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Journal of Soft Computing and Data Mining

Designing a Chatbot-Enabled Laptop Diagnostic Assistant

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DOI: https://doi.org/10.30880/jscdm.2022.03.02.008
Received 02 October 2022; Accepted 28 October 2022; Available online 01 November 2022

Abstract: This paper proposes a chatbot developed with deep learning techniques to help people troubleshoot operating system errors in laptops. In today's world, people can't wait for anything and expect an immediate response when they have a question because they want their problems solved quickly and completely. The system addresses the software aspect of technical laptop issues concerning a laptop's operating system. Deep learning is used to create the chatbot because it has been shown to be more accurate in selecting its response when conversing with users. The chatbot will be integrated into Telegram, an instant messaging service, and users will be able to communicate about laptop issues via Telegram.

Keywords: Chatbot, deep learning, artificial intelligence, agent, laptop troubleshooting, telegram

1. Introduction

It is common in these days of age that everyone wants a swift response and immediate feedback to their inquiry. The rapid growth of technology enables people to deliver fast feedback between them. An example of a situation is we used to communicate with others that are far away via letters. Gradually, people started inventing machines that allow us to communicate more efficiently such as using the telegraph machine. Today, the invention of the smartphone beat all other inventions before it. The existence of smartphones and social media allows people to keep in touch with their friends and even their old friends by using the call application on their smartphones. It is all available at the end of our fingertips. Thus, it is no strange that people nowadays have grown to get immediate feedback whenever they inquire about something.

Other than a smartphone, a computer be it a desktop or laptop is also a necessary item in assisting our daily tasks. A laptop is used to do various things because it is the most convenient device to perform tasks such as watching videos, writing documents, and web browsing. It comes with a keyboard, a trackpad which is a pad that acts like a mouse but has slightly less manoeuvrability, and a screen. We see that a lot of technologies are invented for both entertainment and productivity purposes like laptops, smartphones, and personal computers, but among these inventions, the laptop is overall the best choice when it comes to productivity. Its build allows it to be a mobile workstation as you only need to carry only one item as a whole as opposed to a PC that needs lots of peripherals. A smartphone is mobile and it becomes a necessity for people to bring it anywhere, but it has a significantly small screen. A bigger version of a smartphone, a

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tablet, is a smartphone with a bigger screen but comparing a tablet with a laptop, it doesn't come with a keyboard making it hard to type any report or document, making a laptop the most ideal choice when it comes to mobility and productivity. That being said, companies and workers all around the world depend on technology to continue their operations since technologies have allowed humans to do daily tasks like viewing documents and writing reports.

In today's world, people can't wait for anything and demand an immediate response when they have questions. According to [1], he stated that 90% of customers' rate "immediate response" as very important when they have queries. It means the response time of the channels you provide should be reasonable because people want their problems to be solved quickly and completely. When people are faced with even a minor laptop technical issue, they would visit the internet to study more about it because generally, people may have experienced that same error. For some people, they would prefer to talk to a real person as if they went to a physical store and talk to the worker in the electronic store [2]. Hence, when they wanted to discuss with an online qualified person, they would try to reach out to a trusted electronic service provider who provides the facility and try to chat with the person.

However, this approach is time-consuming since it depends on the availability of the representative on the other side. On top of that, humans tend to forget some knowledge about something, and it is frustrating if the representative is unable to solve the user's problems. Humans need to process and have a lot to think about throughout their day. They need to think about what to eat, what they should buy on their way home and how much they should spend. Therefore, it is common for people to forget about other things that may be categorized as not important. A representative's lack of knowledge or inability to resolve the issue is usually ranked as the most frustrating aspect of poor customer service.

This paper is divided into 4 sections. Section 1 introduces the research, Section 2 discusses the literature review study, followed by Section 3 presents the proposed design of laptop diagnostic assistant and finally Section 4 will conclude this study.

2. Literature Review

2.1 Chatbot

A chatbot is an artificial chatting computer system that imitates a human-like interaction by enabling users to input questions and queries into the system and produce meaningful replies to those questions [3]. Chatbots can be used in situations where they can answer basic practical questions. For a simpler system, the chatbot will recognize keywords by identifying them in the knowledge base but for a more sophisticated operation, Natural Language Processing (NLP) is required to be able to answer the questions [4]. Chatbots can be implemented in various areas like education, healthcare and e-commerce. One scenario that can be used is a chatbot implemented within a college website that enables users like students, lecturers and parents to navigate through the website easily [5].

