2023 International Conference for Advancement in Technology (ICONAT)
Goa, India. Jan 24-26, 2023

Multi-Lingual Hybrid Chatbot for Empowering Rural Women Self-Help Groups in India

Sruthy Anand
Center for Wireless Networks & Applications (WNA)
Amrita Vishwa Vidyapeetham
Amritapuri, India
sruthyanand@am.amrita.edu

Moturi Karthikeya, A.M. Abhishek Sai and Ommi Balamurali
School Of Computing
Amrita Vishwa Vidyapeetham
Amritapuri, India
amenu4aie20148@am.students.amrita.edu,
amenu4aie20101@am.students.amrita.edu,
amenu4aie20154@am.students.amrita.edu

2023 International Conference for Advancement in Technology (ICONAT) | 978-1-6654-7517-4/23/$31.00 ©2023 IEEE | DOI: 10.1109/ICONAT57137.2023.10080347

***Abstract*—Recently, chatbots are bringing new dynamics to customer service by providing instant services to the users of the chatbots. In this work, we aim to extend the utilization of chatbots for women's empowerment by bringing chatbot facilities to support the work of women's self-help groups. To enhance their work, we aim to provide novel means of communication and service response to the rural women's community. Chatbots are usually created to address customer queries and are conversational. In this study, we discuss the potential societal advantages of chatbots and conversational user interfaces and how helpful this is to self-help groups. Chatbots can increase the availability, affordability, and accessibility of necessary services for this community. This work proposed a hybrid multi-lingual chatbot using two approaches and compared the advantages of both methods.**

***Index Terms*—Chatbots, women's community, neural network, CNN, rule-based, mobile application.**

I. Introduction

In order to empower women and improve the quality of their lives, the concept of a women's self-help group has been introduced by the government to provide financial support and skill development. In Kerala, the government established a self-help group called "Kudumbashree" with the same aim of poverty alleviation and women's empowerment [1]. In this paper, we are focusing on one such women's self-help group (SHG) founded by Mata Amritanadamayi Math after the tsunami in 2004 to empower the coastal women community by providing them alternative income, skill development, and collateral-free financial support [2]–[4]. These SHGs are made up of ten to twenty women living close by and meet weekly for their activities and are now a massive network of more than 13,000 SHGs spanning many states in India. Currently, there is no support for any online tool for their execution and management. Even though they are doing financial transactions, everything is managed using conventional methods of ledger maintenance. To digitize their financial transaction, and to support their work, a software tool design has been proposed [3] with consensus agreement [4] to avoid any errors or mismanagement of these ledgers.

This SHG comprises a wide range of people of various ages and literacy levels. Due to this, their digital capacity and skills are low compared to the urban women community, who use digital applications for infotainment and other services. Hence, novel digital adoption methods and support systems are required to make them adopt the designed software tool. To address this objective, we propose a multi-lingual chatbot for SHG members, which helps them to use the software tool efficiently. This hybrid chatbot is a blend of rule-based and AI-based chatbots, which will act as a support system for the SHG members. This chatbot envisions answering queries regarding software use and other help options the SHG members would require. Introducing a chatbot will increase the system's usability by improving the software system's responsiveness to meet users' needs. The whole software system is designed considering the Technology Acceptance Model [5] with a great emphasis on usability.

In recent years, the usage of chatbots has exponentially increased in several industries, including marketing and education. In our work, we try to use the potential of chatbots to support women's communities by increasing the availability and accessibility of necessary services. The two most common chatbots are AI and rule-based chatbots. In this work, we made use of both AI-based and rule-based chatbots. The AI-chat is included in the design to address the local advertisement within the self Help Group to support their small-scale home-made business activities. For this, the AI chatbots have been trained to conduct conversations that resemble those of humans using natural language processing (NLP). Generally, the AI chatbots are supposed to learn from the interaction with the user and provide a reply to suit the situation. An AI chatbot's essential function is comprehending and transforming incoming data to offer pertinent outputs. Due to this AI chatbot can provide the optimal response to the user by analyzing the user's purpose. Similarly, these users also need frequent help to learn the user interface and navigate between the different functionality. To address this, we included rule-based chatbot in the design as it is suitable to provide well-defined responses corresponding to the user input. Hence the users will receive predefined responses based on their needs. We also presented the details of our proposed design, User Interface design, and the experimentation results of this AI chatbot. This paper also

978-1-6654-7517-4/23/$31.00 ©2023 IEEE

presents this hybrid chatbot's advantages and potential benefits to this women's self-help group.

