IAES International Journal of Artificial Intelligence (IJ-AI)
Vol. 12, No. 4, December 2023, pp. 1543~1556
ISSN: 2252-8938, DOI: 10.11591/ijai.v12.i4.pp1543-1556

Productivity of incident management with conversational bots-a review

Orlando Iparraguirre-Villanueva[1], Luz Obregon-Palomino[1], Wilson Pujay-Iglesias[1], Fernando Sierra-Liñan[2], Michael Cabanillas-Carbonell[3]
[1]Facultad de Ingeniería y Arquitectura, Universidad Autónoma del Perú, Lima, Perú
[2]Facultad de Ingeniería, Universidad Privada del Norte, Lima, Perú
[3]Vicerrectorado de Investigación, Universidad Privada Norbert Wiener, Lima, Perú

Article Info

Article history:

Received Aug 23, 2022
Revised Jan 27, 2023
Accepted Jan 30, 2023

Keywords:

Bot
Chatbot
Conversational
Incidence
Management
Productivity

ABSTRACT

The use of conversational agents (bots) in information systems managed by company's increases productivity in the development of activities focused on processes such as customer service, healthcare, and presentation. The present work is a systematic literature review that collects articles from 2019 to 2022 in the databases Scopus, Springer, Willey, Indexes-Csic, Taylor & Francis, Pubmed, and Ebsco Host. PRISMA methodology was used to systematize 47 relevant articles. As a result of the analysis, 2/19 very important benefits were obtained, which are: helping to obtain information and facilitating customer service; as for the types of conversational bots, a total of 9 types were found, of which conversational agents and chatbots with artificial intelligence (AI) are the most common; in the case of processes, 3/5 processes that optimize conversational bots were found, where the most prominent are: teaching process, health processes, and customer service processes. An architecture model for conversational bots in incident management is also proposed.

Corresponding Author:

Orlando Iparraguirre-Villanueva
Facultad de Ingeniería y Arquitectura, Universidad Autónoma del Perú
Lima, Perú
Email: oiparraguirre@ieee.org

1. INTRODUCTION

Productivity in incident management worldwide in companies is scalable and optimizable. This productivity according to [1], is a very important indicator that defines the quantification of the products or services produced based on the resources used. In turn, the difference in productivity between companies is related to three common situations such as: i) experience and knowledge of the partners, ii) use of technologies, and iii) organizational structure. The primary goal for a business is to increase productivity and positively affect it to generate value for the product or service that is provided to the end user. Therefore, in [2], [3] the authors state that automation in the information technology environment is considered a foundation for increasing productivity and quality of services. The use of technology, is important to take advantage of its rapid development by integrating the tools it provides, resulting in great benefits [4]. In the same way, by investing in and implementing ICT, companies can increase their productivity and staff performance, while reducing costs [5], since, is proven to provide automated student queries with an accuracy that is above 75%. On the other hand, in the technological area, there are many relevant advances, for example, Eliza, a bot-based program developed in the late 1970s by MIT professor Joseph Weizenbaum, [6] is said to be the first conversational bot that can answer questions and engage in conversation depending on the words or phrases it receives. This was the beginning of advances in the research and improvement of artificial intelligence (AI) that could later perform jobs effectively. Many companies have carried out the development and

implementation of these bots for their business to generate productivity and value, and to provide a quality service to the customer [7], [8]. The authors, in [9] mention that, for customer management and satisfaction, the company's activities must be addressed by a quality management system.

From the point of view of information technology (IT), an incident is considered as the interruption of the services offered by a company, which can be reported by users or, on the contrary, it can be generated by applications in an automated way [10], In [11] it is stated that an incident management system has the purpose of providing resolutive attention to the users within the shortest possible time and acts as an information center in charge of managing the monitoring, registration, and follow-up of the incidents; likewise, in [11] it is mentioned that the purpose of the implementation of ITIL-based models to manage incidents increases the quality of the service, and according to [12], The status of incidents can vary between assigned (which does not allow adding violations), closed (which does not allow modification) and open (default or initial status of the incident). Incidents can be related to customer service, and request processes, among others. In IT, incident management with conversational bots is of great support, since it allows streamlining processes to meet the needs of customers according to their needs [13]. Similarly, the steps involved in incident management are incident entry, registration, classification, diagnosis, resolution, control, and closure of the incident. Good incident management will allow companies to have better interaction with both their internal and external customers [14].