Chatbots are built to answer queries from users. Every query that is given by users can be categorized into their intents. Intents are the aim, goal and purpose of the users communicating with the chatbot's system. It is essentially what the user is trying to find a piece of information from the chatbots. Generally, there are two types of user intentions which are Seeking for Something and taking an action. Seeking for Something means that the user is looking for information that can be retrieved from the chatbots. The second type is taking an action like booking an appointment for a doctor's checkup in a hospital [6]. Intents are linked with tags and patterns. When users enter input into the system, the system will check the pattern from the input and try to match the pattern with the intents from the knowledge base [5].

Chatbots are divided into two types of architecture models [4]. The first type of architecture is retrieval-based models. Retrieval-based model is a kind of rule-based method. This system has a predefined knowledge base and it cannot create new responses based on the queries given [3]. The second type of chatbot is the generative model. This system can generate new responses from the given input. The system uses machine translation technology and can refer to previous information, making it seems like the user is interacting with a real person. But, given the advantages of the generative models, it will produce many grammatical mistakes and users may feel annoyed when interacting with the chatbots.

Chatbots can be classified into 3 different types of goal-based bots [6]. The bots can be classified based on the primary function they are intended to achieve. The first type is Informative bots. It functions by providing the users with information from a fixed database. It is usually integrated into a Frequently Asked Question bot. The second type is Conversational or Text-based bots. The bot acts by trying to interact with users as another human being and responds appropriately according to the user's request. The third type is Task-based bots. It carried out a particular task like booking a doctor's appointment.

2.2 Existing Laptop Diagnostic Chatbot

Developing a laptop diagnostic chatbot has never been easier. A quick Google search will bring up many results of websites that offer guidance and templates to build a chatbot. For instance, Zebrabuzz is a website that offers features to design a friendly chatbot for computer repair [7]. It includes diagnostic features which will identify and solve computer problems and provide 24/7 customer support.

An example of a laptop customer service using a chatbot that can be used online is Lenovo Customer Service. They use a virtual assistant called Lenovo Virtual Agent, Lena as shown in Fig. 1 [8]. The chatbot offers repair solutions features that may help users with laptop problems.

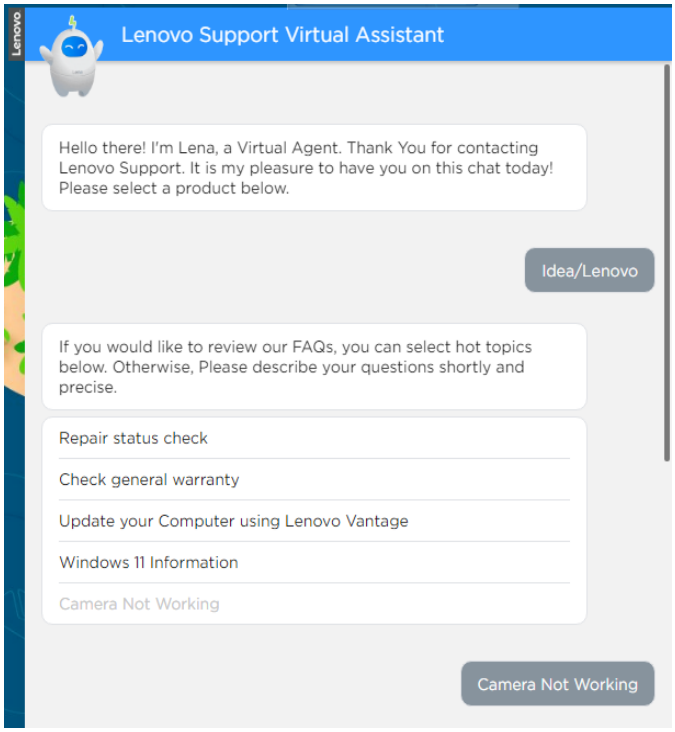

Fig. 1 - Virtual Agent Lena [8]

The first question the bot asked is what lineup of your Lenovo laptop the users used. Then, users are required to select an option from the selection. Based on your inquiry, the chatbot will respond accordingly as shown in Fig. 2. For instance, when users select the option camera is not working, the bot will provide solutions one at a time. If a solution was not able to solve the problem, the bot will respond with another solution that may solve the same problem. When all the solutions given by the bot were not able to solve the problem, the bot will prompt the users to live chat with a representative from Lenovo to go deeper into the problem.

