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SEMANTIC AND NATURAL LANGUAGE PROCESSING DEVELOPMENT APPLICATIONS FOR CHATBOTS TO ENHANCE ONLINE STORE CUSTOMER SERVICE

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Abstract

Since customer support is time-limited, chatbot programs can assist potential online store visitors before they make a purchase. The general public cannot always answer inquiries or respond to customer requests. Virtual customer support allows potential customers to contact vendors regarding products they wish to purchase. This technology is very helpful in providing quick and accurate answers to various customer concerns and issues. The study focuses on the online retail environment where customer support is crucial for potential buyers before making a purchase. The Artificial Intelligence Markup Language (AIML) and Semantic Ontology were used by A.L.I.C.E. (Artificial Internet Linguistic Computer Agency) to develop an AI chatbot application. There are no online stores that use virtual customer service (chatbots) for customer support, so Batik Cloth, an application that offers batik textiles for sale in Malang, was chosen as the online store chatbot application for this study. Creating a chatbot with semantic capabilities involves using ontologies to process queries with more precise meaning. It achieves 92% accuracy for 15 types of relevant queries and responses, followed by 10 frequently asked questions as answers. Created by a potential buyer. Virtual customer support systems (chatbots) can respond to queries with similar terms or meanings by employing ontologies and semantics to deliver answers that fit the queries.

Keywords: *Artificial Intelligence, Customer, Online Shops, Ontology, Semantics*

1. INTRODUCTION

Semantics-based chatbots are computer programs that mimic conversations and exchanges via conversational applications with other users, including humans. These rely on artificial intelligence, either through the use of the Semantic Web or other means. A digital assistant is a type of technology that can comprehend and handle questions from prospective customers of online shops and rapidly deliver pertinent replies. One of the advanced manifestations of interaction between humans and machines utilizing semantic ontologies is commonly referred to as semantic-based chatbot applications. An online store is a digital platform for selling products or services via the internet without having to physically meet the buyer or supplier. Therefore, it requires customer care that is always available to assist potential customers.

At the moment, online retailers are able to better serve their potential clients by using chatbots to obtain information about products that customers purchase and by using virtual customer care programs to support their needs. This is the modification we are looking for in our sales model. At online retailers, shoppers keep asking questions about what they want to buy, including price, model, design, material, size, and product quality.

Online shops must offer customer service enabled by the Semantic Web in order to assist customers in finding information about the products they wish to buy and make it

easier for potential customers. To serve all of the online business's leads in a way where the chatbot application's responses are pertinent to the leads' questions, a business needs a semantics-based virtual customer support application. This question will be evaluated using the semantic web's ontology technology first to determine whether its intent has a broad meaning in order to create replies that are pertinent to the query. As a result, in order to better serve their clients, online retailers want a virtual customer support team that can answer their questions via a semantic web.

A Semantic Web-based customer assistance prototype for a virtual customer care application was developed in this project. This technology can respond to inquiries by retrieving data from the A.L.I.C.E. Offers database. Understanding chatbot applications with semantic web capabilities that use ontologies will allow these applications to interpret potential customer questions in an online store and provide better answers. A chatbot that can understand requests from potential customers in both text and voice. Based on the solutions stored in the database, discussions are generated between virtual customer services and potential customers with semantics and ontology. If the database does not provide an answer, search for additional information from pre-configured websites and add it to the chatbot's database.

In a previous study titled "Using chatbots on online store websites as virtual customer service to improve sales" (Afandi et al., 2023) researchers used an ontology to understand the meaning of questions from potential customers. We tried to complicate the search process by understanding and generate more relevant questions & answer. In previous research, searches were based solely on keywords provided by potential customers. If the keyword is not in the database, no results will be returned. Researchers use ontologies to create chatbots that search the Semantic Web for answers that match user queries that do not match queries in the database. If no match is found, the chatbot searches the specific girlfriend website for the answer.

