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Chatbot Assistant for Enhancing Religious Court Services in Indonesia Using Deep Learning-based Algorithms

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ABSTRACT The Religious Courts have the authority to carry out and settle Islamic law cases and need to continue to adapt to improve legal services for Muslim communities in Indonesia. This research aims to build chatbot artificial intelligence technology to improve the services of the Religious Courts, which are optimal, available at any time, responsive, and real-time. Chatbot technology is built using the Deep Neural Network (DNN), Transfer Learning-based, and Long Short-Term Memory (LSTM) as deep learning methods. Experiments were conducted using 1,702 pairs of questions and answers with service and case labels handled by the Religious Court. Experiment results using LSTM with 50 epochs, the SoftMax activation function, and Adam's optimization show that the LSTM has an accuracy rate of 0.9583 and a loss of 0.0848. LSTM has the best results compared to Transfer Learning-based and DNN on the chatbot service of the Religious Courts in Indonesia. This research contributes to using artificial intelligence technology in the legal sector to improve the quality of Religious Courts services.

KEYWORDS chatbot; court services; deep learning; long short-term memory; religious courts.

I. INTRODUCTION

Religious Courts in Indonesia are part of the state justice system whose duties and functions are serving Muslim communities who need justice regarding certain cases based on Islamic law [1, 2]. Judicial is a function or task of upholding justice and law, while the court is an institution or organization that carries out the functions and tasks of the justice. In Indonesia, there are at least 358 Religious Courts, and the first level of justice is domiciled in the city or district capital with the legal and district law region [3]. As well as 29 appellate courts or High Religious Courts in the provincial capital whose jurisdiction covers the provincial territory.

Based on Article 24, paragraph 2 of the 1945 Constitution of the Republic of Indonesia, the Religious Courts is a judicial body with the authority to administer law and justice regarding certain cases based on Islamic law and for people of the Islamic faith. Furthermore, it has been regulated in Article 49 of Law Number 3 of 2006 concerning amendments to Law Number 7 of 1989 concerning Religious Courts; it is stated that the first-level Religious Courts have the authority and duty to examine, decide, and settle cases in the field of *zakah*, *infaq*, *sadaqah*, marriage, inheritance, grants, wills, endowments, and the *sharia* economy. Religious Courts have four main functions: adjudicating, coaching, supervising, advisory, and administrative. In addition, other functions include coordinating with various related parties, legal counseling, and research services.

Service standards in the field of Religious Courts based on the Supreme Court Decree Number 26 of 2012 concerning judicial service standards part IV there are 15 services. Figure 1 shows the services of the Religious Courts in resolving legal cases, including application service, lawsuit service, group service (class action), trial administration services, mediation services, mobile session services, *isbat rukyatul hilal* (the activity of witnessing the determination of the beginning of the *hijriyah*/Islamic calendar month in a way based on month observations), legal efforts administration services (appeal cases), legal efforts administration services (cassation case), legal efforts administration services (review cases), free case services (*prodeo*), complaints services, information request service, sharia economic services, and e-court service.

Based on a simple observation of 29 official websites of the High Religious Court, in general, the online services provided by the PTA are in the form of live chat by sending messages via the website that are equipped with the email identity and

contact number of the questioner. In addition to live chat, there is a One-Stop Integrated Service that is used as a communication medium. In this system, there is live chat, video calls, and information on WhatsApp numbers that can be contacted. Seeing this fact, the High Religious Court, which is the parent of the Religious Courts in Indonesia, has not generally provided a chatbot as a virtual assistant that is available 24 hours and in real-time answers various questions or needs of the community regarding services at the Religious Court. Because the live chat feature is still answered by humans, who are limited by office hours. So that, at certain hours, when the community needs information or consultation, the communication media with the Religious Court or the High Religious Court is limited.