The use of chatbots allows to solve the problems that the user might currently have, besides being a beneficial tool in customer service, it can reduce up to 30% of care costs [15], however, it is normal to find that it most important use is in entertainment and as a complementary messaging software; it is also frequently used as a virtual assistant on websites, highlighting that this can be the subject of research for larger purposes. Therefore, the contributions of this systematic review are the following:

- Mention the characteristics that a chatbot must have.
- Identify the methodologies for the development of a chatbot.
- Mention the most used architectures in the implementation of a chatbot.

In section 2, several works on incident management with chatbots are presented. Section 3 describes the research methodology, which is the focus of the study. The results are presented in section 4. Section 5 presents discussions of the research findings, as well as recommendations for future studies. Finally, section 6 presents the conclusions.

2. REVIEW OF RELATED WORK

2.1. Bots in software engineering

In [16], the authors relate chatbots in software engineering. The scope of bots in software engineering and their application is broad, as it is considered that bots should be analyzed to provide a general picture of why and how they should be applied in software engineering. Also, they mention that bots are more than automated scripts, but that they can become systems that make decisions; as in [17] where an artificial intelligence machine LAMBDA, tries to convince its creators that it thinks and feels after several conversations, is exposed.

2.2. Bots in the health sector

In the health sector, in [18], [19] the authors indicate that conversational interfaces (CI) have been implemented in different forms applied for health and behavioral intervention purposes, patient self-management, and clinical decision support, based on information extracted from a review of 42 funded projects, 428 research publications, and 162 patents. Similarly, according to [19] the increase in demand for mental health care has been driving. Also, the development of digital mental health interventions (DMHI), generated that conversational bots are integrated into DMHI as support in diagnosis, detection, symptom management, behavior change, and content delivery; however, only 24% of DMHI entities consider a chatbot and a small number of professionals have had interaction with them on this topic.

In terms of solution evaluation, the authors state that the means to verify user satisfaction through the use of conversational bots are not currently standardized. In [20] the authors describe four studies, where the overall sample of 141 survey participants (experts and novices) to define attributes for interaction quality testing, designed and piloted a new scale to measure satisfaction after an experience with conversational chatbots. This arises for the diagnosis of a checklist (BOT-Check), a 15-item questionnaire (BOT Usability Scale, BUS-15) with estimated reliability between 0.76 and 0.87 distributed over five factors; however, the latter requires further validation testing. Likewise, in the AI categories, in [21] reference is made to interactive AI, which enables efficient and interactive communication automation, which is oriented to the commercial sphere. Also, techniques such as machine learning, frequent pattern mining, reasoning, and heuristic AI search is used for its development.

3. METHODOLOGY

For the development of this article, the PRISMA methodology has been used. According to [22] assists authors in concisely documenting the conduct and findings during the search for manuscripts related to the research topic. The PRISMA method contains the following steps:

- Identify important manuscripts on the subject.
- Exclusion of duplicate manuscripts.
- Eligibility analysis.
- Selection of final manuscripts for in-depth analysis.

3.1. Research questions

This section provides a review of the recent state of the art in research related to the productivity of incident management with conversational bots. For this reason, the following research questions (RQ) are mentioned. The questions for this research in the systematic review are:

RQ1: What are the benefits of using conversational chatbots for incident management?

RQ2: What types of chatbots are available to improve incident management?

RQ3: What types of processes do conversational chatbots optimize?

3.2. Search strategy

The search strategies used to answer the research questions were the following string of words as shows in Figure 1. This chain has been introduced in databases of scientific manuscripts such as Scopus, Springer, Index, Taylor & Francis, Ebscohost, Willey, and Pubmed, to analyze each of the manuscripts found through a systematic review matrix where filters are made to determine the number of manuscripts to be included.

```
((productivity OR performance OR efficiency) AND
(Incidence OR incident OR occurrence OR event) AND
(Management OR administration OR diligence)) AND
((conversational AND bot) OR (conversational AND assistant) OR (conversational AND agent) OR (chatbot))
```

Figure 1. A search query for manuscripts related to the research topic

After obtaining the results through the search chain, we proceeded to validate that the manuscripts were adequate to meet the objective of this work. For this purpose, the PRISMA methodology was taken into account, where the inclusion and exclusion criteria were applied, with their respective justifications detailed in Table 1. This was done in order to classify the manuscripts that would be eligible for the present work. Figure 2 shows the classification of the manuscripts expressed in a flow chart according to PRISMA.