Ontology is a means of defining knowledge in the information domain that aids potential customers in quickly locating answers from pertinent sources. This is done through the use of artificial intelligence-powered chatbots and the integration of ontology-based semantic web. When the accuracy generated by questions that are comparable to and overlap with chatbot responses was studied, 92% accuracy was achieved in this study. The management of an online Malang batik store can benefit from this research by offering services to potential customers in an effort to boost public confidence (Dinata et al., n.d.).

A computer program that is based on artificial intelligence and has a feedback ontology is called a chatbot. Chatbots serve as virtual customer support when seamlessly integrated into an online store, facilitating assistance for prospective buyers in the process of selecting the optimal item. The use of chatbots in online store services is necessary for the development of information technology, because many potential customers learn about the desired product before making a purchase (Izza et al., 2022).

Chatterbot, also known as *Alicebot* or *Alice*, is an artificial intelligence natural language processing application that chats with people over the Internet by analyzing their requests using a series of algorithms. pattern matching math (Ramadhani et al., 2019).

Artificial Intelligence Markup Language is a language that uses artificial intelligence to distinguish between questions and replies that are pertinent. Artificial

intelligence-enhanced chatbots employ the language known as AIML in order to react to questions and identify similar responses (Ali & Arvindhan, 2020; Maskur et al., 2022).

Search engines employ computer programs called web crawlers, commonly referred to as web spiders, to index web pages and the content of various websites. When a question cannot be answered by exploring a preset page and adding the information to the chatbot database, a web crawler is utilized. With the addition of new information, search engine answer results become more pertinent. The ideal way to browse webpages and find relevant information to later save in a knowledge database is with this web crawler methodology (Pramartha et al., 2023).

A traditional Malang batik shop is an online store where goods are offered, either directly or through online retailers. Online shops who utilize chatbots for virtual customer service can provide support to potential clients (Khder, 2021).

Artificial intelligence (AI)-enhanced chatbots are used to rapidly and accurately create content that is relevant to questions from potential customers. Chatbot programs are crucial for responding to numerous inquiries from potential customers and serving any customers who require information. Hence, this research proposes the use of chatbot programs to assist potential online store visitors. These chatbots are designed to provide quick and accurate answers to customer concerns and issues

2. LITERATURE REVIEW

2.1. Chatterbot

A chatterbot, sometimes referred to as a chatbot or bot, is a piece of computer software created to improve textual and spoken communication among several individuals. This computer program (bots) is first put through the Turing Test, which entails examining its identification as a machine in order to determine who is trustworthy and who is not. Artificial intelligence (AI) is the term used to describe chatterbots that users are unable to identify as computer programs.

The Turing Test was first presented as a means of assessing intelligence in Alan Turing's well-known article "Computing Machinery and Intelligence" that was published in 1950. In a written real-time dialogue with human judges, these requirements rely on a computer program's ability to mimic human behavior. More specifically, they ask if the program is realistic enough that participants are unable to distinguish between a real computer program and a real person based only on the exchange's content.

This test is linked to Turing's interest in ELIZA. ELIZA was the first chatbot created in 1996 by Dr. Joseph Weizenbaum of the Massachusetts Institute of Technology, with the intention of resembling a Rogerian psychologist. A program published by Joseph Weizenbaum in 1966, which can trick users into believing they're talking to humans. By developing the knowledge base, the chatbots that the researchers create want to resemble human abilities that can be replicated by machines, so that when users engage in conversations with a chatbot or a machine that they create, researchers can behave as intelligently as humans, even if conversations are not as intelligent as human thinking.(Sari & Sarosa, 2018).

2.2. *A.L.I.C.E*

A.L.I.C.E. (Artificial Linguistic Internet Computer Entity) is one of the chatbot apps being created these days. Originally developed in 1995, the A.L.I.C.E. was inspired by Dr. Richard S. Wallace. Originally written in SETL, A.L.I.C.E. was rewritten in Java (sometimes referred to as Program B) in 1998. Then, Program B was made available in 1999. In the creation of free software, Program B is the triangle made up of A, L, I, C, and E. In 2000, Program B was awarded the Loebner Prize.