The rest of the sections are as follows. Section II gives an overview of the literature. Section III offers the user characteristics and requirements. Section IV and V presents the proposed system architecture and the experimentation details. Section VI discusses the advantages and disadvantages of neural network-based and rule-based chatbot. Section VII concludes the paper.

II. Literature Review

There are many areas that use chatbots for various customer service applications. Banks and other financial institutions widely use chatbots to address consumer complaints and questions [6]. Many applications which use chatbots to interact with customers to provide helpful services are discussed in [7]. Similarly, a chatbot that makes context-aware recommendations for products and services is mentioned in [8]. A historical overview of how users' interest in chatbots has varied around the world was presented in [9]. This work highlighted the benefits of employing chatbots along with how they might be used in a variety of contexts and how societal preconceptions influence chatbot design [9].

A chatbot system, along with the techniques used in chatbot creation, was proposed in [10]. An overview of cloud-based chatbot technology, details on how to create chatbots, and the challenges are presented in [11]. Similarly, another work that discusses the design approaches used to construct chatbots were presented in [12]. All these works demonstrate significant developments in chatbots during the last decade. The creation of a chatbot prototype to help students with their academic work was proposed in [13]. The chatbot intends to assist pupils by acting as a virtual tutor. The system applies the ontological description of the knowledge domain to automatically recognize the requests of the students [13].

Chatbots become more efficient if they are aware of the context to respond. A chatbot based on a context-aware system was presented in [8]. A customized approach that uses the chatbot to analyze the user's current emotion and provide a playlist was presented in [14]. This chatbot ascertains the user's mood by asking some general questions. A score is given to each response, and the playlist is created using the sum of the scores.

The use of chatbots powered by artificial intelligence, primarily in the banking sector, has altered the nature of the customer-bank communication interface. The effectiveness of using chatbots in Singapore's banking industry was examined in [15]. A Knowledge Graph Based ChatBot 'Kbot' was proposed in [16]. Using a machine learning approach, they created this bot. KBot is adaptable; it can be added to different knowledge bases and supports additional languages.

Rule-based chatbots use pattern-matching algorithms to retrieve responses to the user corresponding to the user input. Pattern matching was initially used by ALICE chatbots [17]. However, it is challenging to address the problems such as grammatical problems and requires a series of rules to operate adequately. This method offers a quicker response time than other alternatives.

Numerous chatbot solutions have been developed to handle various demands from the banking industry to help students academically. However, more work is needed on using it to empower the women's community to assist them in embracing technology. In this work, we use a blend of AI and rule-based chatbots for the rural women's community to help them with their women's self-help group activities.

III. User Characteristics and Requirements

This section discusses why this SHG mobile application requires a chatbot and how it helps SHG members. The users in this group majorly formed from the rural parts of India, and the majority are from the coastal fisher community with varying ages and educational backgrounds. These users require more help during the initial phase of the software use compared to the women community, who are well versed in using mobile applications and digital services. The software is designed to address this digital gap, and the inclusion of a chatbot aims to improve the perceived usefulness of the software and help them adopt the system. The followings are the primary requirements and characteristics of the designed chatbot:

- Better Experience: Generally, chatbots help improve the user experience and build a deeper rapport with users. Similarly, chatbots respond with predefined, polite responses, connecting them with the user. This software tool is designed for the SHG in an attempt to help the groups digitize their weekly tasks and help them with their activities. To accept any new technology in such a group with varying ages and literacy, they must be familiar with using it properly. We assume this chatbot feature helps the SHG members get acquainted with the technology without using a human responder.
- 24/7 Availability: It is possible to arrange manual training for a short duration and for a few users simultaneously. A chatbot can help to learn the system without much manual training. It saves much waiting time for the SHG members compared to manual software training over and over until they are familiar with the system. Chatbots can handle queries of multiple SHG members instantly and simultaneously, improving the average response time.
- Multilingual: Since most users cannot understand English, it is essential to have multi-lingual capability. The chatbot needs to be trained in multiple languages to provide desired answers to the users.
- Advertisement: Few of the SHG members do have small-scale businesses in their native town. We have proposed local advertisement as a new feature to help users advertise their small-scale businesses through the AmritaSREE App. It will support their small shops' initiatives. Chabot can provide response advertisements if other users are trying to buy anything related to the business owned by other SHG members. This feature will motivate other SHG members or groups to form new initiatives.