Table 1. Criteria for inclusion, exclusion, and the corresponding justification.

Inclusion criteria	Justification
Include related manuscripts	Manuscripts related to the research topic
Include manuscripts published in the last 4 years (2019 - 2022)	For academic research, the last 5 years are considered
Include English language manuscripts	Usually, the work is carried out in this language
Include open access manuscripts	Unrestricted access is required
Include computer science manuscripts	Sector more specific to the aspect and subject under investigation
Exclusion criteria	Justification
Review manuscripts	Manuscripts of results are needed
Duplicate manuscripts	Manuscripts should not be repeated
Manuscripts in Spanish	Limited to certain countries only

The 4 phases of the PRISMA methodology are shown in Figure 2. In phase 1, manuscripts were excluded based on titles and duplicates, resulting in 642 publications. In phase 2, manuscripts were excluded based on abstract selection, resulting in 550 publications that did not meet inclusion criteria, while 92 manuscripts will be evaluated. In phase 3, 45 manuscripts that do not address the research questions were excluded. In phase 4, after eligibility analysis, 47 publications were screened for inclusion. The 47 manuscripts have been categorized as shown in Tables 2 to 4.

- Benefits of using conversational bots.
- Types of conversational bots.
- Processes that optimize conversational bots

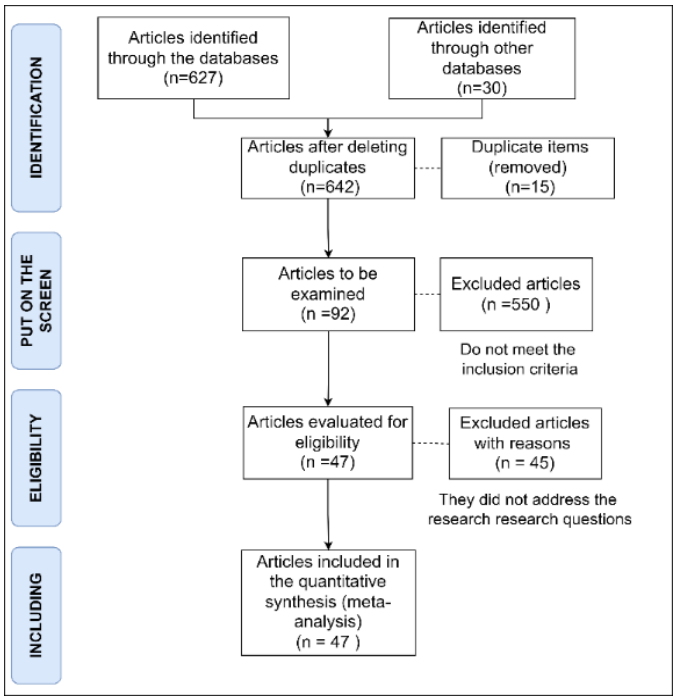

Figure 2. Scientific steps for the analysis of proposed manuscripts, "Flow chart according to PRISMA"

Table 2. Benefits of using conversational bots

#	Benefits	Application	Reference
1	Helps to attract customers	Customer service for the search for new products.	[23]
2	Helps educate patients	Used with diagnosed patients and educate in the management of asthma.	[24], [25]
3	Helps to obtain information	Obtaining and collecting relevant information from users, without the need for agglomeration.	[26]–[31]
4	Assistance in patient care	Prescreening for symptoms of a disease and contacting a physician.	[32]–[34]
5	Assistance in tourism	Guide for museum visitors.	[35]
6	Assist in testing or practice	They allow users to rehearse job interviews, get immediate answers, and reduce labor requirements and costs on repetitive tasks.	[36]–[38]
7	Benefits knowledge of skills	Extract metrics on skills, Semantic understanding, response paraphrase generation, help to understand technology use by adults.	[39]–[42]
8	Delegating tasks	Assigning and delegating tasks, among others.	[43]
9	Determine the authenticity of publications	Determining the authenticity of social media posts.	[44]
10	Stimulates learning	Chatbot generates increases in learning performance, by coaching, and teaching students.	[45], [46]
11	Stimulates customer understanding	Accurately understand the user's intent or request, improving their experience.	[47]
12	Stimulates communications	The conversational bot allows high availability in customer service and improves communication because it is endowed with empathy, personality, and skills to interpret their needs through natural language.	[48]–[52]
13	Ease of use	Easy and simple to learn user interface, perception of high-level audio and video features.	[53], [54]
14	Facilitates information dissemination	The chatbot can amplify and distribute reliable information, disseminate information in a local area by application or SMS, and automatically generates responses to postings.	[55]–[57]
15	Facilitates customer service	Accurate response to peak requests also serves as an intermediary for incident management on a bus by voice and message.	[58]–[63]
16	Facilitates tasks	Reducing transaction costs, precompetitive effects, and boosting e-commerce economics.	[64]
17	Promotes decision making	Facilitating business tasks and decisions, managing employee workload, and helping organizations provide relief.	[65], [66]
18	Motivates people to lead a healthy lifestyle	Motivating people to adopt healthy lifestyle behavior.	[67]
19	It can be used in various aspects	Chatbots can fulfill a variety of functions in a virtual environment, which is configurable and adaptable.	[68], [69]