Jacco Bikker created Program C, an AIML implementation of C/C++, in 2000. Program B Java Edition has been operating on multiple platforms prior to utilizing Java 2 technology. However, it has not yet incorporated new Java features like swing and collection. Using Java 2 technology, Jon Baer rebuilt Program B and added a few new features. The Shakespeare creator Elizabeth Perreau then wrote a new AIML interpreter named after the D Program. Elizabeth named the program with the O Program based on PHP and MySql in order to uphold the custom of referring to the interpreter by the names of Program B, Program C, Program D, and so on (Karimeni Peedikayil Tharammal et al., 2022).

2.3. AIML *(Artificial Intelligence Markup Language)*

An AIML object is a data object defined using Artificial Intelligence Markup Language (AIMl). AIMl also represents the surroundings of the computer software that examines the AIMl. Parsed and unparsed data are included in topics and categories, which are the building blocks of AIML objects. Characters, character data, and AIM L elements make up the parsed data. The knowledge about stimulus responses contained in the document is represented by AIMl elements. An interpreter can provide translation of character data between these parts. To give the response more time to process the AIML (in this case the chatterbot), they are sometimes left untranslated.(Ramadhani et al., 2019)

2.4. *Knowledge Base*

The Knowledge Base is a representation of an expert, which can then be inserted into a programming language specific to artificial intelligence. The knowledge base contains expert knowledge such as facts, concepts, rules, procedures and relationships between them, which have been presented in an understandable form, formulating, and solving the problems faced by a system, the more knowledge a knowledge base possesses, then the system will be closer to being "intelligent" (Sari & Sarosa, 2018).

2.5. Program O

Elizabeth Perreau is a Shakespeare craftsman, has written an interpreter for AIML. In order to maintain the tradition of naming the interpreter by the alphabet name (Program B, Program C, Program D, etc.), Elizabeth named her program by Program O (the letter O read "Oh"). Like the program that is no longer in use, Program O is based on PHP and MySql. Program O was introduced on March 1, 2009. Another development is allowed to help Elizabeth try programs to find errors and talk to bots on her website (Maskur et al., 2022).

2.6. Ontology

The philosophical word "ontology," which denotes something that genuinely exists and how to define it, is where the word "ontology" actually originates. Ontologists are employed in the computer industry to define a conception. Stated differently, ontology is defined as a representation of a certain area of knowledge that includes terms from that domain as well as the connections between terms that already exist.

The semantic web, or web technology intended to comprehend the meaning of a word or sentence provided by the user, is primarily supported by ontologies utilized today. It may seem hard to make computers understand like people, yet this goal is being pursued by offering a set of tools that enable machines or computers to analyze information and comprehend the information that the user wants (Nguyen et al., 2021).

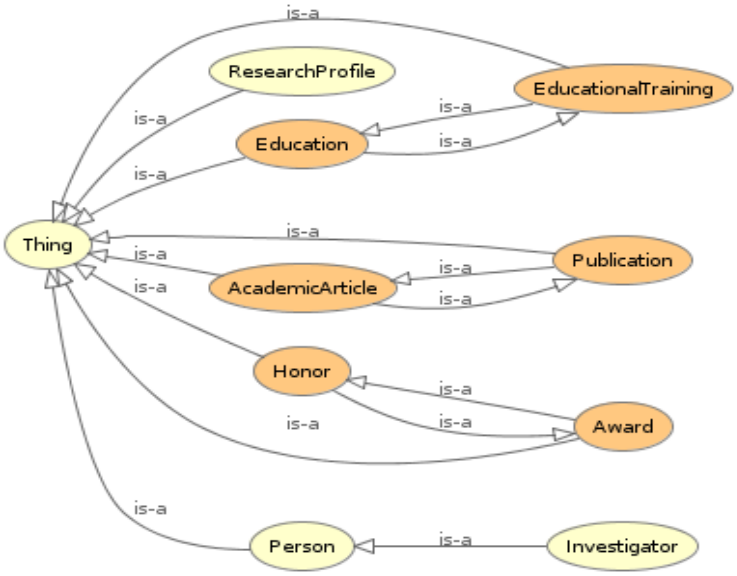

Figure 1. Structure Ontology

3. RESEARCH METHODS

To help prospective customers learn more about the goods available at the traditional malang batik online shop, an online business offers a virtual customer support application (chatbot) outfitted with an ontology-based semantic web. The availability of chatbot features allows customers to communicate with sellers about their desired products at any time and from any location. This will make potential customers happier with the product of their choosing.

