Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 6, July, 2021: 8414 -8424

Research Article

Chatbots: Cross-Domain Engineering Applications

Ajay Sudhir Bale[1], Subhashish Tiwari[2*], B C Hemapriya[3], Subramanya S G[4], Vinay N[1], Baby Chithra R[1], Nithin Gowda N[1], Dixit Shetty[1], Ravindra V[5] ,M Kaushik[6] and Anandhakumar Ramasamy[7]

Abstract

This paper overviews the cross-domain engineering applications of Chatbots. Chatbots are powerful software built using artificial intelligence and machine learning algorithms that respond to user input data and have impacted a wide range of working fields, including healthcare, journalism, and finance. In Journalism, chatbots mean the rise of interactive news communication, spreading awareness more effectively among the younger generation. In the Healthcare systems, chatbots prove to be extensively useful in emergencies where identifying symptoms for individual patients can be difficult, but having stored a vast amount of personalized data, chatbots can predict quite accurately what problem the patient might be facing – including chronic illnesses. In Finance, chatbots are used to customize responses to each user based on factors like age which vary their intention of using their account to secure financial stability. Further research on chatbots will thus prove to enhance their efficiency in several fields like these where they have immense potential**.**

Keywords- Healthcare, Finance, Journalism, Growth, Restrictions.

I. INTRODUCTION

The Chatbot is a word contracted using two words Chat and Bot, where the word bot is derived from robot. Chatbots are intelligent software that reacts to the input data or the information [1-5]. In recent years chats bots are built above the most powerful algorithms of artificial intelligence and machine learning, showcasing the impressive User interfaces (UI) with a natural humanistic response. However, with the advanced development of natural language processing (NLP), chatbots are also integrated with voice-to-voice responsive technology [6-7]. There are many applications of chatbots in the field of manufacturing industry, marketing, medical and education, etc. For many years, businesses have benefited from the use of social,

[1]Department of ECE, School of Engineering and Technology, CMR University, Bengaluru, India-562149
[2]Department of ECE, Vignan's Foundation for Science, Technology & Research, Guntur, India, 522213
[3]Department of CSE, Sir MVIT, Bengaluru, India, 562157
[4]Department of CSE, Nagarjuna College of Engineering and Technology, Bengaluru, India, 562164
[5]Department of ECE, Reva University, Bengaluru, India-562149
[6]Department of ECE, Bannari Amman Institute of Technology, Satyamangalam,Tamilnadu, India- 638401
[7]Cloud Architect, Mississauga, Ontario, Canada, L5B 4A1
[*]drst_ece@vignan.ac.in

conversational bots, and improving customer service and minimize response times, increasing loyalty and interaction in communication [8-10].

The Figure 1 depicts the various elements of Chatbot [11]. It basically comprises of an interaction channel. This channel can be an email agent at the front end or a web page and so on. In order to understand the language of humans, natural language (NL) processor is used. After taking the input from the human, the response is given by the NL generator. The source for actual identity of various types of information is the knowledge-based data. The information of how to react to the end users is decided by the business logic. The automation in various operation for these elements is possible due to the machine learning models. NLP uses AI techniques and works in the direction of accessing the accurate information about human language. Chatbot is the common application of NLP. It is also termed as Artificial Conversational entities (ACE). Usually, these systems do not need the human intervention to have an interaction with the end user [12]. The industries have given lot of attention towards this revolutionary conversational AI platforms [13].