From what is shown in Table 2, it can be extracted that the benefits of using chatbots are diverse [67], [68], and transversal to health fields such as [23], [24], [31]–[33], and [66], customer service according to [25]–[30], [42], [46]–[51], [54]–[62], education according to [35]–[41], and trade in general according to [60]. From what is shown in Table 3, it can be extracted that the types of chatbots are called virtual assistants or agents, conversational, health, a chatbot with AI, natural language processing (NLP), and information management. The processes that are optimized by conversational chatbots are also shown, as shown in Table 4.

Table 3. Types of conversational bots

Chatbot types	Application	Reference
Conversational agent	AI-based multitasking conversational agent	[23], [25], [27], [38], [44], [45], [53], [64]
Virtual agent	Text-messaging-based interviewing agent	[36], [65]
AI assistant	Artificial Intelligence Assistant.	[24], [70]
Virtual assistant	Virtual Assistance with AI Architecture	[54], [71]
Health assistants	Chatbots in multiple scenarios.	[43]
Chatbot con NLP	Chatbots with NLP and NLC (Natural Language Classifiers) technologies, architecture on microservices.	[34], [39], [48], [52]
Chatbot that manages information	Chatbot in information management.	[53]
Chatbots con AI	Chatbots with AI and cloud computing.	[23], [30], [31], [33], [35], [41], [42], [44], [45], [56]–[58], [68]

Table 4. Processes optimizing conversational bots

Processes	Aplicación	Ref.
Bots training	Analysis and prediction process.	[25], [28], [43]
Teaching process	Teaching process and query resolution.	[26], [37], [46]–[48], [53], [54], [59], [69]
Customer service processes	Customer management process.	[24], [35], [44]–[46], [51], [52], [63], [67]
Health processes	Personalized attention process.	[42], [49], [64]
Processes for personal assistance	Personal assistance process through communication.	[40], [47], [62]

4. RESULTS AND DISCUSSION

This section presents the bibliometric analysis and detailed analysis of previous work. The first part shows the relationships between the common terms concerning incident management with conversational bots and density visualization. The second part seeks to find the scientific gap between the manuscripts proposed in this study to develop an architectural model that allows the implementation of a conversational bot for incident management.

4.1. Bibliometric analysis

VOSviewer has been used, which, according to [72], is a research tool for creating bibliometric networks based on manuscripts and journals, also, it applies text mining in the creation and visualization of co-occurrence networks on relevant words. This tool helped the study with visual information, allowing us to visualize the keywords associated with incident management with conversational bots. It also helped to identify the benefits, types, and processes that optimize conversational chatbots in clusters. The VOSviewer divides the terminology into clusters according to their relevance to one another. Figure 3 represents the visualization of the bibliometric map showing the relationships between the most used terminology and how it is linked. The largest node represents the most used terminology in the manuscripts, and its size represents the number of times these words appear in the manuscripts.

The analysis was performed on the title and abstract using a binary counting method of 108 keywords examined with a minimum threshold of 2 occurrences, resulting in 28 terminologies, as shown in Figure 3. The largest nodes representing each cluster in the network map are determined as a cluster of “artificial intelligence” (red), a cluster of “conversational agent” (green), a cluster of “natural language processing” (violet) cluster of “ai” (blue), and, finally, cluster de “chatbot” (sky blue).