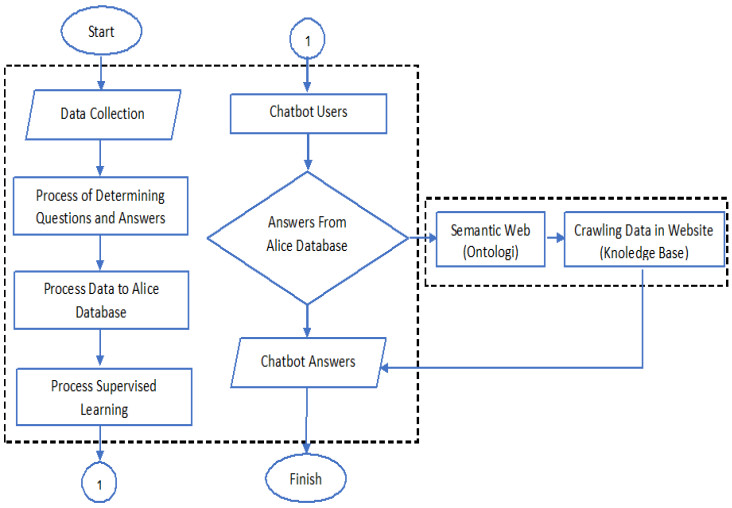

Figure 2. An ontology-based flowchart for a chatbot application for virtual client support

3.1. Data Training

3.1.1. Database

Different types of inquiries commonly received from potential customers of a typical batik online business in Malang were used as training data for this study. Research factors include the name, category, price, material, and quality of traditional Malang batik products that are sold online. The gathered question records are stored in the chatbot database, which also updates them with relevant responses.

3.1.2. Information Source

The websites that have a track record of answering searches are the sources of the dataset used in this study. There are many possible consumers, but the necessary requirements are: batik cloth, traditional Malang batik, batik shape, etc. offered in an online store. This is a result of the lack of a chatbot, or online customer service representative (Susilo, 2018).

3.2. Test Data

For the purpose of conducting research and building knowledge databases for applications that offer virtual customer support, data collecting is currently being done. AIML text problems require carrying out processes including breaking down sentences into smaller pieces that can be processed, resolving word puzzles, enhancing meaning, fixing grammar and spelling errors, and other basic knowledge tasks.

3.3. The process of modifying questions and responses

Continuing the previous process is the step of drafting related questions and answers. Before proceeding with the process of extending semantic meaning using the ontology, appropriate or relevant queries and answers are first selected from the database.

3.4. Stages in the ALICE database for chatbots

Incorporating information from questions and responses into a chatbot program. Before starting the meaning expansion procedure, the next step is modified to ensure that it can be transformed into a knowledge database that complies with the AIML standard and that the responses are pertinent to the questions posed using the ontology.

3.5. Questions From Users

The chatbot is currently being tested as a fictitious customer support agent, taking inquiries from users—most notably prospective online store customers—and processing them in a number of ways. After the questions are examined, words with a wider meaning are added to the responses that are already in the database.

3.6. Responses from Online Customer Service

Following responses to questions derived from input variations submitted by chatbot users and a database of fresh data acquired from the chatbot's learning model process through various kinds of inquiries sent by prior users, the ontology is Semantic expansion is performed utilizing in order to obtain the optimal result.

3.7. Semantic Search (Ontology)

In ontology, searches are performed taking into account various factors, such as intent, contexts of similar meaning, word variations, synonyms, and general and specific queries. more possible.