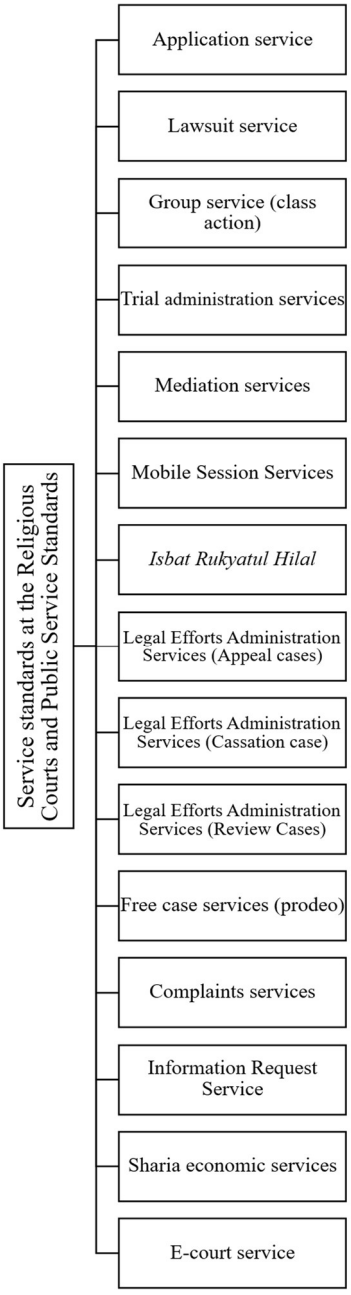

Figure 1. Legal case services in Religious Courts

Being part of the society in the Industrial 4.0 and Society 5.0 eras, almost all human activities use technology, especially the internet. There are 4.66 billion people in the connected world utilizing Internet technology by 2021 [4, 5], even in Indonesia until 2021 there will be 212.35 million Internet users in Indonesia or 76.8% of the approximately 276.3 million Indonesian population [6]. Around 61.8% of active internet users in Indonesia spend their activities on the internet using social media [7]. This phenomenon also gives rise to big data, which has abundant data volumes, varied data types, and very fast data flows [8, 9]. Big data is an exciting source that can be processed into critical information and knowledge (insight knowledge) using technology [10–13].

Various digital services are imperative to support the progress and efficiency of the business processes of an institution, institution, or company. Natural Language Processing (NLP), part of Artificial Intelligence (AI) technology, is important in developing intelligent digital services. NLP is an artificial intelligence technology that processes and discovers insight knowledge from a collection of natural language data, whether text, audio, or video. [14–17]. One of the most popular and growing NLP technologies is chatbots. Chatbot is intelligent communication that simulates and processes human conversation with spoken and written digital devices as if communicating with a real human [18, 19]. Of course, this chatbot technology can be used in various sectors as an automated service that can improve the performance of business processes, one of which is the Religious Courts system.

This study has novelty in that it uses powerful AI-driven chatbot technology to improve the service efficiency and accessibility of Indonesia's Religious Courts. This study combines cutting-edge Natural Language Processing (NLP) techniques, notably Deep Neural Networks (DNN), Transfer Learning, and Long Short-Term Memory (LSTM), to develop a chatbot system capable of assisting complicated legal processes under Islamic law. By bringing these advanced deep learning algorithms to the Religious Court environment, the study addresses a distinct and crucial requirement for rapid, accurate, and real-time contact with people seeking legal information and assistance.

This implementation is an innovative technique inside the Indonesian legal system, particularly in Islamic judicial institutions, where traditional procedures have always relied on in-person contacts. Chatbot technology integration coincides with the wider digital transformation goals of the Industrial 4.0 and Society 5.0 eras, responding to Indonesia's growing need for accessible digital services. Furthermore, this study employs big data analytics, drawing on the huge and diverse data created by internet usage in Indonesia, to develop insights and changes that especially target and improve the user experience within the Religious Courts.

II. RELATED WORK

Research related to the development of chatbot artificial intelligence technology has been widely carried out and continues to grow: (1) Chatbots have been widely used to support the financial and banking sectors [20], including chatbots that store expert knowledge related to *sharia* finance [21, 22], to improve banking services [23–25], applied to the financial industry [26, 27]. The banking sector in Indonesia has also started using chatbots as service assistants [28–30], as well as insurance services [31]; (2) Educational institutions have

also used chatbots for services [32–36] as well as learning, such as prenatal assessment education in obstetrics and gynecology education [37], radiology [38], health literacy [39, 40], learn programming [41], and nursing education [42, 43]; (3) In the tourism sector, chatbot technology has also been developed [44–46]. Tourism in several regions in Indonesia has also started using chatbot technology as a tourist traveling assistant [47–50]; (4) Chatbots are also starting to be widely researched and implemented in the industrial and business world in many ways [51], such as training new employees [52, 53], customer satisfaction services in luxury brand businesses [54], and services in e-commerce [55–60]; (5) In the legal field, several studies have used chatbot artificial intelligence technology in legal-related services and information [61–63]; (6) Various methods or algorithms have been used for chatbot technology in various case studies, including using knowledge-based [42, 46], support vector machine [64–67], random forest [39, 50, multinomial naïve bayes [68–71], deep neural network (DNN) [72–76], Transfer Learning [77–79], and Recurrent Neural Network (RNN) with Long Short-Term Memory (LSTM) [80–82].

Based on several studies that have been carried out above, chatbot artificial intelligence technology is widely used in various sectors with various approaches or algorithm models. Chatbots as an optimal and efficient communication tool for users or service users are important to improve service performance in the current era of Industry 4.0 and Society 5.0. However, in the legal sector, especially as a Religious Court service in Indonesia, the use of chatbot technology is an opportunity to improve the quality of Religious Court services which are available 24 hours, responsive, and real-time. Therefore, this research aims to build intelligent chatbot technology that stores information and knowledge related to Religious Court services. So that Religious Court can carry out their main duties and functions in serving the community more optimally because services can be accessed 24 hours quickly and in real-time. Apart from that, chatbots are not only built for one or several specific Religious Court but can apply generally to all PAs because they are built based on the main tasks and functions regulated in Article 49 of Law Number 3 of 2006 concerning Amendments to Law Number 7 1989 concerning Religious Courts.