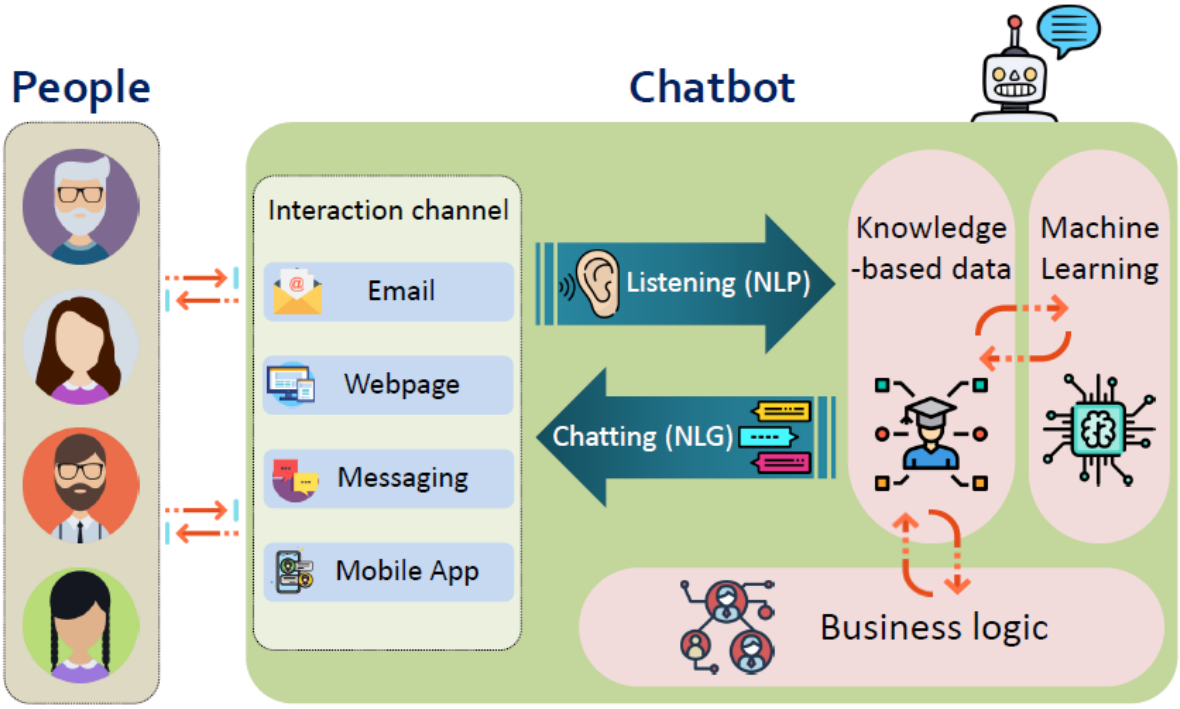

Figure 1: Different elements of Chatbot. [11]. Reproduced from open access article.

The Figure 2 shows the category of Chatbot [14]. The categories have simple criteria. At a time the Chatbot can work as a function of multiple categories. As a front end, the Chatbot either provides a web application or a mobile application to the user [15-17]. The query is being submitted by the user through the application interface. Once the request is received, the Bot control logic is in charge of responding to it. The request is pre-processed using Natural Language Processing, which converts raw text to vector format. After classification is performed to determine whether or not the predetermined response can be found, the appropriate response can be returned to the user [18-20].

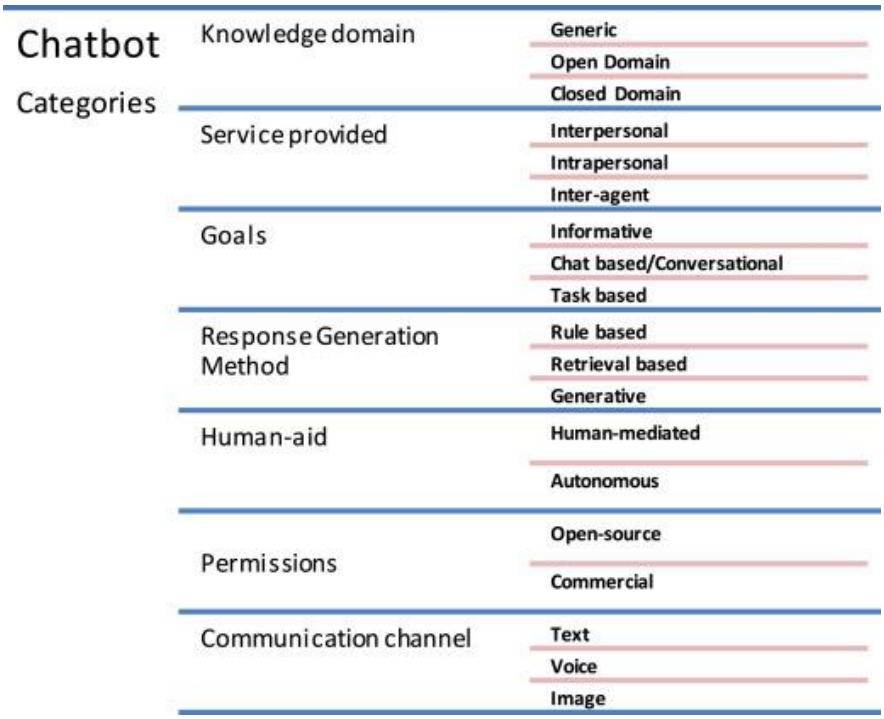

Figure 2: Categories of Chatbot. Reproduced from open access article [14].