Looking at the network map in Figure 3, we can see that the 6 clusters are connected; for example, the terms "artificial intelligence" is connected to "chatbots", "collaboration", "conversational agents", "deep neural networks", "dialogue systems", "virtual assistants" in the same red cluster, it is also connected to the cluster “conversational agent”, is also connected to "conversational interfaces", "customer service", "healthcare", "human-robot interaction", "voice assistants" in the green cluster. On the other hand, it is also connected to “natural language processing” in the violet cluster; is also connected to "data augmentation" and "human-machine interaction". In addition, “ai” in the blue cluster is connected to "autonomy", "human-

computer interaction (hci)", "social presence", "trust"; likewise, “machine learning” are connected in the light brown cluster with “covid-19", "deep learning", "natural language understanding". Finally, “chatbots” are connected in the light blue cluster with "mobile learning"y "teamwork". Figure 4 shows the document density displays to identify keywords in the analyzed manuscripts by calculating their recurrence. Keyword density optimizes online search engines based on bibliometric analysis. Finally, by analyzing the network map in Figure 3 and the document density visualization in Figure 4, it was possible to identify the most important terms in each cluster, as shown in Table 5.

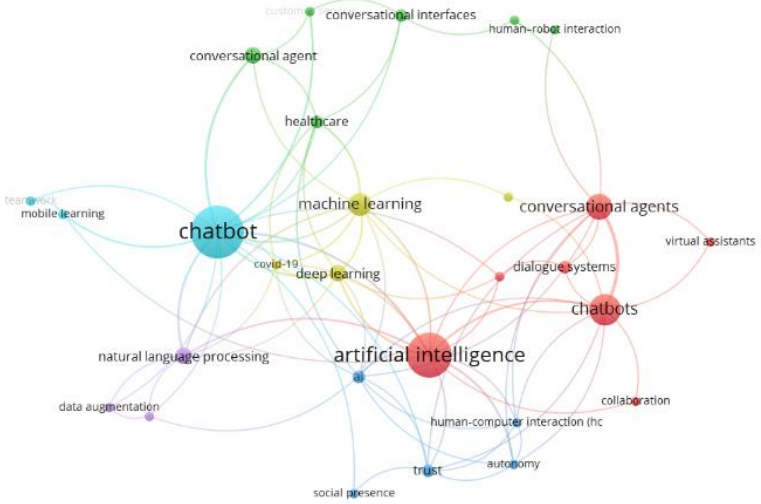

Figure 3. Relationships between common terms using bibliometric mapping

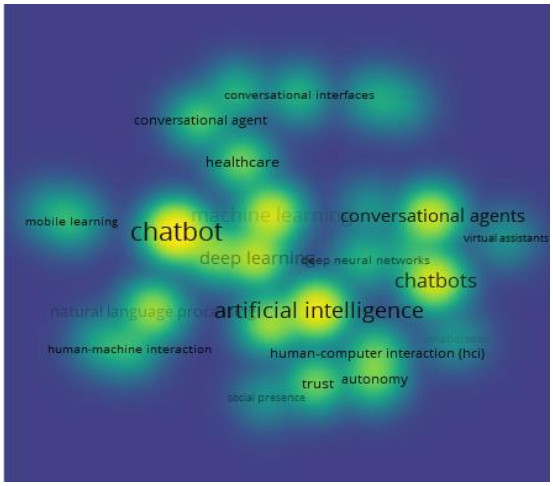

Figure 4. Density visualization based on bibliometric analysis

Table 5. Results obtained in the search

Type of database	ID	Source of data Name	Initial search results	Selected final results
Main databases	D1	Scopus	205	21
	D2	Springer	88	5
	D3	Willey	74	1
	D4	Índices-CSIC	105	10
	D5	Taylor & Francis	155	2
Secondary databases	D6	Pubmed	24	3
	D7	Ebscohost (Applied science & technology source ultimate)	6	5
		TOTAL	657	47

One of the most popular conversational chatbot models was introduced by [49] which describes the development of Microsoft Xialoce, a socially popular chatbot, which is designed as an AI companion with social and emotional communication. Whereas, the author [52] presented a chatbot that communicates with the customer in a variety of interaction styles that allows pleasant online ordering. These chatbots serve as guides in information systems, [63] features a chatbot that guides the user to perform banking transactions, while [27] has created a chatbot that serves as a guide for visually impaired customers. It is noted that 2 authors describe conversational chatbots that are social, while 2 others present those that serve as guides.

In [24] introduced two agents with a wealth of voice- and text-based diabetes information, AIDA Chatbot, and AIDA Cookbot, to support diabetes patients, physicians, and caregivers in text-based dietary recommendations for diabetic patients. Similarly, [67] presented conversational agents using mHealth interventions, to generate healthy lifestyle changes for audiences with diabetes disease. While [39], [47] presented a conversational system that interacts with the user so that it can provide more precise recommendations according to the user's context.