Many machine learning methods or algorithms can be used in building a Religious Court service chatbot. Several related studies use model-based reasoning [46], support vector machine [64–67], multinomial naïve Bayes [68, 71], artificial neural network [83–85], to deep learning [86–90] to build a chatbot. As machine learning technology develops into deep learning, this research also uses several deep learning algorithms, including deep neural networks (DNN) [72–76], *Transfer Learning* [77–79], and *Long Short-Term Memory* (LSTM) [80–82]. These three deep learning methods are popularly used to build chatbot technology because they have good performance. Therefore, in this study, the process of building a chatbot engine for Religious Court services uses the DNN algorithm, transfer learning, and LSTM.

II. MATERIAL AND METHODS

This research activity uses stages using the Cross Industry Standard Process for Data Mining (CRISP-DM) method. CRISP-DM is a process model used as a basis for data science. CRISP-DM itself has 6 stages [91–94]. First, the business understanding phase is where the problem to be solved, how it impacts an institution, and why it must be addressed are all well understood. Second, the "Data Understanding" phase is where the available data are examined, described, and assessed. Third, the Data Preparation process involves transforming the original data into data ready for model analysis. Fourth, the modeling phase involves using mathematical methods to build models (equations or other logic) that can be utilized to support business choices. Fifth, evaluation is the stage where it is determined whether the created model matches expectations. Finally, deployment is the stage in which the developed model is incorporated into regular operations so users can use it. Figure 2 shows research activities from business understanding to developing a chatbot software for the Religious Courts service.

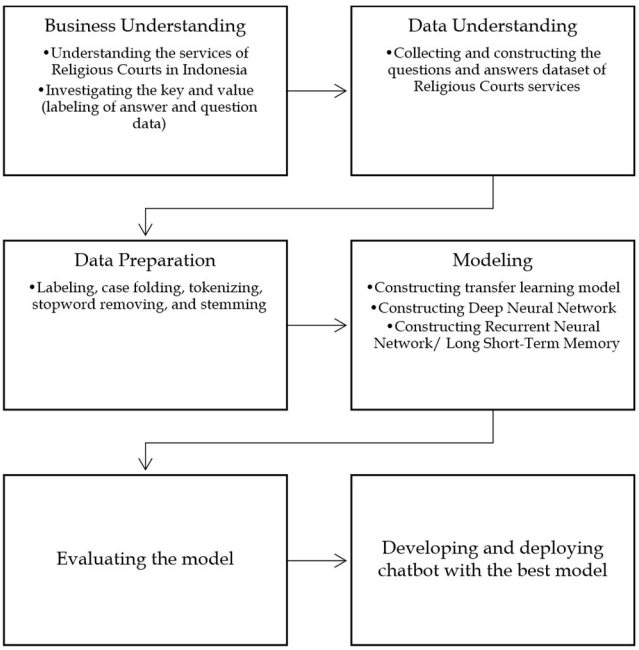

Figure 2. Research activities

The data understanding process in this study was carried out by understanding and collecting from all sources and the legal basis for the services of the Religious Courts. Official sources for Religious Court services come from the official website of the Religious High Court and the Religious Courts, interviews, comparative studies in several Religious Courts, and based on the legal basis that applies to Religious Court services. Furthermore, the data is prepared by conducting a review and pre-processing of the text data. Pre-processing text data is very important because, at this stage, the data is prepared, cleaned, and selected based on the need to maintain the quality of the input data [95, 96].

Then, building a knowledge model for the chatbot engine was carried out using a transfer learning algorithm, Recurrent Neural Network (RNN) with Long Short-Term Memory (LSTM), and simple Deep Neural Network (DNN). The model-building process is carried out with various experimental scenarios, for example, in variations in training and testing data distribution. Evaluation is carried out using the Confusion Matrix for model development results [97]. The final activity is chatbot software development. The development of chatbot software is carried out by wrapping the best model that

disseminates web-based Religious Court chatbots ready to be used to serve people who need legal services at Religious Courts.

A. DEEP NEURAL NETWORK (DNN)

DNN algorithm is a development of an artificial neural network that consists of various multi-layered structures that use human and animal cranial nerve circuit models to recognize neural network patterns [98]. Neural Networks are a set of algorithms that can recognize patterns by mimicking the human brain and interpreting sensory data through labeling or grouping raw data [99]. Patterns that can be recognized by Neural Networks include the numeric elements contained in the vector and all the data present, whether it is time, text, images, or sound.

DNN is a basic deep learning algorithm with more than two layers of neural network complexity. The term "deep" refers to functions with a higher complexity regarding the number of layers and units present in a layer [100]. A collection of datasets residing in the cloud allows the building of more accurate models. To obtain a higher-level pattern, larger layers are used. Training or learning and inference or prediction are two stages that DNNs usually go through. In building a DNN model, we can choose how many layers and weighted training.