II. COMPARATIVE STUDY

A. Journalism

The robotic innovations have gained attraction in the news media in recent years by providing realistic solutions to journalistic everyday routines. The introduction of these AI- Bots in journalism have created a major impact, resulting in the boom of a new way of journalism, that is "automated journalism" and "automated news", using advanced algorithms [21].

The media industry is raising its competition from social, digital, and mobile media, in terms of collective revenue and also information broadcasting, both public sector, and commercial news organizations are facing the major issue in reaching an audience. Even the largest broadcaster of journalism, BBC is also facing this issue in the current situation. The introduction of chatbots can help in conversation journalism raise. In public service news organizations facing budget cuts, innovations like bots, which offer efficiency savings and can illustrate increased involvement with younger viewers, resonate, and they work to allay concerns of diminishing importance among coming generations [21-22]. Bots also reflect changes in the newsroom community, such as a trend toward personalization and increased audience monitoring and tracking [23-24].

In the age of big data, automation was designed to minimize human effort and make it easier for journalists to deliver news to the public. Using the Quriobot plugin the chatbots have been developed, which demonstrated in gathering the information also behaving as the news article for interactive communications [25]. These Quriobot plugin-based chatbots are also adaptable in interfering with Facebook messenger, WhatsApp, Viber, telegram, and other communication

apps. The Chatbot was based on the pre-collected data that also includes the data analytical skills integrated. The BBC has also tested several communicative chatbots based on the pre-scripted definition provided in a multiple-choice format, mostly for special events such as the UK general elections [22]. The integration of chatbots in journalism has achieved many results in terms of performance, functionality, reliability, personalization, interactivity, ethics, behavior, and accessibility. Like The ability to respond quickly and effectively, Linguistic accuracy, knowledge, language simplicity, identification and grouping of information source, listing personality traits that characterize a typical reporter, easy navigation and access, etc. [21].

The COVINFO Reporter Chatbot is developed with an aim to provide quick and accurate information about the COVID-19 pandemic crisis. The public requires personalized reports of the information which are successfully facilitated by chatbots. It is developed simply, keeping in mind that media organizations must easily incorporate it into their workflow and that users must access it easily.

The COVINFO Reporter Chatbot as shown in Figure 3 undergoes three development steps [26]. The first step is focusses on its design. As shown in Figure 1, the design consists of interdependent past experience (Quriobot plugin embedded in a News article published on WordPress [27]) and related Chatbot implementation (which includes WordPress alongside more social media platforms). The second step is the implementation of the Chatbot. The COVINFO reporter deployment implements all the Chatbot features, the main idea being to provide users with any specific information required alternatively. The COVINFO Reporter interface is used by them to access the information selected by the journalists. The last step highlights the evaluation of the Chatbot. This is done by two sets of professionals – experts and a group of 80 journalism students – based on performance, reliability, functionality, personalization, interactivity, ethics, behaviour and accessibility. This development process continues as a cycle via repetitive improvements and research directions, in order to deliver accurate crisis information.