3.8. Extension of meaning to deepen understanding of chatbot

When an inquiry is submitted and no relevant response is received, the ALICE database will perform an automatic search for data, launch a crawler on the chosen website, add new information, and use an ontology to expand meaning [12].

4. RESULTS AND DISCUSSION

Results of a study conducted using a virtual customer care chatbot in an online store selling traditional batik as a platform for system development as a communication medium. The first step in the research process was to implement, discuss, and test the chatbot and measure its success. The phases of system development are:

4.1. ALICE Database Structure

A chatbot's database for information gathering is part of its structure. There is a predetermined list of questions and answers in this database. The arrangement of the chatbot tool is as follows:



Figure 3. ALICE Database Structure

The predetermined questions and responses are kept in the chatbot application's database structure. Chatbots that are designed to respond to inquiries from potential customers of online stores are built on this database.

4.2. Specify Keyword Patterns

Identify keyword patterns used using the AIML (Artificial Intelligence Markup Language) standard ALICE database on the chatbot application. To get relevant answers for chatbot adoption, use the Learn the keywords used process.

Table 1. Keyword determination patterns in AIML

No	Pattern	Template	Recommendation
1	batik malang	<srai> batik gantring malang </srai>	*batik gantring*
2	* batik malang	<srai>batik druju </srai>	*batik druju*
3	batik malang *	<srai> batik celaket </srai>	*batik celaket*
4	* batik malang *	<srai> batik malangan </srai>	*batik malangan*
5	* batik malang *	<srai> batik singosari </srai>	*batik singosari*
6	motif batik	<srai> bunga teratai </srai>	*bunga teratai*
7	* motif batik	<srai> tugu malang </srai>	*tugu malang*
8	motif batik *	<srai> rumbai singa </srai>	*rumbai singa*
9	* motif batik *	<srai> sulur sulur </srai>	*sulur sulur*
10	* motif batik *	<srai> mahkota </srai>	*mahkota*

4.3. SPARQL Query Process

Ontology searches are performed using the query SPARQL. The data that will be searched will be constrained by the SPARQL architecture in order to avoid the search from becoming too broad and to produce relevant data. The following describes the SPARQL design that was used for the search process.

```
PREFIX chatbot:
http://www.semanticweb.org/chatbot/ontologies/2023/8/batik-ontology#
PREFIX rdf: <http://www.w3.org/2023/06/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2023/06/owl#>
PREFIX xsd: <http://www.w3.org/2023/XMLSchema#>
PREFIX rdfs: <http://www.w3.org/2023/01/rdf-schema#>";
SELECT ?subject
```

Figure 4. SPARQL Query Process

4.4. Deploy application interface design to serve virtual customers

Potential clients of the online store can communicate with each other using a chatbot software that is accessible through the virtual customer care application interface. A virtual customer service interface allows customers of online stores to ask questions and receive tailored answers. demonstration of ontology-enabled chatbot applications.