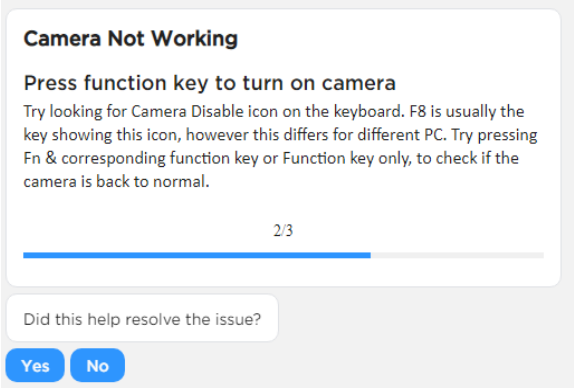

Fig. 2 - Chatbot responded with solutions

2.3 Knowledge Base (KB)

A Knowledge base (KB) is used to store data about patterns and responses. Question-Answer pairs are used to create a knowledge base [2]. The collected data will undergo pre-processing and cleaning for noise. The pre-processed steps include tokenization, lemmatization, and punctuation removal. Pre-processed data will be stored in the knowledge base. The data stored are in JSON format as it allows structured data to be stored and an understandable manner of data that can help generate answers quicker and enables faster parsing.

2.4 Natural Language Processing (NLP)

Natural Language Processing is a branch of artificial intelligence that helps computers interpret and understand human language. A python library called Natural Language Toolkit (NLTK) that has an inbuilt tokenizer is massive support in Natural Language Processing [5]. The purpose of Natural Language Processing is to recognize the user's aim of conversing with the bot. Natural Language Processing is crucial in cleaning unstructured data which involves a pre-process phase where it will format and clean the data so that the accuracy and efficiency of the data improve.

Some of the Natural Language Processing transformations are tokenization, stemming, lemmatization and punctuation removal. Tokenization refers to the process of separating a sentence into smaller units. Each word in the sentence is separated and each word is considered as one token. For example, "Good morning beautiful" will have 3 tokens as the sentence consists of 3 words. Stemming and lemmatization aim to reduce the inflectional forms of each word by finding its base word. Punctuation removal removes punctuations from the data since it has little meaning in Natural Language Processing [5]. In addition, stop words that frequently appear in data are removed as well since it does not add value to the analytic part. By doing the Natural Language Processing transformations, it will reduce the vocabulary size in the knowledge base [9].

2.5 Technique

This section will review prior studies on the techniques related to the development of a chatbot system.

2.5.1 Rule-based

Rule-based also refers to decision tree bots. They use a series of predefined rules to generate an appropriate response. The input of rule-based chatbots is processed through a set of predefined rules [10]. Rule-based chatbots will reply only when the query matches exactly with the information stored in the knowledge base [2]. To some degree, they are built with heuristic imitation of the human ability to respond based on their memory [4]. Generally, rule-based chatbots are chosen to build when their main function is to receive simple queries and answer straightforward questions. It is developed to have predetermined dialogues with users [4]. But, since the chatbot only can answer queries simply, it cannot answer any questions outside of the predefined rules. To build the chatbot on a large scale, it requires a longer time to create the knowledge base so that the chatbot can answer more questions and become more efficient [11].

2.5.2 Deep Learning

Neural Networks are a type of computational learning system that uses a network of functions to understand and convert data presented in one form into another. Deep learning is a subset of a broader family of artificial neural networks. The architecture consists of multiple layers between the input and output layers. It is a feedforward network, where the data flows from the input layer to the output layer without looping back [11]. It is said to be more complicated than the neural network in a way that it can analyze the data more efficiently and produce a better accuracy prediction [2].

Artificial Intelligence-based chatbots do not rely on pre-defined rules and answers [4]. AI-based chatbots are smarter in the way that they refer back to previous information so that users can have a more natural conversation. It focuses on stylizing language understanding and this makes the environment feel like users are conversing with another human being [10]. Artificial Intelligence enables chatbots to produce new patterns. This means the chatbots do not have fixed responses but rather produce their output from the given input.

A deep neural network contains three or more layers. The more layers, the deeper the network [2]. The layers are connected with all the nodes with the following layers. As opposed to a simpler neural network, its architecture is more complicated. The nodes from the input layer are not directly connected with the nodes in the output layer. The layers in between the input and output are called hidden layers.