In education [54] bots can be used in educational or general presentations to enhance interaction; they are also conversation-based learning support frameworks. Whereas, [57] mentions that these conversational bots adopt relevant educational approaches and technology-enhanced learning. Given such research, it is reaffirmed that the application of chatbot technology is fully favorable in the educational sector.

For the operation of these chatbots, the architectural basis on which it is designed must be considered. Therefore, [48] has proposed an advanced architecture that has scalability and receives services for the NLC and means of communication with the end user. Whereas, [56] admits that architecture based on neural networks is a promising outcome for building chatbots that can respond to unanswered messages.

4.2. Manuscript analysis

Seven databases of manuscript results were used for the search, the number of manuscripts retrieved was a total of six hundred and fifty-seven (657) in the initial search, and the final results with a total of forty-seven (47) manuscripts. As presented in Table 5. The initial search of manuscripts has gone through a cleaning process using the PRISMA methodology, where phase 1 shows the initial search, phase 2 after eliminating the 15 duplicates and those that are not related to the research topic, phase 3 has 47 manuscripts that are related to the research topic. For more detail, Figure 5 shows the number of manuscripts by databases, with Scopus with 21, the source that maintained the highest number of manuscripts after the filters. Also shown is the number of manuscripts obtained in the other databases such as Springer 5, Willy 1, Indices 10, Taylor & Francis, Ebscohost 5 and Pubmed with 3.

Figure 6 shows a line graph of the publication of manuscripts by year and the databases to which they belong. The databases with the highest number of manuscripts published between 2019 and 2021 are Scopus and Indices. Table 6 shows in detail the countries where the largest number of manuscripts have been published: Taiwan with 6 articles, and Germany with 6 articles, Italy with 4 articles, Followed by USA, Spain, China with 3 articles. While there are other countries where the number of manuscripts is between 1 and 2.