The Deep Neural Network (DNN) was chosen for this project because of its strong ability to recognize complex patterns within big datasets, which is required for developing an effective chatbot capable of understanding and responding accurately to a wide range of legal inquiries in Religious Courts. This capability is critical for adjusting to the changing needs of the Religious Courts, where a wide range of legal concerns and inquiries necessitate precise, real-time help.

B. TRANSFER LEARNING

A machine learning method known as transfer learning uses a pre-trained model to train a new model [101–104]. In other words, old learning methods are reused to train another model on a new task, and by applying transfer learning to a new task, one can achieve much better results than training with a smaller amount of data. There are six steps in the transfer learning concept, including getting a pre-trained model, creating a basic model, freezing the initial layer, adding new layers that can be trained, training all existing new layers, and perfecting the model being built. In more detail, the following is the process for each step of the concept of transfer learning [104]. Transfer learning was used for this study because it enables the chatbot model to use knowledge from a pre-trained model, which is especially valuable when data is limited or building a model from scratch would take a significant amount of time and computer resources. Transfer learning allows the model to benefit from previously learned insights and patterns in similar tasks, leading to faster and more accurate training for the Religious Courts chatbot's specialized tasks.

C. LONG SHORT-TERM MEMORY (LSTM)

LSTM is part of the RNN algorithm. RNN is an artificial neural network in which the connection of nodes creates a sequentially directed graph [105]. LSTM architecture is ideal for classifying, processing, and predicting time series [106–108]. LSTM units are a type of repeating network unit that excels at remembering values over long and short periods. Recurrent neural networks all have repeating cell chains. This repeating module of a conventional RNN has a relatively simple structure consisting of a single layer of soil. The LSTM also has a chain-like structure, though the iterative module has a different structure. In each LSTM cell, there are three gates: Forget Gate, Input Gate, and Output Gate [109].

The input Gate, also known as the input layer, receives data, while the output gate, also known as the output layer, receives predicted results. The Forget Gate is then inserted into the LSTM layer, with the number of LSTM layers determining its value. By scaling the cell's internal state before adding it as input to the cell via cell-alone iterative linking, forget gates adaptively forget or reset the cell's memory. In addition, modern LSTM architectures include peephole connections between internal cells and gates in the same cell to learn the exact timing of outputs.

Formula (1) is used to calculate the input value at the input gate, formula (2) is used to calculate the output gate value, formula (3) is used to calculate the forget gate value, and formula (4) is used to calculate the memory update value. after the input values get and forget get are calculated.

$$i_t = \sigma(W_{ix}X_t + W_{ih}h_{t-1} + W_{ic}C_{t-1} + b_i)\ o\ \phi(W_{cx}X_t + W_{ch}h_{t-1} + b_c) \quad (1)$$

$$O_t = \sigma(W_{Ox}X_t + W_{Oh}h_{t-1} + W_{Oc}C_t + b_O),\ h_t = O_t\ o\ \phi(C_t), \quad (2)$$

$$f_t = \sigma(W_{fx}X_t + W_{fh}h_{t-1} + W_{fc}C_{t-1} + b_f), \quad (3)$$

$$C_t = f_t\ o\ C_{t-1} + i_t, \quad (4)$$

where ft is Forget Gate, it is Input Gate, Ct is Memory Update, Ot is Output Candidate, ht is Output Gate, Xt is Input Value, $ht-1$ is the output value of the previous block, $ctt-1$ is the memory value of the previous block, b is the Bias value, W is the weight value, ϕ is the Tanh value, and σ is the Sigmoid value. LSTMs were chosen because they provide extensive sequential processing capabilities, allowing the chatbot to understand and effectively answer complex, context-dependent queries, making them an excellent choice for improving the Religious Courts chatbot's responsiveness and reliability.

III. RESULTS

A. BUSINESS UNDERSTANDING

The Religious Courts are a sub-system of the judicial system in Indonesia. Based on Law Number 50 of 2009, the Religious Courts are one of the "executors of judicial power for justice seekers who are Muslim regarding certain civil cases regulated in law" [1], [110–112]. Based on initial observations on several Religious Court websites as implementers of religious justice in Indonesia, none specifically provides communication service features with chatbots.

The results of preliminary observations or observations of several websites of the High Religious Courts in Indonesia, which supervise several Religious Courts, show that online services provided by High Religious Courts are in the form of live chat by sending messages via the website accompanied by an e-mail identity and contact number of the questioner. In addition to live chat, a One-Stop Integrated Service (OSIS) is used as a communication medium. In OSIS, live chat, video calls, and information on WhatsApp numbers can be contacted. Apart from OSIS, there are virtual assistants such as SIPEKA, which is owned by High Religious Courts Manado or SIALIPP PTA Ambon, but in principle, they still use live chat. Because of these facts, the PTA, which is the parent of the Religious Courts (PA) in Indonesia, in general, has not yet provided

chatbots as virtual assistants that are available 24 hours and in real-time answer various questions or community needs regarding services at PA. Because the live chat and PTSP features are answered by humans, who are limited to office hours. So that at certain hours, when the community needs information or consultation, communication media with PA and PTA are limited.