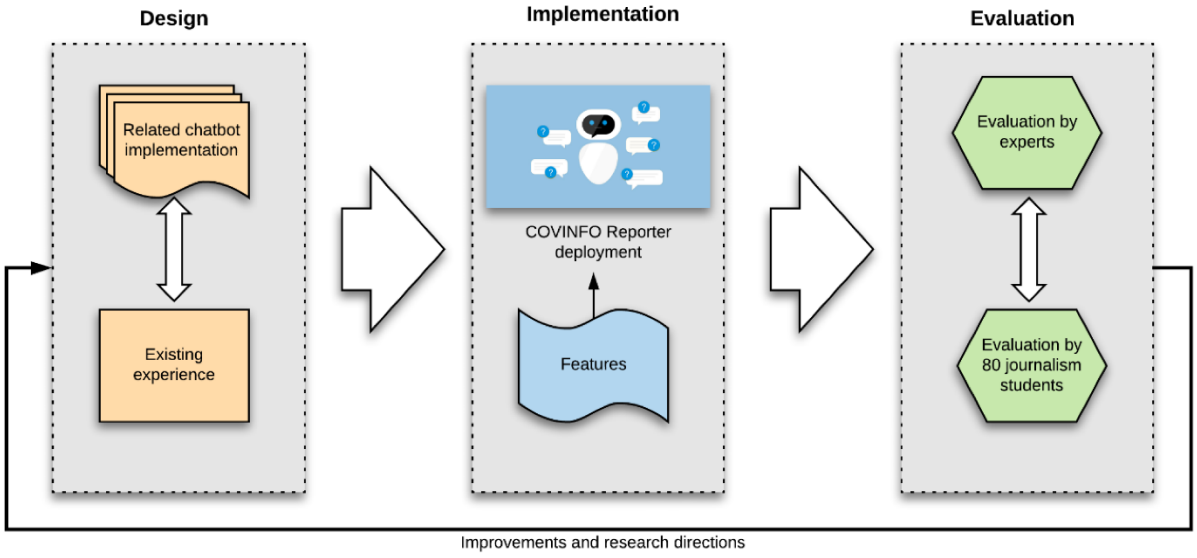

Figure 3: COVINFO Reporter Chatbot [26]. Reproduced from open access article

B. Healthcare

Healthcare services integrating with modern technology are established for diagnosis and treatment of health issues, as a result of this integration of this many pieces of research have been undergone for the advancement of medical systems. The information and communication technology in medical research plays an important role because the medical data is complicated and hard to collect and control medical data using traditional approaches [25-30]. As medical is a complicated subject in terms of symptoms detection, it is tough to select valuable data from a large number of big-medical data sources during care. An AI algorithm is needed to provide personalized care for patients based on vast collections of personalized medical data; as a result, global hospitals have developed AI systems for emergency prediction. The chatbots enabled with AI technology are playing a major role in this prediction mechanism in emergencies [31-32].

Microsoft and Google have also launched the health platform chatbots that can be used in real-life situations. Melody, the intelligent Chabot developed by Baidu, interacts with the patient, gathers data, and sends vial data to medical staff, and also helps to schedule a meeting appointment with a doctor [28, 33]. Integration of medical AI-chatbots with other social networking platforms can help to give a variety of services. The mobile healthcare platforms integrated with chatbots can react quickly to incidents that occur in daily life as well as help patients with chronic disease. The chatbots are built on the framework of data, knowledge, and service layers, integrating with the big data and artificial neural network techniques [28].

Healthcare chatbots work in associated with healthcare information systems (HIS) and personal healthcare records (PHR). The entire architecture of the chatbots that includes UI and data analytics are only used for information collecting and identification (also includes analysis), but the solution sends data to PHR and HIS [28]. Since the chain of management value related to treatment, diagnosis, and flow process are implemented in hospitals, it is now anticipated that medical institutions will handle the entire customer life cycle, where chatbots play a major role.

The outer diagram of Chatbot is shown in Figure 4 where the patient data is collected from one-to-one sections, in most cases that also is one through chats bots as an initial process [28]. The collected data includes medical data, previous medical history data, and results of previous medical data. The collected data is then parsed, which means data parsing, where the collected data is identified and converted into different types of data. As a next step that data is converted into the required type, in most cases, it is XML or JSON format. The data in a proper format is then processed, that is data processing that includes data identification, data partition, data classification, and data visualization and in some cases, it also includes decision making that depends on previously trained data [28]. That data procession is the major part of the entire system that includes modeling and algorithms to take a proper decision. The data parsing, data conversion, and data processing are continuously communicated through the database where the data is stored, in some cases, all these 3 units come under databases only, which is a cloud platform in many of the models. After data processing and decision making the feedback is sent to two way communicating user interface in a device like mobile, laptop tab. Which is viewed by the user. In some bots this a cyclic two-way communicating process.