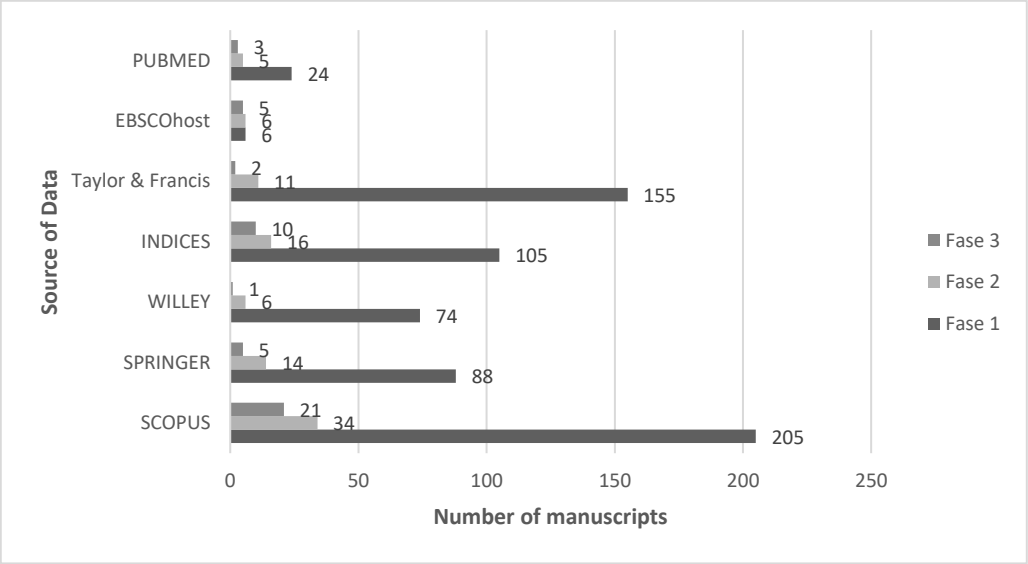

Figure 3. Manuscripts in the stages of PRISMA

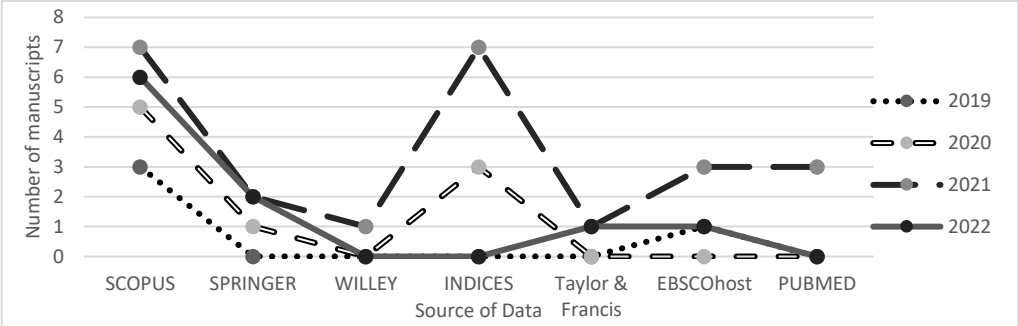

Figure 4. Number of manuscripts by year of publication

Table 6. Manuscripts by the city of publication

#	Country	Quantity	Articles
1	Italy	4	[24], [52], [59], [69]
2	Switzerland	2	[25], [43]
3	Taiwan	6	[31], [32], [37], [44], [53], [58]
4	Spain	3	[39], [46], [54]
5	Serbia	1	[48]
6	Greece	1	[35]
7	China	3	[49], [51], [56]
8	South Korea	1	[23], [33]
9	Singapore	1	[67]
10	Francia	2	[34], [36]
11	United Kingdom	1	[45]
12	Germany	6	[26], [47], [50], [55], [64], [65]
13	Bulgaria	1	[40]
14	Indonesia	1	[41]
15	Chile	1	[66]
16	USA	3	[29], [42], [63]
17	Netherlands	1	[68]
18	Czech Republic	1	[27]
19	Finland	1	[60]
20	Saudi Arabia	1	[61]
21	Thailand	2	[57]
22	Brazil	1	[28]
23	Malaysia	1	[38]
24	Austria	1	[62]
TOTAL		47	

4.3. Recent work on the benefits of using conversational chatbots

RQ1. The benefits of using chatbots, as shown in Table 7, focus on very essential points in the current context of the Covid-19 pandemic. According to [32]–[34], mentioned that these bots offer assistance in patient care, which is considered to have been and continues to be a very valuable aspect. Likewise, the new normal of isolation and health care generated that businesses offering their products and services, [55]–[63] can be benefited with ease of information dissemination and customer service, also according to what was mentioned by [47] helps to understand customers; and according to [59]. The benefit of delegating tasks; whereas, in the case of [55]–[57]. It was found that it facilitates the dissemination of information and favors decision-making; therefore, it is considered that the use of chatbots will contribute to productivity in Incident Management within the framework of ITIL best practices, for the allocation of incidents, management, and escalation of service level agreement (SLA).

4.4. Recent work on the types of conversational chatbots that exist

RQ2. There is a great variety of types of chatbots from the simplest to the most advanced, Table 8 shows 9 types of chatbots that have been found in the rigorous analysis of the manuscripts included. For example, the most outstanding are: (Conversational agents), with 8 manuscripts where the authors have developed an agent to solve problems such as information management for an organization, personalized recommendation, language learning, and survey management, among others. (Chatbots with AI) has 14 studies, wherein one of them, mentions the bots with AI, in which using trained neural networks allows the decision making in front of incidences on the diseases of the rice plant, where the agent receives as input photos. (Chatbots with NLP) with 4 related studies where the authors highlight that it is very important because it can

help in language translation, and generation of languages either colloquial or formal. Also, there is a (Virtual Agent) where 2 authors present this agent to play an interviewer role, based on text and messaging. Finally, there are the chatbot types that contain only 1 article (AI Assistants), (Virtual Assistant), (Health Assistant) (Chatbot that manages information), and (Chatbot with AI, NLP, and NLC)".

Table 7. Studies show the benefits of using chatbots

#	Group benefits	Quantity	Articles
1	Helps to attract customers	1	[23]
2	Helps educate patients	2	[24], [25]
3	Helps to obtain information	6	[26]–[31]
4	Assistance in patient care	3	[32]–[34]
5	Assistance in tourism	1	[35]
6	Assist in testing or practice	3	[36]–[38]
7	Benefits knowledge of skills	4	[39]–[42]
8	Delegating tasks	1	[62]
9	Determine the authenticity of publications	1	[44]
10	Stimulates learning	2	[45], [46]
11	Stimulates customer understanding	1	[47]
12	Stimulates communications	5	[48]–[52]
13	Ease of use	2	[53], [54]
14	Facilitates information dissemination	3	[55]–[57]
15	Facilitates customer service	6	[58]–[63]
16	Facilitates tasks	1	[64]
17	Promotes decision making	2	[65], [66]
18	Motivates people to lead a healthy lifestyle	1	[67]
19	It can be used in various aspects	2	[68], [69]
	TOTAL	47	