B. DATA UNDERSTANDING

Based on the results of business understanding, it is necessary to collect data on questions and answers labeled services and cases. The service and case labels used are adjusted to research needs, such as *isbat* services not included as a dataset. Therefore, the dataset is collected with the need for four data variables, including questions, answers, service labels, and case labels. Questions and answers were obtained from various credible sources, such as the Religious Courts profile website (Religious High Court and Religious Courts), the Supreme Court profile website, Google Scholar, scientific journal articles, and other credible sources. The service labels prepared in the dataset that was built include application services, lawsuits, groups, court administration, mediation, mobile court, appeal cases, cassation cases, judicial review, *prodeo*, service complaints, general information, sharia economics, and e-court. While the case labels prepared include marriage, inheritance, grants, endowments, *zakah*, *infaq*, *sadaqah*, *sharia* economics, and general.

Dataset development is a challenge as well as a contribution to this research. The data that was successfully collected as the initial dataset amounted to 395 data, with the distribution of each case label and service label shown in Figures 3 and 4. Data collection was carried out manually and by crawling from the websites of the High Religious Court and Religious Court as official sources of religious court services. Based on the data distribution, general cases, and public services have the most data. This is because the information that is asked the most and is widely available is general information, namely 113 data. For charity cases, not much information is obtained, with a total of 3 pieces of data, this is because the services for charity cases are not handled by the Religious Courts. Meanwhile, based on the type of service, the most information obtained was general information services with 208 data, then application services with 54 data, e-court services with 51 data, and lawsuit services with 43 data. Meanwhile, other services have less than 10 data.

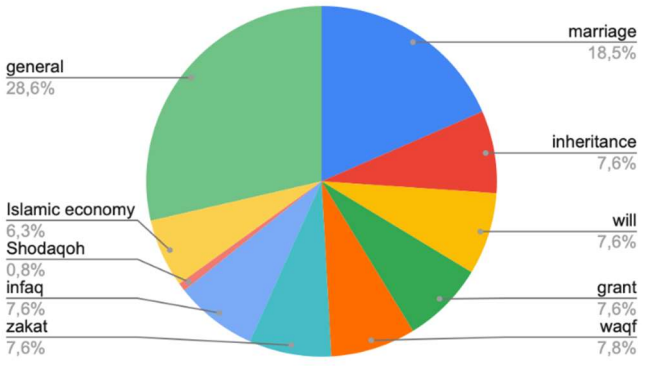

Figure 3. Data distribution based on the case label

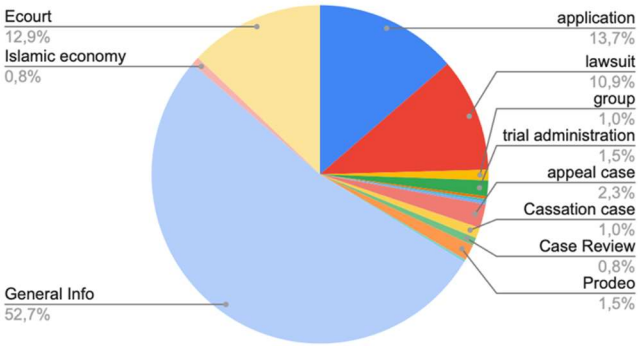

Figure 4. Data distribution based on the service label

C. DATA PREPARATION

The initial data obtained from the data understanding process amounted to 395 data, the process of preparing and adjusting the data form according to the needs of developing the model with transfer learning algorithms, LSTM, and DNN. The dataset collected on a tabulation basis is converted into a JSON file with the keys being tags, patterns, and responses. Each key contains a value as needed. The "tag" key contains the class value of the questions and answers which are taken as keywords from the questions and answers collected. The "patterns" key contains the question value, while the "responses" key contains the answer value. The amount of data produced after being prepared in JSON form was 1,702 Indonesian language documents with a combination of service and case label classes. The following is an example of data in JSON form in this research:

```
{
"tag": "gugatan_waris_sengketa_harta",
"patterns": [
        "saya memiliki masalah sengketa harta waris,
        bagaimana tindak prosesnya?",
        "bagaimana proses masalah sengketa waris?",
        "proses sengketa harta waris",
        "proses sengketa waris",
        "sengketa harta waris",
        "sengketa waris",
        "masalah harta waris"
    ],
"responses": [
        "masyarakat yang mempunyai permasalahan atau
        sengketa mengenai sesuatu yang berkaitan
        dengan wewenang Pengadilan Agama, dapat
        mengajukan gugatan atau permohonan ke
        Pengadilan Agama Tingkat I (Pertama) susuai
        dengan wilayah hukumnya dimana dia
        berdomisili",
        "masyarakat yang mempunyai permasalahan atau
        sengketa mengenai sesuatu yang berkaitan
        dengan wewenang Pengadilan Agama, dapat
        mengajukan gugatan atau permohonan ke
        Pengadilan Agama Tingkat I (Pertama) susuai
        dengan wilayah hukumnya dimana dia
        berdomisili"
    ]
},
```

Furthermore, in the data preparation stage, the data cleaning process is carried out on the text data collected, such as case folding, extracting the unique words, removing punctuation, removing stop words, stemming, lemmatization, tokenizing, padding text, vectorization, and encoding. All data preparation processes are not always carried out for all models built, the process is carried out according to the needs of the algorithm

used. As with the MNB algorithm, it does not require an encoding process for text data. Pre-processing of text data is very important, at this stage, the data is prepared, cleaned, and selected based on the need to maintain the quality of the input data [95, 96].