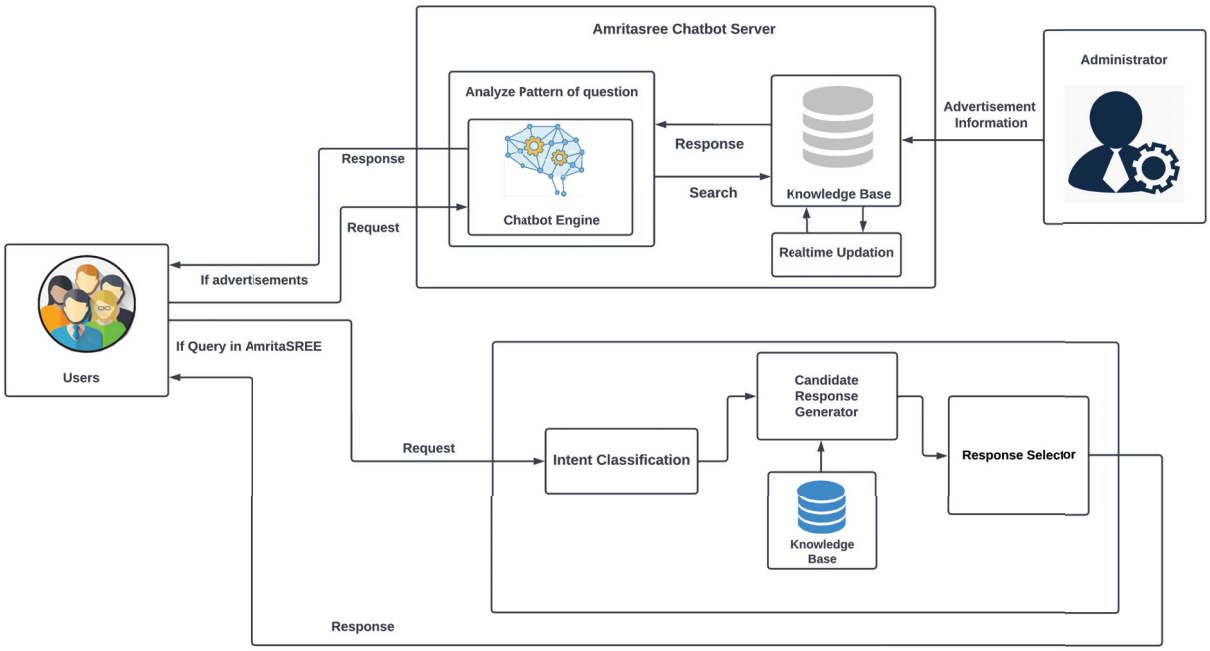

Fig. 1. Proposed System Architecture

Usually, conversations with chatbots tend to sound artificial and, in many cases, do not produce the desired response. We have employed neural networks (a machine learning approach) to address this problem, allowing a chatbot to recognize intent and context and provide more accurate responses. The following section shows details of our proposed hybrid chatbot design for AmritaSREE SHG.

IV. Proposed System Architecture

The chatbot is designed to integrate with the AmritaSREE mobile application. The chatbot design helps the user to get a better experience in using the system as it allows the users to provide helpful information in their convenient language. Here in this software suite, the chatbot helps to meet the user requirements, such as help requests to navigate between the various screens for users who find it challenging to navigate between screens and for providing local advertisements to the SGH members. The primary algorithm for the chatbot selection is shown in Algorithm 1. Based on the user response selection, the algorithm will redirect to the help/support bot, which is a rule-based chatbot, or to the advertisement bot, which is an AI chatbot designed to provide advertisement of certain items produced by the SHG members itself. This feature will motivate more and more SHG members to start small-scale homemade bakery items, pickles, vegetables, flowers, and so on, providing them with income opportunities.

The workflow of the proposed architecture is shown in Fig 1 based on the algorithm; the user is directed to the appropriate chatbot. If the user response is related to the advertisement, it is sent to the AI chatbot engine. It analyzes the pattern of the question and searches for the response corresponding to the identified tag in the database. Then a suitable response is finally sent back to the user if the correct answers are available. The responses are created dynamically with the participation of all the stakeholders, such as the administrator and the users. We have proposed a dynamic database update where the answer is updated continuously by the administrator or the users who want to provide these advertisements. For instance, if the stakeholder wishes to update the item details or add a new item. In that case, they can log in to the app using their stakeholder details and update the information or pass it to the administrator to update it in the system.