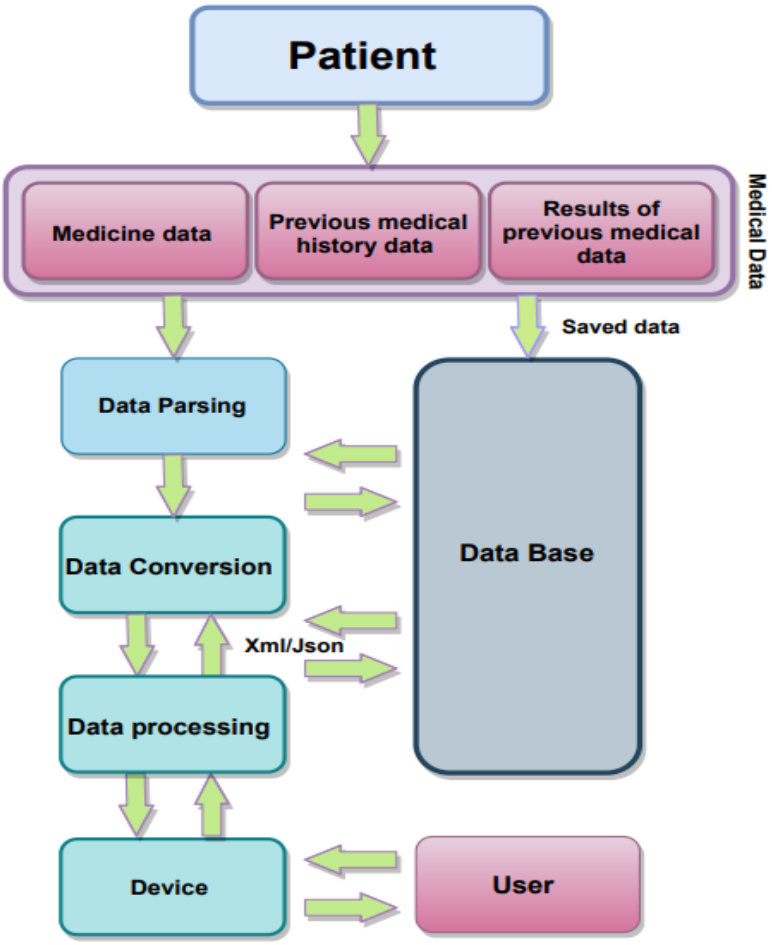

Figure 4: Chatbot working flow. Modified from [28]

C. Finance

There is a demand for improving the chatbots in the field of finance which can work with more added features. It should possess good awareness when a conversation or a chat session is in progress. This should always respond with a personal answer which is relevant to the user [34]. It is usual to expect all the users to get the same response when enquired about their retirement account as a Q&A. But the Chatbot needs to respond differently to different people as the profile differs with age. For this, Conversational Concept AI is utilized which can identify the intent of the user, can understand the intent clearly, and can respond with personalized answers. The Figure 5 shows the taxonomy development in which the technique is employed to extract the terms based on automatic taxonomy development. This approach involves the evaluation of this taxonomy manually by the individuals who are having expertise in the field. This results in terms that are assigned being called valid or invalid.

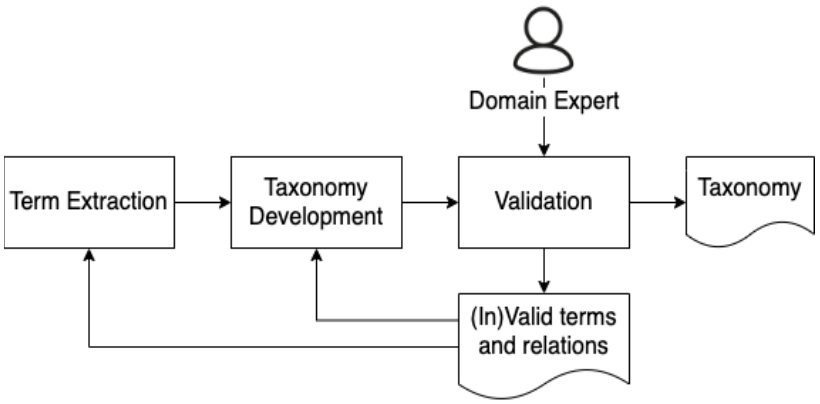

Figure 5: The approach for improvising the automatic taxonomy. (A Human-in-the-loop) [34]. Reproduced from open-source article

Providing expertise for customer service will result into more profit of the banks [35].