D. MODELING AND EVALUATION

The modeling process is built using the Python programming language, with several libraries used based on the needs of the algorithms. Those libraries include NumPy, the natural language toolkit (NLTK), Pandas, Keras, sci-kit, and TensorFlow.

a. Deep Neural Network Result

The Deep Neural Network (DNN) model was built using a Sequential model with a dense, activation, and dropout layer. The optimization used in this DNN model is Stochastic Gradient Descent (SGD) optimization. SGD is a machine learning optimization approach often used to identify model parameters corresponding to the best match between expected and actual output [113, 114]. This is a crude but effective strategy. SGD is a popular metric in machine learning applications. This is prevalent in neural network training applications when combined with backpropagation. Since there is more variation in updates, the learning rate in SGD is often much lower than the corresponding learning rate in batch gradient descent.

Before building the DNN model with a sequential model, data is prepared through the import layer process, tokenization, lemmatization, and model building with dense 128, 64, and according to the number of neurons. Then the dropout value in the model built is 0.5 with the ReLu and Softmax activation functions. The optimization of the SGD model uses a learning rate of 0.01, an epoch of 200, and a batch size of 5. Then the model is encapsulated with the h5 extension. Figure 5 shows the evaluation results of the DNN model that was built. The average loss value obtained was 1.5428, with an average accuracy value of 0.6278.

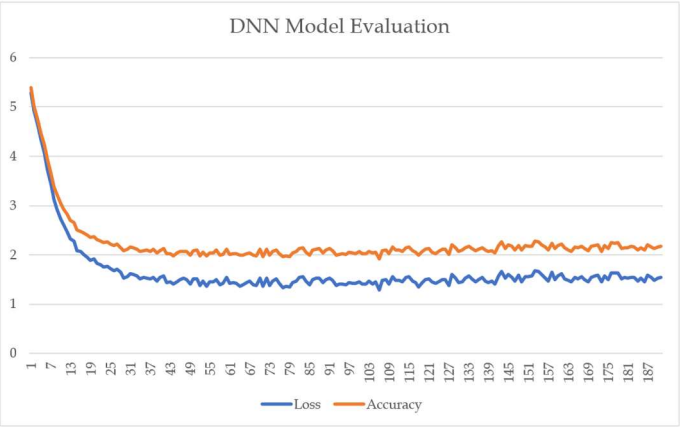

Figure 5. DNN model evaluation results

The DNN model constructed in this study illustrates the potential for deep learning to improve chatbot functionality for Religious Courts services but with certain limitations in accuracy and loss. The usage of Stochastic Gradient Descent (SGD) with a learning rate of 0.01, 200 epochs, and a batch size of 5 showed to be an effective, albeit fairly basic, optimization method, offering a solid foundation but potentially benefiting from adjustments to improve convergence and stability. Future work could include tweaking hyperparameters, experimenting with more complicated architectures, or including other optimizers to improve accuracy and reduce loss, making the chatbot more effective and dependable for real-world legal inquiries in the Religious Courts environment.

b. Transfer Learning Result

This research builds a model with transfer learning, one of the learning approaches in machine learning (which is a core of AI technology). The transfer learning approach is popular today because it can streamline the model-building process by utilizing similar models that have been built before. This research uses pre-trained DNN as a transfer learning model. The transfer learning model was built using batch size 8, epoch 1000, Adam optimizer, and the softmax activation function. The model evaluation results show that the transfer learning model in this study has a loss value of 0.081070 and an accuracy value of 0.9503 (Figure 6). The results of this evaluation show that the performance of the transfer learning model is much better than the sequential DNN model.

```
random.shuffle(training)
training = np.array(training)

train_x = list(training[:,0])
train_y = list(training[:,1])
tf.compat.v1.reset_default_graph()

net = tflearn.input_data(shape=[None, len(train_x[0])])
net = tflearn.fully_connected(net, 8)
net = tflearn.fully_connected(net, 8)
net = tflearn.fully_connected(net, len(train_y[0]), activation='softmax')
net = tflearn.regression(net)
print("Training....")

WARNING:tensorflow:From c:\Users\fawza\AppData\Local\Programs\Python\Python38\lib\site-packages\
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the constructor
Training....

model = tflearn.DNN(net, tensorboard_dir='tflearn_logs')

model.fit(train_x, train_y, n_epoch=1000, batch_size=8, show_metric=True)
model.save('model.tflearn')

Training Step: 216302  | total loss: 0.08662 | time: 1.186s
| Adam | epoch: 1016 | loss: 0.08662 - acc: 0.9448 -- iter: 1696/1698
Training Step: 216303  | total loss: 0.08170 | time: 1.191s
| Adam | epoch: 1016 | loss: 0.08170 - acc: 0.9503 -- iter: 1698/1698
--
```