Similarly, if the user wants a help option, the user query is sent to the rule-based chatbot. A knowledge base is already there based on the intent. Once the user query intent is classified, the response generator will respond with the most suitable response based on the classified intent. If the user wants a help manual, the chatbot will provide a manual

Algorithm 1: Algorithm for Chatbot selection

```
Input: Series of Options
Result: Decided Chatbot
Selection = 0;
if Selection equal Advertisement then
    AI Chatbot ← Selection(Input)
else
    if Selection equals Help/Support then
        Rule Based ← Selection(Input)
    end
end
```

corresponding to the requested intent and an option to open the required UI screen.

V. Experimentation and Results

The hybrid chatbot is a combination of dynamic AI-based chatbot that answers a user's query on products and help requests using rule-based. As part of the implementation, we focused on the neural network based AI-chatbot. AI chatbots employ natural language processing (NLP) to learn from the context of the entire conversation and don't require prepared responses to every user input [18].

A. AI Approaches for Chatbot

There are several ways of implementing the AI chatbot using NLP using Artificial Neural Networks (ANNs) or Recurrent Neural Networks(RNNs). In retrieval and generative based kind, the system takes user input to compute features in vector representations and uses word embedding techniques for this [18]. However, RNN provides an opportunity to use the previous context in a conversation [18]. High dimensional hidden states in RNN work like a memory [19]. This helps to provide better meaning while processing the text from the user. However, in this work, for experimentation, we used Convolutional Neural Network (CNN) for the AI chatbot, considering it can learn better in the current local context.

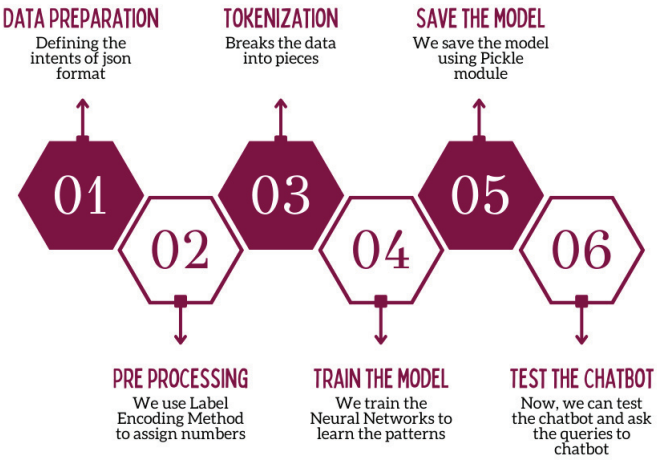

Fig. 2. Chatbot architecture using Neural networks

For this work, as part of the experimentation, we focus only on some sectors of small-scale businesses such as bakeries, sweets making and selling, Fruits, vegetables, and handicrafts. The steps involved in the AI chatbot design are shown in Fig.2.

1) Dataset Preparation: The first step begins with intent creation, and we use a JSON file to map the intent with its corresponding response. The JSON file is dynamic and will be updated from time to time by the stakeholders if they wish to change the responses. It consists of questions the user might ask and responses the chatbot should answer.

2) Neural Network using TensorFlow: Neural networks have interconnected nodes that perform functions analogous to the brain neurons. Using algorithms, they can categorize and raw cluster data, find hidden correlations and patterns and improve over time. For the experimentation, we used the TensorFlow framework, which was developed by Google [20]. CNN is a prevalent deep learning technique used for images [21], and our chatbot is trained using CNN as it learns features at the local level [22], and that makes it suitable for the chatbot. The primary components of convolutional neural networks' structure are the convolutional layer, dense layer, pooling layer, and fully connected layers. The convolution layer does most of the computation work and extracts features from the input data. The resultant contains a feature map. The subsequent layer receives the feature maps as input data [23].