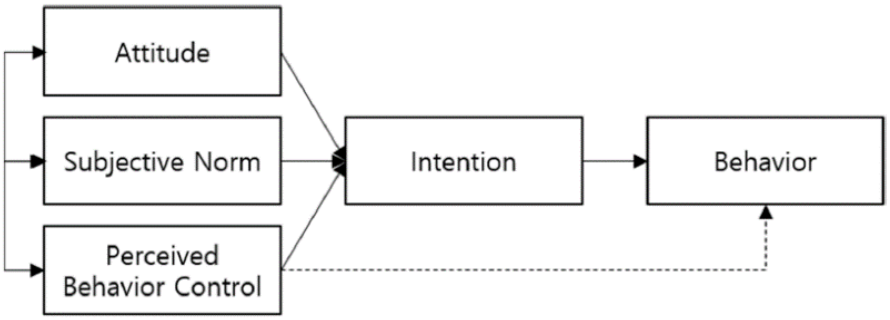

Figure 6: Theory of planned behaviour [35]. Reproduced from open-source article

The theory depicted in Figure 6 exhibits unique actions as it is based on the planning of behaviour control. According to this theory, the performance of actions should be based on the planned actions in the model. It is under human control to have any intention of performing a task, and this is the main determinant of behaviour. The new added feature, perceived behaviour control is used to compensate for the disadvantages found in rational behaviour theory. Thus, this theory can be employed in analyzing the effect of customer service with the existing models with the Chatbot systems currently utilized in banks. The Chatbot and the service provided to the customers forms two main channels determining the profits earned by the banks. In order to help banks, take up suitable measures to secure financial stability and simultaneously realize through observation how the current customer service-based business can be taken over by chatbots based on AI-based chatbots, a Korean banking company's product data is studied. Data of target customers were used to analyze the contribution of each channel to bank profits statistically by using financial services as well as products using two different methods – the Chatbot and calls via Customer service. In order to find the impact of service purchases along with customer products on the profit made by the bank, ARS was used.

In January 2018, Bank A established the use of the AI Chatbot where it sold four major products and services daily for 36 months up to December 2020. The study collected 34,089

personal data through the Chatbot. Alongside, the customer service business sold similar products under similar conditions like age. Since the bank's target audience was Korean residents, region and seasonality were also constant. Here they collected 317,438 unstructured voice data converted to text. To standardize this data, use of a voice recognition model and a convertor were made. The product data's statistical sampling bias is assumed to be controlled as it is reported to be handled parameter data, and not extracted. Although in the case of customer service data, counseling staff responses could be subjected to promotional situations, which cannot be measured – and is considered negligible. Sensitive information from customer data was deleted via blur-masking. Moreover, the primary key was converted into the mixed combination and set as analyzable by data cleansing [35].

The main products sold by Bank A included Fund subscription, Savings Housing subscription services, services to pay loan interests, and Utility bills– with the number of cases summing up to 351,527. It is reported to be counted all duplicate products sold as the data was based on the number of customer cases. The data contained the following: Contractor and his id, the date and product sold, and its id number. Analysis of this consisted of basic statistical analysis (using SAS and Oracle virtual machine), data pre-processing, hypothesis setting, and testing.

III. CONCLUSION AND FUTURE WORK

Chatbots are becoming increasingly common in a variety of environments, and they have the potential to save time and money. However, many users continue to have negative experiences with chatbots that create the restriction and limitation in technology. Overcoming all these chatbots are still making potential growth and showcasing their applications in various fields like healthcare, banking, journalism, and also in other sectors. In this study, we have discussed the various use of chatbots and how chatbots are solving real-time problems in the particular domain, we have also overviewed the technical structure of Chatbot. We believe that our study will help further research into an established standard in Chatbots and enhancing AI-based capabilities in and outside of healthcare, journalism, finance, and other customer self-service environments.

Regardless of technological advancements in automation through the use of chatbots, a minority of users are dissatisfied. Satisfying the needs of this group of users is also important from a business standpoint. To address this issue, an integrated approach of chatbots and manual customer support agents can be proposed. Most basic questions and properly addressed queries can be handled by a Chatbot. Some customized queries, as well as poorly framed query sentences, may result in the inability to obtain a predefined response. In most cases, chatbots will provide a generic response that may or may not be appropriate. When no predefined response can be found from the user input in the hybrid approach, it should automatically involve a customer support agent in real-time so that they can effectively understand the question and address the queries. If the Chatbot does not receive a response from an agent within the time frame specified, it may proceed with a general response to the customer.