Figure 6. Transfer Learning model evaluation results

The results show that the transfer learning model outperforms the Sequential DNN model for optimizing the chatbot for Religious Court services. With a loss of 0.081070 and an accuracy of 0.9503, the transfer learning strategy outperforms the Sequential DNN model in terms of both precision and error reduction. The model's high accuracy and low loss support the use of transfer learning as a powerful and effective method for this application, leveraging pre-trained models to streamline the training process and produce a dependable, high-performing AI solution. These findings indicate transfer learning is the most effective strategy for developing strong chatbot systems in the legal arena.

c. Long Short-Term Memory Result

Developing the model using the LSTM algorithm starts with preparing the data, configuring the parameters of the LSTM architecture to be built, and the model evaluation process. Next, the data pre-processing stage is the tokenization process and converting text data into sequence patterns. The sequence pattern of text data has a variety of lengths, so it requires a padding process to uniform the sequence length. The padding process is done by adding 0 by default at the beginning of shorter sequences. After padding, the next step is the data

transformation process through encoding. The tokenization process using TensorFlow assigns a unique token for each different word. Apart from that, padding is done to get all data of the same length so that it can be sent to the LSTM layer. The target variable is also coded into a decimal value.

LSTM model for chatbots is built using the SoftMax activation function and Adam optimization with 50 epochs and 5 batch sizes. After the construction of the LSTM model is complete, the next process is to analyze the model by visualizing the accuracy and loss plots to see the accuracy results of the Neural Network model training algorithm with the LSTM. Figure 7 shows a graph of the accuracy and loss values for each epoch performed in the LSTM model. The model evaluation results show that the LSTM has an accuracy level of 0.9583 with a loss value of 0.0848.

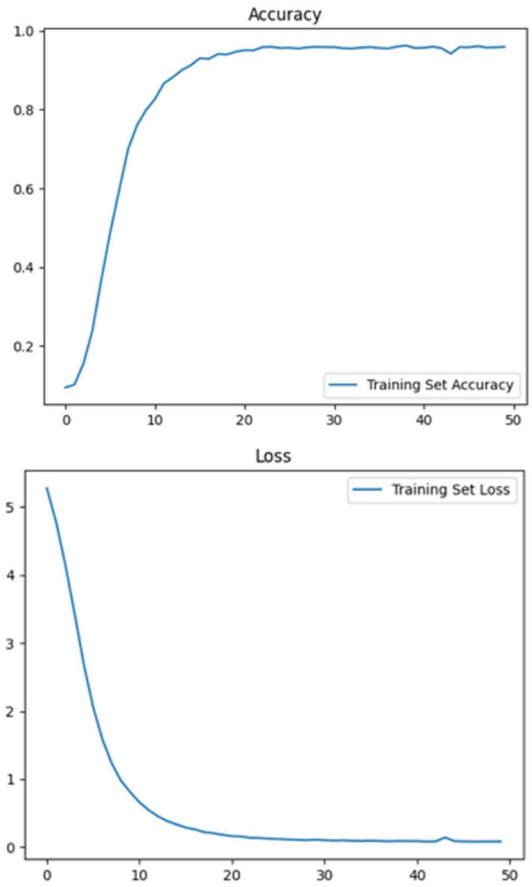

Figure 7. LSTM model accuracy and loss graph

This result shows that the LSTM model successfully detects complicated patterns in data, making it ideal for natural language processing jobs within the chatbot. The visualization of accuracy and loss plots reveals the model's dependability and stability during the training process, further supporting LSTM as a strong choice for developing responsive and accurate chatbots in legal service applications such as Religious Courts.

d. Overall Result

Based on the evaluation results of developing the three deep learning models (shown in Figure 8), namely DNN-Sequential, transfer learning, and LSTM, the LSTM algorithm performs best with an accuracy level of 0.9583. Therefore, the model used as an intelligent machine in the chatbot application for Religious Court services in Indonesia is the LSTM model. These results also prove that the LSTM algorithm, a development of RNN, is the choice of the most widely used and popular deep learning algorithm because of its good performance for text documents [115, 116].