The pooling layer decreases each activation map's dimensionality but retains the most crucial data. A non-linear operation, such as maximum, downsamples each region. In our Chatbot Architecture, we have used Maximum Operation, which helped achieve better generalization and quicker convergence. The activation function used in our chatbot engine is rectified linear activation function (ReLU), which simplifies the training of neural networks. The function returns the value if the input is positive and returns "0" if the input is negative. RELU activation function can be written as $f(x) = max(0, x)$ [24]. The final few layers are fully connected layers, and the output of the last pooling or convolutional layer is forwarded to this layer and gets flattened. The final layer employs the softmax activation function to calculate the probabilities of the input class after going through the fully connected layers [24].

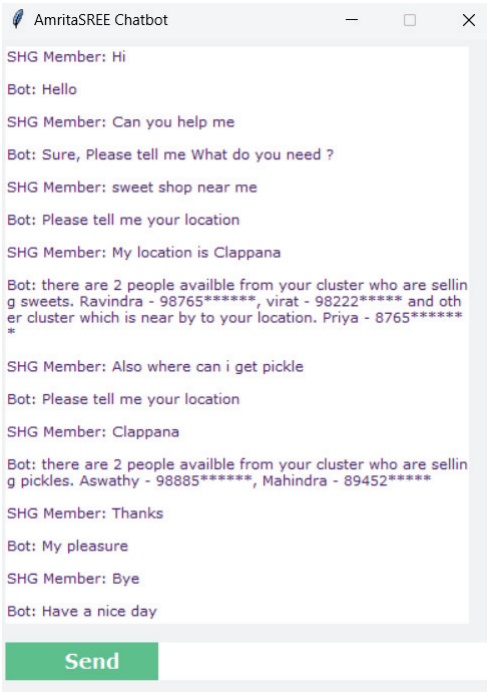

Fig. 3. Advertisement AmritaSREE Chatbot

We train our model with the CNN with the JSON file and save the model for further use. For improved accuracy, we have to use a larger dataset [25]. As soon as the chatbot receives the user's message, it will compute the level of similarity between the new text's sequences and the training data. It sorts the user's message into the category with the highest similarity score based on the scores acquired for each type. These are the basic steps to decide the intent corresponding to the user query. The response is provided based on the selected intent. Fig.3 shows the output generated by the AI chatbot model for Advertisements. Here we have created a python interface for the experimentation. Considering the literacy variation and varying digital capacity, many SHG members will not be able to use the chatbot in English, and there is a chance of spelling mistakes from the user side. To overcome this challenge, we have used the language_tool_python module, which corrects the errors. Another approach we used is to extend our chatbot as a multilingual chatbot; hence users from multiple states can use their local language to converse with it. We implement a translator from the google trans module, and with the help of this module, we can translate the text from English to the local language. When the user inputs a query in their local language, it checks for the language, converts the question to English, and sends the converted text to the chatbot module. In some cases, accuracy is a problem. The reason for most of the accuracy-related problems in chatbots is spelling and grammatical mistakes made by the user. More research is required to improvise the spelling mistakes and grammatical mistakes.

B. Rule-Based Chatbots for Help

Rule-based chatbots are designed to handle help requests. It uses pattern-matching algorithms to provide an appropriate response. The advantage of this approach is that it helps to retrieve the same required content for any number of users. Here we are using a rule-based chatbot for users' help requests by providing them with the desired output. The steps used for the rule-based chatbot are shown in algorithm 2.

The user input is considered as the chatbot's input in this algorithm. We consider intents and keywords when mapping the user query to the pre-set inputs. Initially, all intents are identified and stored in an intent set during the design. If the user's input contains no intent, the input is analyzed, and all keywords are found. The best-matched response is then chosen and given back to the user as the response using the get function and the extracted keywords. If the intent is not identified and the user query contains the required words, then a search for intents is performed in the database, having all kinds of intents related to a response content. The chatbot will return the nearest response depending on the intent based on search results. The proposed UI design for rule-based implementation is shown in Fig.4. The proposed mobile application is building using google flutter. An icon-based alternative UI is also designed for elderly users.

