry (Plaintiff/Defendant or representing a worker or employer)	The user must select his or her role on the main page. The user selects through the list on the presented checkbox. The role selected will determine the contents of a user in the second function.	The entire functional plaintiff-side entry feature runs as needed
Entry Instance Attributes of Defendant/ Defendant	Plaintiff/Defendant Selects from a List of Instances of Each Attribute on Dropbox	The entire functional plaintiff-side entry feature runs as needed
Prediction of Court Decision	When the Prediction Button is pressed, a Court Decision is presented that corresponds to the attribute instance previously given by the Plaintiff/Defendant	All functional prediction features run as needed

4. CONCLUSION

Based on the entire series of studies that have been conducted, it can be concluded that the attributes and instances in the training data derived from the IRD court decision, both from the plaintiff and defendant sides or both from individual users and company users, have represented all the material needed to make predictions. The selection of experimental research methods has been appropriated to identify the algorithm/prediction method that best suits the problem based on each algorithm's percentage (%) accuracy and F-1 score. The results of testing the decision tree algorithm as the method selected during laboratory experiments gave a 75% accuracy score of 75% and 65% for F-1 scores. This means that the decision tree algorithm is good at predicting court decisions from the IRD case dataset. Based on experiments, the decision tree gives good accuracy results in this case because the dataset used is discrete data with explicit value constraints, so the technique with Rule-based approaches such as decision trees can be used. In addition, only 6 (six) classes on the court decision attribute act as class attributes. Several studies related to court process have been conducted using machine learning algorithms. One is the decision tree, including the decision tree for article predictions corresponding to cases [35], predictions of global court rulings [36], and others. Final testing with additional raw data for the decision tree as the method selected from the laboratory experiment generated 80% accuracy and 65% F-1 score. This means that our model gives good results to validate the data testing. Our model can predict correctly 80% of the total prediction, and our model gives good precision. Another conclusion is that the prototyping method for system development is appropriate because the results of system functional testing with black box methodology show that all features presented in the system prototype are by system needs. This simulation system can be an initial consideration for both plaintiffs and defendants in deciding whether to continue to take legal channels or use mediation channels or family approach. From the

research output, for further research development, it is proposed that it also be built for mobile platforms for ease and flexibility of utilization. In addition, it can be further developed by adding additional information in the form of similar case history that has occurred before when simulating new cases. Related articles accompany similar case histories.

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