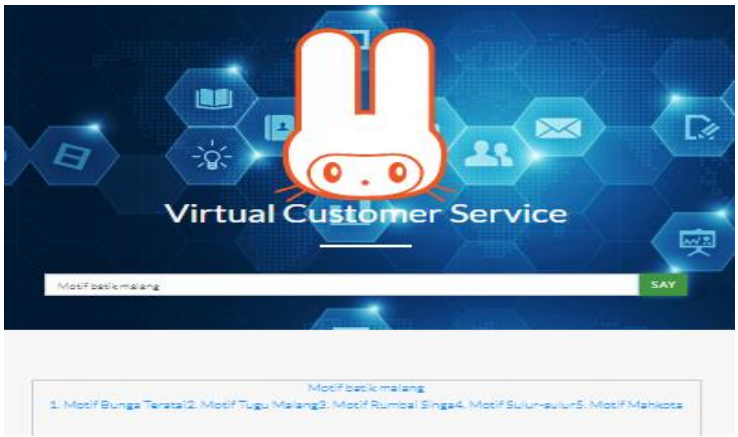

Figure 5. Virtual Customer Service Interface Design

4.5. The practice of scanning websites for new information

The process of looking through website data to obtain information that can be used to update virtual customer service systems is known as web crawling. Use cURL to crawl the given webpage.

```php
function crawl($url) {
    // start inisialisasi curl dan setting curl

    $ch = curl_init();
    curl_setopt($ch, CURLOPT_SSL_VERIFYHOST, 0);
    curl_setopt($ch, CURLOPT_SSL_VERIFYPEER, 0);
    curl_setopt($ch, CURLOPT_FOLLOWLOCATION, 0);
    curl_setopt($ch, CURLOPT_RETURNTRANSFER, 1);
    curl_setopt($ch, CURLOPT_URL, $url);
    // settingan ini bisa beda, ada yang diubah ada yang d
    // end inisialisasi curl dan setting curl

    $proses_curl = curl_exec($ch); // melakukan curl
    curl_close($ch); // menutup proses curl


    $html = str_get_html($proses_curl); // str_get_html()
```

Figure 6. CURL Process

Subsequently, proceed to navigate through the page or website where the incorporation of new information is intended. A Simple HTML DOM library is required in order to read and extract data from websites and traverse through them. The following is the program used to process data from web scanning.

```
require_once('simple_html_dom.php');

function crawl($url) {

    $ch = curl_init();
    curl_setopt($ch, CURLOPT_SSL_VERIFYHOST, 0);
    curl_setopt($ch, CURLOPT_SSL_VERIFYPEER, 0);
    curl_setopt($ch, CURLOPT_FOLLOWLOCATION, 0);
    curl_setopt($ch, CURLOPT_RETURNTRANSFER, 1);
    curl_setopt($ch, CURLOPT_URL, $url);


    $proses_curl = curl_exec($ch); // melakukan curl
    curl_close($ch); // menutup proses curl


    $html = str_get_html($proses_curl);

    $ambil_produk = $html->find('.product-grid-item');
    $produk = array();
    foreach ($ambil_produk as $list_kategori) {
        $nama_produk = $list_kategori->find('.product-title a', 0)->plaintext;
        $url_produk = $list_kategori->find('.product-title a', 0)->href;
        $foto_produk = $list_kategori->find('img', 0)->getAttribute('src');
        $produk[] = array('nama_produk' => $nama_produk, 'url' => $url_produk, 'foto' => $foto_produk);
    }

  return $produk;
}
```

Figure 7. Programs to Browse Web Sites



Figure 8. Web-based Artificial Intelligence-Based Chatbot Application

4.6. Scenario Test

To collect accurate test result data, a test case is a sequence of testing steps from start to finish.

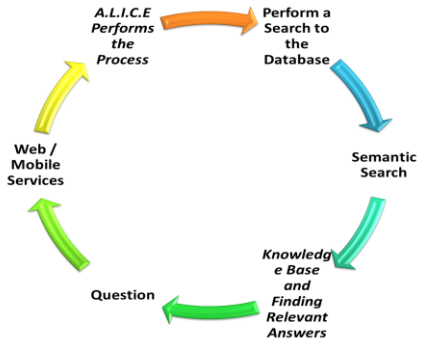

Figure 9. Chatbot testing scenario

4.7. Validation Testing

A validation method is needed to compare the results of the answers provided by the virtual customer service application with the user's answers to typical Malang Batik questions.

1. The conversation in the traditional Malang batik character is between users' questions and the replies provided by a virtual customer support program.
2. Response results from virtual customer care application responses