2.6 Telegram

Telegram is one of the many instant messengers that are available in the mobile device market. It is a free application that can be downloaded by users to interact with others by chatting. Instant messengers' application has a big competition in the market. For instance, WhatsApp dominates the instant messenger market because of its simplicity, and it is owned by Facebook, LINE is widely used in South Korea and Vibers offers great features as an instant messenger but lacks in the aspects of security. On the other hand, Telegram is generally a better instant messenger because it offers features like fast service, synchronization, unlimited cloud storage, reliable backup and better security. Connecting Telegram with the chatbot requires an intermediary between them. Hence, Telegram Bot API is introduced to enable Telegram as a platform to use the chatbot. Telegram Bot API functions as an intermediary between Telegram and the chatbot [12]. The Application Programming Interface (API) acts as a bridge that provides communication between Telegram and the chatbot. The API offers features like customized notifications and news, accepting payment transfers and building a social service [3]. Building social services is the main focus when integrating a chatbot into an instant messenger application.

3. Designing Laptop Diagnostic Chatbot

To develop a laptop diagnostic assistant with a chatbot, a research framework will be adapted as shown in Fig. 3. The framework begins with problem formulation, data acquisition, data pre-processing, system design, system development, system testing and evaluation, and documentation.

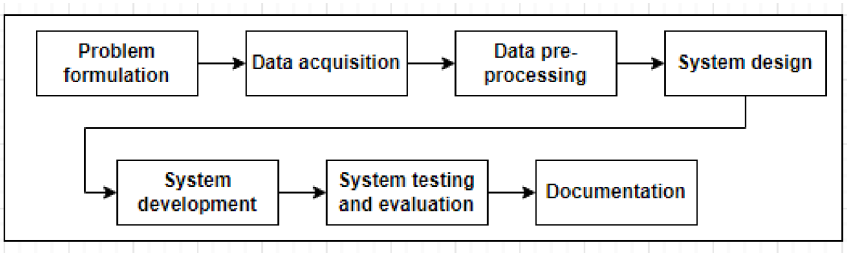

Fig. 3 - Research framework

3.1 Problem Formulation

Problem formulation as shown in Table 1 is the first step in preparing the project which is a laptop diagnostic assistant chatbot. From this phase, the study can construct the problem statement, research questions, project objectives, project scope and project significance. It is also allowed to create a literature review table and the notes written by reading the articles. In addition, the specific technique to use is also identified and the process for deploying the chatbot on Telegram is recognized.

Table 1 - Example of laptop diagnostic problem

Laptop problem	Category	Symptom	Solution
Overheating	Hardware	Computer crashes, freezes	Clean out air vents, put filtered material over the inhalation vent, or update BIOS
Slow Hard Drive	Hardware	Excessive program load times, slow file transfers	Disk defragmentation
The battery Won't Hold a Charge	Hardware	Your notebook runs only a few minutes when unplugged	Battery replacement
Bad Keyboard	Hardware	Missing or Loose Keys	Replace keyboard
Can't Connect to Wireless Network	Hardware	No Internet connection, frequent time-outs while Web browsing	Make sure wireless is turned on, smarter software tools, make sure the router is broadcasting the network name (SSID)
System Crash	Hardware	Notebook won't boot up	Remove the hard drive and place it into an external enclosure. Run Checkdisk.
Virus or Spyware Infestation	Software	Excessive pop-ups, slow downloads	Install anti-spyware programs, use free virus scans
Outdated Video Drivers	Software	Garbled or distorted video	Download the latest drivers
Activating windows	Software	A text appears on the bottom-right corner of the display stating "Activate Windows"	Buy a copy of the window key and enter the product key in the windows settings page
Factory reset laptop	Software	Stuttering, freezing, low laptop performance	There's an option in the windows settings page where the user can choose to factory reset by deleting all files and run windows with no additional application installed
No camera display output	Software	When opening the camera app, no output and it stated no camera is detected	Some laptops have a built-in function where users can disable the camera. It can be the main reason why no camera is detected. Users can also try to switch camera devices if there are too many camera drivers installed

3.2 Data Acquisition

Data acquisition refers to acquiring data. The data was obtained from the official Kaggle website. The dataset contains questions answering facts that will be used later in the development phase as shown in Fig. 4. The answers that

are in the dataset come in two forms. The first one is a one-word answer such as “yes” or “no”. The second form is in the form of sentences. For instance, “How long was Alessandro Volta a professor at the University of Pavia?”. In the dataset, there is also a difficulty variable. The purpose is to classify how difficult it is for the system to generate the answer to the given question. For example, an “easy” difficulty question usually pairs with a one-word answer such as “yes”. From this phase, a dataset from the internet was acquired that contains the question-answering facts.