Algorithm 2: Algorithm of the Rule-based Chatbot

Input: User Input
Result: Chatbot Response
Intents = 0;
Keywords = 0;
newIntent ← GetIntent(Input)
foreach *Word* $W_i \in$ *Input* **do**
  Intent ← Intent Classify(W_i)
  Intents ← Intents + newIntent
end
if *Intent equals 0* **then**
  Keywords ← Parser(Input)
  Response ← Get(Keywords)
else
  Query ← Database(Intent)
  Response ← Get(Endpoint, Query)
end
return Response

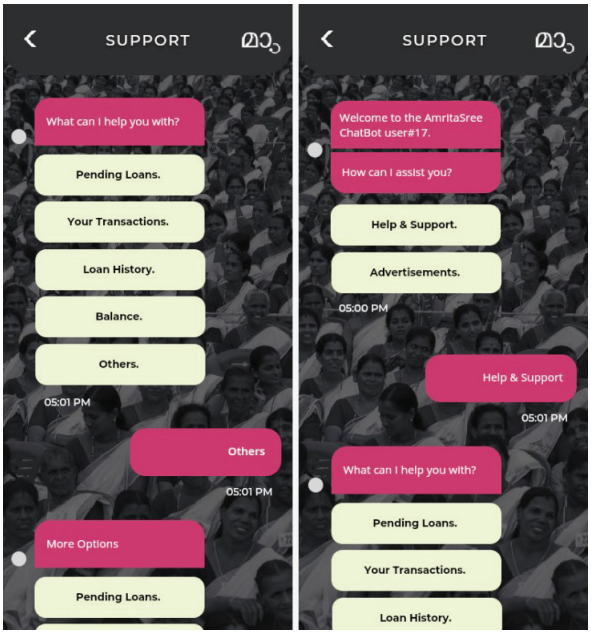

Fig. 4. AmritaSREE Chatbot Responses

VI. Rule Based Chatbots VS Neural Network

Deep neural network models are trained using enormous amounts of data and information which develop the ability to respond to input texts in an appropriate way. The results from neural networks are more accurate than those from other traditional machine learning methods. The advantages of a Neural Network based chatbot are as follows:

- This conversational chatbot can converse with the user to understand their queries and response by providing the required details.
- Minor spelling mistakes will not affect the response of the chatbot.
- The chatbot can provide more accuracy if trained using a

larger dataset, and this chatbot acts as a local advertisement bot.
- Every time a user asks a question, this chatbot can reply corresponding to the query making it more dynamic in its response.

However, some disadvantages exist, such as the chatbot not acting according to the user's mood. Similarly, it does not provide accurate answers every time. There might be no answer to the question by the user if the chatbot is not trained for that question. On the other hand, rule-based chatbots are much simpler than learning-ba sed ones. There are specific guidelines. The user must be informed that in case the response to the user's query doesn't exist the chatbot won't provide any answer. Rule-based chatbots always provide correct results if it meets the defined rule. However, they don't scale well and hence we must establish additional rules in order to add more responses.

VII. Conclusion

This work presented a hybrid multi-lingual chatbot for a rural women's self-help group. This work aims to improve digital access and efficient use of the software developed for them. The inclusion of a chatbot for this community will eventually enhance digital access and strengthen confidence in the rural women's community towards efficient use of modern technology. In this paper, we presented the details of the hybrid chatbot designed for the community and how it supports these SHG activities. We also presented the advantages of rule-based and AI-based chatbots. We effectively utilized the benefits of both chatbots in our design based on the different needs of the users.

Acknowledgment

I would like to express my immense gratitude to our beloved Chancellor Dr. Sri. Mata Amritanandamayi Devi (AMMA) for being the guiding light and inspiration to do this work.

References

[1] J. Devika and B. V. Thampi, "Between 'empowerment'and 'liberation' the kudumbashree initiative in kerala," *Indian Journal of Gender Studies*, vol. 14, no. 1, pp. 33–60, 2007.

[2] AmritaSree, "Amritasree self help groups," http://www.amritasree.com, Accessed November 21, 2022.

[3] S. Sreeraj, A. Unnikrishnan, K. Vishnu, N. E. Kennith, S. Anand, and M. V. Ramesh, "Empowerment of women self help groups: human centered design of a participatory iot solution," in *2020 IEEE Global Humanitarian Technology Conference (GHTC)*. IEEE, 2020, pp. 1–8.

[4] A. N. KA, A. Rakesh, V. Alok, M. Ananthu, S. Anand, and M. V. Ramesh, "Consensus agreement for secure transactions in self help groups," in *2021 12th International Conference on Computing Communication and Networking Technologies (ICCCNT)*. IEEE, 2021, pp. 1–6.

[5] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS quarterly*, pp. 319–340, 1989.