Chatbots in future should be designed in such a way that it has the ability to analyse the facial expressions of the human being who makes live chat with the chatbots provided the system has required facilities to capture the face expressions.

References

[1] Hill, J., Randolph Ford, W., & Farreras, I. G. (2015). Real conversations with artificial intelligence: A comparison between human–human online conversations and human–chatbot conversations. Computers in Human Behavior, 49, 245–250. doi:10.1016/j.chb.2015.02.026

[2] Smutny, P., & Schreiberova, P. (2020). Chatbots for learning: A review of educational chatbots for the Facebook Messenger. Computers & Education, 103862. doi:10.1016/j.compedu.2020.103862

[3] Dhyani, M., & Kumar, R. (2020). An intelligent Chatbot using deep learning with Bidirectional RNN and attention model. Materials Today: Proceedings. doi:10.1016/j.matpr.2020.05.450

[4] Fryer, L. K., Nakao, K., & Thompson, A. (2019). Chatbot learning partners: Connecting learning experiences, interest and competence. Computers in Human Behavior, 93, 279–289. doi:10.1016/j.chb.2018.12.023

[5] Androutsopoulou, A., Karacapilidis, N., Loukis, E., & Charalabidis, Y. (2018). Transforming the communication between citizens and government through AI-guided chatbots. Government Information Quarterly. doi:10.1016/j.giq.2018.10.001

[6] Balas, V. E., Kumar, R., & Srivastava, R. (Eds.). (2020). Recent Trends and Advances in Artificial Intelligence and Internet of Things. Intelligent Systems Reference Library. doi:10.1007/978-3-030-32644-9

[7] Lalwani, Tarun and Bhalotia, Shashank and Pal, Ashish and Rathod, Vasundhara and Bisen, Shreya, Implementation of a Chatbot System using AI and NLP (May 31, 2018). International Journal of Innovative Research in Computer Science & Technology (IJIRCST) Volume-6, Issue-3, May-2018, Available at SSRN: https://ssrn.com/abstract=3531782 or http://dx.doi.org/10.2139/ssrn.3531782

[8] Griol, D., & Callejas, Z. (2013). An Architecture to Develop Multimodal Educative Applications with Chatbots. International Journal of Advanced Robotic Systems, 10(3), 175. doi:10.5772/55791

[9] Brandtzaeg, P. B., & Følstad, A. (2017). Why People Use Chatbots. Lecture Notes in Computer Science, 377–392. doi:10.1007/978-3-319-70284-1_30

[10] H. N. Io and C. B. Lee, "Chatbots and conversational agents: A bibliometric analysis," 2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), 2017, pp. 215-219, doi: 10.1109/IEEM.2017.8289883.

[11] Rodríguez, J.I.; Durán, S.R.; Díaz-López, D.; Pastor-Galindo, J.; Mármol, F.G. C3-Sex: A Conversational Agent to Detect Online Sex Offenders. Electronics 2020, 9, 1779. https://doi.org/10.3390/electronics9111779

[12] Gao, J.; Galley, M.; Li, L. Neural Approaches to Conversational AI. Found. Trends Inf. Retr. 2019, 13, 127–298.

[13] Walker, M. Hype Cycle for Emerging Technologies, 2018. In 2018 Hype Cycles: Riding the Innovation Wave; Gartner: Stamford, CT, USA, 2018.

[14] Eleni Adamopoulou, Lefteris Moussiades, Chatbots: History, technology, and applications, Machine Learning with Applications, Volume 2, 2020, 100006, ISSN 2666-8270, https://doi.org/10.1016/j.mlwa.2020.100006.

[15] Chatbots Magazine. 2018. How To Develop a Chatbot From Scratch. Retrieved from https://chatbotsmagazine.com/how-to-develop-a-chatbot-from-scratch-62bed1adab8c. Accessed on 06 July 2021

[16] K. Tajane, S. Dave, P. Jahagirdar, A. Ghadge and A. Musale, "AI Based Chat-Bot Using Azure Cognitive Services," 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), 2018, pp. 1-4, doi: 10.1109/ICCUBEA.2018.8697737.