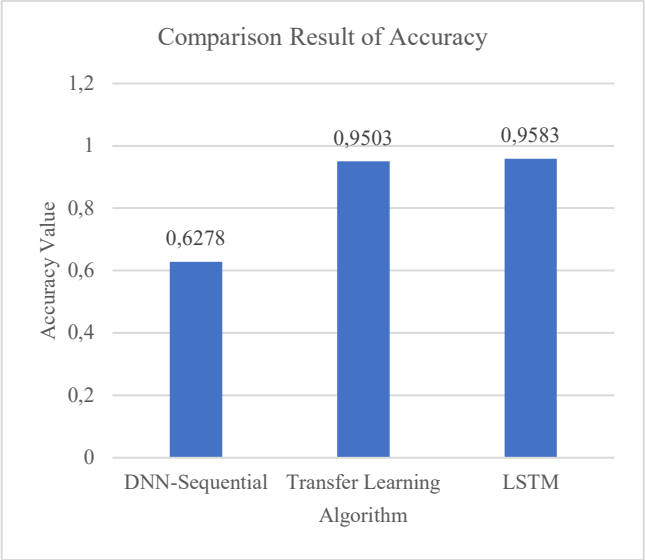

Figure 8. Comparison of models for Religious Court chatbot intelligent engines

The evaluation findings show that the LSTM model outperforms the other two deep learning models, DNN-Sequential and transfer learning, with an accuracy of 0.9583. As a result, the LSTM model has been chosen as the fundamental AI for the chatbot in Religious Court services in Indonesia. This result not only verifies LSTM's performance in handling text-based tasks but also demonstrates its appropriateness in applications that need exact language interpretation, such as legal information services.

The findings highlight the effectiveness of the LSTM algorithm, a form of RNN, at processing sequential data and extracting complex language patterns. The capacity of LSTMs to preserve important context across input sequences makes them an excellent candidate for chatbot creation, especially in industries that require accurate and context-sensitive answers. This study further strengthens LSTM's reputation as a top deep learning algorithm for text processing tasks, validating its widespread use in comparable NLP applications.

E. DEPLOYMENT

The Religious Court service chatbot application was developed after obtaining the best model from the four machine-learning algorithms. The evaluation results show that the best model is LSTM. Therefore, the LSTM model is encapsulated in .h5 and .pkl (pickle) formats for later use on the website-based Religious Court service chatbot application using the Indonesian language.

The main page of the first version of the Religious Court service chatbot application, as shown in Figure 8, uses a simple and easy-to-understand design. At the bottom of the Religious Court service chatbot application is an input box that can be filled in according to the user's questions. Furthermore, the application will instantly display answers or responses to user questions based on the experience of the Religious Court learning service chatbot engine. The Religious Court service

chatbot application will bring up interactions between the user and the machine like other personal messenger applications.

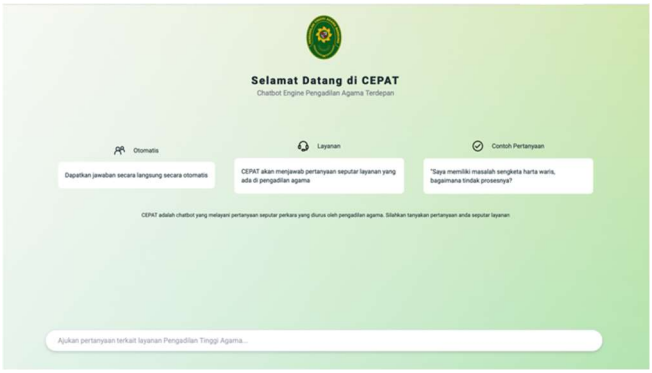

Figure 8. Religious Court service chatbot application interface

Implementing the Religious Court service chatbot with the LSTM model in real-world conditions presents several challenges and limitations that need to be considered, among others: (1) Even though the chatbot is made in Indonesian, it can be difficult to handle the precise and frequently complex terminology of legal inquiries. Misunderstandings may arise from user-specific language, dialectal variances, and legal terms. To increase language comprehension, it is essential to continuously refine and add a variety of legal query samples; (2) Imbalanced data can lead to biased responses, where the model performs well on more common cases but struggles with less frequently asked questions; and (3) The chatbot must keep updated of any changes to the law since legal policies and laws are subject to change. Although it can be time-consuming, it is crucial to implement frequent modifications to the model parameters and training data. To appropriately represent the most recent legal norms, the system might require ongoing retraining.

IV. CONCLUSIONS

This study evaluated three deep learning approaches: DNN, LSTM, and a transfer learning-based model as intelligent engines for a chatbot application designed specifically for Indonesia's Religious Courts. According to the testing data, the LSTM model was the best option for creating the chatbot because it had the maximum accuracy. This study presents a useful argument for the use of artificial intelligence (AI) in the legal industry by presenting a real-world example of how AI might improve accessibility and efficiency in legal services. A key component of providing trustworthy, context-sensitive responses in legal information services is the LSTM model's robustness in processing complicated, sequential linguistic data, which is highlighted by its high accuracy and low loss values. Because it gives users of the Religious Courts an easier way to communicate, its performance represents a major advancement for AI in legal applications.

Future research is expected to be able to collect more datasets so that data unbalance does not occur for each service label and case. In addition, the religious court service chatbot can be developed into a more intelligent machine with a reinforcement learning approach. This study thus not only advances AI applications within legal contexts but also sets a foundation for continuous, adaptive learning systems in public services.

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