[6] S. Khan and M. R. Rabbani, "Chatbot as islamic finance expert (caife) when finance meets artificial intelligence," in *Proceedings of the 2020 4th International Symposium on Computer Science and Intelligent Control*, 2020, pp. 1–5.

[7] M. S. Satu, M. H. Parvez *et al.*, "Review of integrated applications with aiml based chatbot," in *2015 International Conference on Computer and Information Engineering (ICCIE)*. IEEE, 2015, pp. 87–90.

[8] F. Clarizia, F. Colace, M. De Santo, M. Lombardi, F. Pascale, and D. Santaniello, "A context-aware chatbot for tourist destinations," in *2019 15th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS)*. IEEE, 2019, pp. 348–354.

[9] E. Adamopoulou and L. Moussiades, "An overview of chatbot technology," in *IFIP International Conference on Artificial Intelligence Applications and Innovations*. Springer, 2020, pp. 373–383.

[10] M. Dahiya, "A tool of conversation: Chatbot," *International Journal of Computer Sciences and Engineering*, vol. 5, no. 5, pp. 158–161, 2017.

[11] A. Rahman, A. Al Mamun, and A. Islam, "Programming challenges of chatbot: Current and future prospective," in *2017 IEEE Region 10 Humanitarian Technology Conference (R10-HTC)*. IEEE, 2017, pp. 75–78.

[12] S. A. Abdul-Kader and J. C. Woods, "Survey on chatbot design techniques in speech conversation systems," *International Journal of Advanced Computer Science and Applications*, vol. 6, no. 7, 2015.

[13] F. Colace, M. De Santo, M. Lombardi, F. Pascale, A. Pietrosanto, and S. Lemma, "Chatbot for e-learning: A case of study," *International Journal of Mechanical Engineering and Robotics Research*, vol. 7, no. 5, pp. 528–533, 2018.

[14] A. Nair, S. Pillai, G. S. Nair, and A. T, "Emotion based music playlist recommendation system using interactive chatbot," in *2021 6th International Conference on Communication and Electronics Systems (ICCES)*, 2021, pp. 1767–1772.

[15] J. T. Quah and Y. Chua, "Chatbot assisted marketing in financial service industry," in *International Conference on Services Computing*. Springer, 2019, pp. 107–114.

[16] A. Ait-Mlouk and L. Jiang, "Kbot: a knowledge graph based chatbot for natural language understanding over linked data," *IEEE Access*, vol. 8, pp. 149 220–149 230, 2020.

[17] B. AbuShawar and E. Atwell, "Alice chatbot: Trials and outputs," *Computación y Sistemas*, vol. 19, no. 4, pp. 625–632, 2015.

[18] E. Adamopoulou and L. Moussiades, "Chatbots: History, technology, and applications," *Machine Learning with Applications*, vol. 2, p. 100006, 2020.

[19] H. Salehinejad, S. Sankar, J. Barfett, E. Colak, and S. Valaee, "Recent advances in recurrent neural networks," *arXiv preprint arXiv:1801.01078*, 2017.

[20] P. Vallimeena, B. B. Nair, and S. N. Rao, "Machine vision based flood depth estimation using crowdsourced images of humans," in *2018 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC)*, 2018, pp. 1–4.

[21] P. Gayathri, A. Stalin, and S. Anand, "Intelligent smart home security system: A deep learning approach," in *2022 IEEE 10th Region 10 Humanitarian Technology Conference (R10-HTC)*. IEEE, 2022, pp. 438–444.

[22] T. Toby, U. Gopalakrishnan, and S. N. Rao, "A deeper cnn approach for detection of collapsed buildings in drone images," in *2022 Fifth International Conference on Computational Intelligence and Communication Technologies (CCICT)*, 2022, pp. 404–410.

[23] K. O'Shea and R. Nash, "An introduction to convolutional neural networks," *arXiv preprint arXiv:1511.08458*, 2015.

[24] S. Albawi, T. A. Mohammed, and S. Al-Zawi, "Understanding of a convolutional neural network," in *2017 international conference on engineering and technology (ICET)*. Ieee, 2017, pp. 1–6.

[25] G. Rejith, L. P., T. Toby, S. S. N. B., and S. N. Rao, "Machine learning based criticality estimation algorithm for search & rescue operations in collapsed infrastructures," in *2022 International Conference on Wireless Communications Signal Processing and Networking (WiSPNET)*, 2022, pp. 364–369.