[17] Amir Shevat. 2017. Designing Bots: Creating Conversational Experiences. O'Reilly Media, Inc

[18] Guus Schreiber, Bob Wielinga, Joost Breuker. 1993. KADS: A Principled Approach to Knowledge Based System Development. Academic Press.

[19] Cameron, Gillian & Cameron, David & Megaw, Gavin & Bond, Raymond & Mulvenna, Maurice & O ' Neill, Siobhan & Armour, Cherie & Mctear, Michael. (2018). Back to the Future: Lessons from Knowledge Engineering Methodologies for Chatbot Design and Development. 1-5. 10.14236/ewic/HCI2018.153.

[20] Ardito, C.; Caivano, D.; Colizzi, L.; Dimauro, G.; Verardi, L. Design and Execution of Integrated Clinical Pathway: A Simplified Meta-Model and Associated Methodology. Information 2020, 11, 362. https://doi.org/10.3390/info11070362

[21] Maniou, T. A., & Veglis, A. (2020). Employing a Chatbot for News Dissemination during Crisis: Design, Implementation and Evaluation. Future Internet, 12(7), 109. doi:10.3390/fi12070109

[22] BBC News Labs. 2018. “Scripting chatbots is hard. Here’s how we made it easier for BBC journalists: In our toolkit: BBC News BotBuilder”. Medium. June. https://medium.com/bbc-news-labs/ bbc-botbuilder-ba8e09b6a2e9

[23] Carlson, Matt. 2018. “Confronting Measurable Journalism”. Digital Journalism, 6 (4): 406–441.

[24] Helberger, Natali. 2015. “Merely Facilitating or Actively Stimulating Diverse Media Choices? Public Service Media at the Crossroad.” International Journal of Communication 9: 1324–1340

[25] Veglis, A., & Maniou, T. A. (2019). Embedding a chatbot in a news article. Proceedings of the 23rd Pan-Hellenic Conference on Informatics - PCI ’19. doi:10.1145/3368640.3368664

[26] Maniou, T.A.; Veglis, A. Employing a Chatbot for News Dissemination during Crisis: Design, Implementation and Evaluation. Future Internet 2020, 12, 109. https://doi.org/10.3390/fi12070109

[27] Veglis, A.; Maniou, T.A. Embedding a chatbot in a news article: Design and implementation. In Proceedings of the ACM 23rd Pan-Hellenic Conference on Informatics, Nicosia, Cyprus, 28–30 November 2019; pp. 169–172.

[28] Chung, K., Park, R.C. Chatbot-based heathcare service with a knowledge base for cloud computing. Cluster Comput 22, 1925–1937 (2019). https://doi.org/10.1007/s10586-018-2334-5

[29] Chung, K., Kim, J.C., Park, R.C.: Knowledge-based health service considering user convenience using hybrid Wi-Fi P2P. Inf. Technol. Manag. 17(1), 67–80 (2016)

[30] Yoo, H., Chung, K.: PHR based diabetes index service model using life behavior analysis. Wirel. Pers. Commun. 93(1), 161–174 (2017)

[31] Kim, J.C., Chung, K.: Emerging risk forecast system using associative index mining analysis. Clust. Comput. 20(1), 547–558 (2017)

[32] Sheth, A., Jaimini, U., Thiruarayn, K., Banerjee, T.: Augmented personalized health: how smart data with IoTs and AI is about to change healthcare. In: Proceedings of the 2017 IEEE International Forum on Research and Technologies for Society and Industry (RTSI) (2017)
[33] Schaeffer, D.M., Olson, P.C.: Information and communications technology in Africa: enabling big data, to enable development. J. Comput. Sci. Colleges 33(3), 71 (2018)
[34] McCrae, J.P.; Mohanty, P.; Narayanan, S.; Pereira, B.; Buitelaar, P.; Karmakar, S.; Sarkar, R. Conversation Concepts: Understanding Topics and Building Taxonomies for Financial Services. Information 2021, 12, 160. https://doi.org/10.3390/info12040160
[35] Hwang, S.; Kim, J. Toward a Chatbot for Financial Sustainability. Sustainability 2021, 13, 3173. https://doi.org/10.3390/su13063173