Table 2. Expert Validation Testing

No.	Keyword	Expected Response	Evaluate Results
1	*Motif batik malang*	• *Motif Bunga Teratai* • *Motif Tugu Malang* • *Motif Rumbai Singa* • *Motif Sulur-sulur* • *Motif Mahkota* • *Motif Hias Tumbuh-tumbuhan/Flora* • *Motif Hias Manusia* • *Motif Binatang/Fauna* • *Motif Benda Alam* • *(Motif sapu ular)* • *Motif Sosial (Motif Kembang Api)*	Corresponding
2	*Motif Batik malangan*		Corresponding
4	*Warna apa saja yang digunakan*	• *Merah* • *Jingga* • *Kuning-jingga* • *Kuning* • *Kuning-hijau* • *Hijau* • *Hijau-biru* • *Biru* • *Biru-ungu* • *Ungu* • *Merah-ungu* • *Coklat* • *Abu-abu* • *Putih* • *Hitam*	Corresponding
5	*Apa saja karakter batik malang*	• *Batik Singosasi* • *Batik Celaket* • *Batik Druju* • *Motif Tertunda* • *Motif Parijoto* • *Motif Padma* • *Motif Renggo* • *Motif Candi Singosari* • *Motif Langsep*	Corresponding
6	*Apa saja motif batik singosari*		Corresponding
7	*Apa saja motif batik celaket*	• *Motif Kendedes* • *Motif rambut singa* • *Motif tugu yang melambangkan semangat perjuangan.*	Corresponding

8	*Apa saja motif batik Druju*	• *Motif batik Celaket didominasi motif flora berwarna ceria sebagai simbol Malang kota bunga.* • *Motif bunga bambu* • *Mawar pupus* • *Motif garis* • *Anggur* • *Motif kerrang* • *Motif bola-bola* • *Motif pulau sempu* • *lainnya*	Corresponding
9	*Bagaimana proses produksi batik malang*	• *Mencanting* • *Menyolet* • *Nembok* • *Pewarnaan* • *Pencelupan* • *Pelorodan*	Corresponding
10	*Apa saja model batik malang*	• *Baju Wanita* • *Baju Pria* • *Baju anak - anak*	Corresponding

According to test results, web-semantic chatbot systems perform well since the responses are pertinent to the queries. The query and the entered keywords might not match, thus it's still possible that the virtual customer service application database doesn't have the right answer.

4.8. Precision Testing

Precision testing is used to assess whether a virtual customer support application is appropriate or accurate based on responses to pertinent queries. testing with 15 different keyword iterations utilizing the developed ontology.

Table 3. Precision testing on chatbots

No	Keyword	Relevant results obtained	Total results obtained	Precision (%)
1	*Baju Batik*	89	89	100
2	*Motif Batik*	28	30	93
3	*Warna Batik*	12	12	100
4	*Ukuran Batik*	16	18	88
5	*Model Batik*	16	19	84
6	*Motif Singosari*	6	6	100
7	*Motif Celaket*	27	27	100
8	*Motif Druju*	3	3	100
9	*Karakter Batik*	22	22	100
10	*Proses Produkti*	23	24	95
11	*Batik Modek*	17	18	94
12	*Janis Batik*	6	6	100
13	*Ukuran Batik*	22	24	92
14	*Variasi Batik*	21	21	100
15	*Bahan Batik*	9	11	82
		Average		**95**

The studies in Table 3 demonstrate that in the web-based semantic virtual customer care application, a typical online store offering Malang batik uses an ontology. A good answer is one that is close to a perfect score or matches the answer provided, based on the question asked. The test has a precision rating of 92% on average and uses 15 different keyword categories.

5. CONCLUSION

Ontologies are used by web-based semantic chatbot programs to locate solutions to virtual customer care applications based on user inquiries. If the requested query cannot be answered, the chatbot program will search the website for information and add new information. The chatbot program generates different types of queries regarding the products sold in the regular Malang Batik online store. Its average accuracy score was found to be 92% for his 15 different keywords investigated, which is enough to get correct answers for 10 queries. Virtual customer service (chatbots) equipped with ontology are expected to respond appropriately to potential customers in online businesses.

To improve web-based semantic chatbot programs, it is important to identify areas for innovation and enhancement. One way to do this is by increasing the chatbot's accuracy beyond the current 92% average. Exploring advanced techniques and technologies can also help us better understand user inquiries and improve virtual customer care applications. Collaborating with emerging technologies like artificial intelligence, machine learning, and natural language processing can further advance the field. By combining efforts, we can create more sophisticated and responsive virtual customer service experiences. This collaborative approach expands the scope of research and lays the foundation for a comprehensive framework that can redefine online customer interactions.

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