46	Amedeo_Avogadro	Was Avogadro a professor at the University of Turin?	Yes	easy	easy	S10_set4_a8
47	Amedeo_Avogadro	Was Avogadro a professor at the University of Turin?	Yes, Avogadro was a professor at the University of Turin.	easy	easy	S10_set4_a8
48	Amedeo_Avogadro	Was he a member of the Royal Superior Council on Public Instruction?	Yes	easy	easy	S10_set4_a8
49	Amedeo_Avogadro	Was he a member of the Royal Superior Council on Public Instruction?	Yes, Avogadro was a member of the Royal Superior Council on Public Instructior	easy	easy	S10_set4_a8
50	Amedeo_Avogadro	Is Avogadro's number used to compute the results of chemical reactions?	Yes	easy	easy	S10_set4_a8
51	Amedeo_Avogadro	Is Avogadro's number used to compute the results of chemical reactions?	Yes, Avagadro's number is used to compute the results of chemical reactions.	easy	easy	S10_set4_a8
52	Amedeo_Avogadro	Who first calculated the value of Avogadro's number?	Johann Josef Loschmidt	medium	medium	S10_set4_a8
53	Amedeo_Avogadro	Who first calculated the value of Avogadro's number?	Johann Josef Loschmidt first calculated the value of Avogadro's number.	medium	medium	S10_set4_a8
54	Amedeo_Avogadro	What does Avogadro's Law state?	The relationship between the masses of the same volume of different gases (at	medium	hard	S10_set4_a8
55	Amedeo_Avogadro	What does Avogadro's Law state?	Avogadro's Law states that the relationship between the masses of the same vol	medium	too hard	S10_set4_a8
56	Amedeo_Avogadro	Who showed that Avogadro's theory held in dilute solutions?	Jacobus Henricus van Hoff	medium	medium	S10_set4_a8
57	Amedeo_Avogadro	Who showed that Avogadro's theory held in dilute solutions?	Jacobus Henricus van 't Hoff showed that Avogadro's theory holds in dilute solut	medium	medium	S10_set4_a8
58	Amedeo_Avogadro	In what language was his 1811 paper published?	French	hard	hard	S10_set4_a8
59	Amedeo_Avogadro	In what language was his 1811 paper published?	Avogadro's 1811 paper was published in French.	hard	hard	S10_set4_a8
60	Amedeo_Avogadro	Who was Avogadro's wife?	Felicita Mazz	hard	hard	S10_set4_a8
61	Amedeo_Avogadro	Who was Avogadro's wife?	Felicita Mazzé was Avogadro's wife.	hard	hard	S10_set4_a8
62	Amedeo_Avogadro	Why did Avogadro lose his chair at the University of Turin?	He was active in the revolutionary movements of 1821 against the king of Sardin	hard	hard	S10_set4_a8
63	Amedeo_Avogadro	Why did Avogadro lose his chair at the University of Turin?	Avogadro lost his chair at the University of Turin because he was active in the re	hard	hard	S10_set4_a8
64	Amedeo_Avogadro	Was Amedeo Avogadro was born in Turin?	Yes	easy	easy	S10_set4_a8
65	Amedeo_Avogadro	Was Amedeo Avogadro was born in Turin?	yes	easy	easy	S10_set4_a8
66	Amedeo_Avogadro	Is Avogadro hailed as a founder of the atomic-molecular theory?	Yes	easy	easy	S10_set4_a8
67	Amedeo_Avogadro	Is Avogadro hailed as a founder of the atomic-molecular theory?	yes	easy	easy	S10_set4_a8
68	Amedeo_Avogadro	Did Johann Josef Loschmidt first calculate the value of Avogadro's number?	Yes	easy	easy	S10_set4_a8
69	Amedeo_Avogadro	Did Johann Josef Loschmidt first calculate the value of Avogadro's number?	yes	easy	easy	S10_set4_a8
70	Amedeo_Avogadro	In 1820, Avogadro became a professor of physics where?	University of Turin	medium	medium	S10_set4_a8
71	Amedeo_Avogadro	In 1820, Avogadro became a professor of physics where?	University of Turin	medium	hard	S10_set4_a8

Fig. 4 - Samples of question-answering pairs from the dataset obtained from Kaggle.com

3.3 Data Pre-processing

Data preprocessing is the operation of preparing raw data to be used in the machine learning model. The study focuses on the question-answering pair for chatbots to be able to converse with humans. The pre-processing steps are to use natural language processing transformations such as tokenization, lemmatization, stemming and punctuation removal. The outcome of this phase is coming out with a cleaned and processed dataset that is ready to be trained.

3.4 System Design

System design is the phase of designing the system flow architecture of the chatbot. When users first interact with the chatbot, Telegram will receive inputs from users. Then, Telegram Bot API will play a role to connect with the chatbot. It will pre-process the input and find the intent of users and match it with the answers from the knowledge base. Then, it will respond with an answer to the users by replying in Telegram. From this phase, the system architecture of the laptop diagnostic chatbot using deep learning was designed.

3.5 System Development

System development is the phase of developing the deep learning model to train the dataset. The neural network was developed using the Python programming language. The integrated development environment used to write the Python coding is Jupyter Notebook as the library like Natural Language Toolkit was already installed and ready to use. It will reduce the complexity of installing a new library which may consume energy and time. The outcome of this phase is a deep learning model is built.

3.6 System Testing and Evaluation

System testing and evaluation is a phase where the chatbot will be tested and evaluated based on its performance and accuracy. The chatbot will have a conversation for the first time and the prediction of answers that the chatbot gives will be analyzed. Continuous testing and evaluation will be done so that the accuracy of the chatbot will improve over time. When satisfying accuracy and performance have been found, the collection of data should be recorded for future uses. In this phase, the study should come out with the accuracy of the chatbot.

3.6.1 System Interface Sketch

In the testing and evaluation phase, it will be done in the Telegram messenger application as the complete and final product will be implemented there. The interface of the conversation can be sketched similarly to any other instant messenger service.

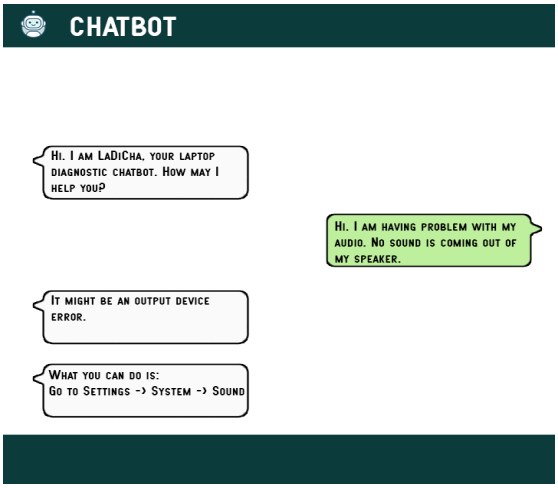

Fig. 5 - Interface design sketching

Fig. 5 depicts a rough sketch of a person conversing with the chatbot, as well as the errors he encountered. The conversation began with a greeting from the chatbot, followed by a query about how it could assist the user. The user reported the error to the chatbot, and the chatbot responded with an answer to the user regarding the error that he reported.

3.7 Documentation

In this study, the documentation will be composed of a user manual about the chatbot's functionality. The user manual will contain an explanation of how to use the chatbot effectively in detail. Users can refer to the user manual for efficient use of the system.

4. Conclusion and Future Works

This study proposes a chatbot to solve technical laptop issues by focusing on the operating system. It is an interactive system that generates automated responses to user questions. It is a great alternative to traditional live chat because it eliminates time constraints and allows users to get answers quickly. The chatbot will be built in Jupyter Notebook using the Python programming language. Deep learning will be used, allowing users to have a more natural conversation with the chatbot, and deep learning has been shown to have higher accuracy when responding to user inquiries. In future, the chatbot will be integrated into Telegram, an instant messaging service, and users will be able to communicate about laptop problems via Telegram. Users may also benefit from the chatbot system, particularly in terms of reducing the time required to visit a physical store and lowering the cost of diagnostic consultation fees.

Acknowledgement

The researchers would like to express the Faculty of Computer and Mathematical Sciences at Universiti Teknologi MARA for their support.

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