Table 8. The number of types of chatbots with the manuscripts

#	Types of chatbots	Quantity	Articles
1	Conversational agent	8	[25], [27], [29], [40], [46], [47], [55], [66]
2	Virtual agent	2	[36], [55]
3	AI Assistant	1	[24]
4	Virtual Assistant	1	[54]
5	Health assistants	1	[43]
6	Chatbot with NLP	4	[34], [39], [48], [52]
7	Chatbot that manages information	1	[53]
8	AI Chatbots	14	[23], [30], [31], [33], [35], [41], [42], [44], [45], [49], [56]–[58], [68]
9	Chatbots with AI and NLC NLP	1	[37]
	TOTAL	33	

4.5. Recent work on the processes that optimize a conversational chatbot

RQ3. After the exhaustive analysis of the manuscripts, 5 processes that optimize conversational chatbots have been found, e.g.: Table 9 shows the processes that the chatbots optimize: according to [24], [27], [42] bots are employed in bot training processes to feed its knowledge base; on the other hand, in [23], [43]–[45], [50], [51], [56], [62], [66]. The use of conversational bots was found to be part of the teaching process [21], [22], [25], [26], [29]–[31], [40], [41], [53], [64], it was realized that healthcare processes have been altered and have incorporated the use of chatbot technology with patients and professionals. Similarly, according to, [39], [46], [61] there is a segment of users who use these bots in Processes for personal assistance for various reasons. It was also found in [20], [28], [32], [33], [36], [38], [58], [59], [63], that chatbots are used in customer service processes. In this analysis, the application of chatbots in incident management processes has not been identified; however, it has been mentioned that the teaching process (student-delivered course), customer service process (customer-supplier), health process (patient-doctor), processes for personal assistance (assisted-assistant) and even the training of bots (trained-trainer), are carried out by conversational bots; in the case of the Incident Management Process (user-technician), its application is highly necessary and important to increase productivity in this process.

Table 9. Processes optimizing conversational chatbots

#	Processes	Quantity	Articles
1	Bots training	3	[27], [30], [45]
2	Teaching process	10	[26], [37], [46]–[48], [53], [54], [59], [65]
3	Customer service processes	9	[23], [31], [35], [36], [39], [41], [61], [62], [66]
4	Health processes	11	[24], [25], [28], [29], [32]–[34], [43], [44], [56], [57]
5	Processes for personal assistance	3	[42], [49], [64]
	TOTAL	36	

5. PROPOSED ARCHITECTURE

After analyzing the manuscripts related to incident management with conversational bots, we have found very customized architecture models that do not adapt to multiple realities; therefore, in this section, we propose an architecture model that adapts to different realities and contexts. The proposed architecture model called (LUWI), seeks to improve incident management and has characteristics such as interactivity, semi-human conversation, informative assistance, and novelty. This model has 3 modules which are: Users, Interaction channels, and Conversational Chatbot. These modules are mutually related for their optimal functioning. As shown in Figure 7.

In modules 1 and 2, the user communicates with the chatbot via SMS, Web Page, or E-mail. The user can ask the conversational chatbot (CC) what he/she needs. The CC has a data input and an information output. In module 3, in the input, the CC receives data from the user, in turn, this data goes through 3 stages to give a response to the user. In stage 1, there is the information extraction module which contains 6 components, dialog state tracker (DST), neural intent encoding (NIE), NLC, NLP, and neural recommender system (NRS). Where DST, NIE, NLC, and NLP are responsible for understanding what the user wants by analyzing the context of the dialog. Then, the data is studied by the NRS which generates a recommendation that will be sent and stored in the knowledge base (KD). In stage 2, the KD of the conversational chat CC interacts with 2 components: machine learning (ML) and business logic (BL). The CC evaluates the initial extraction data by interacting with the ML model where the results are stored in the KD in question and answer format. In turn, the model is trained to assert its learning with the interaction of many data. Then, the KD interacts with the BL, i.e. it manages the incidents through the system connected to a database focused on the first 4/8 ITIL processes which are:

1. Incident registration.
2. Incident categorization.
3. Incident prioritization.
4. Incident assignment.
5. Task creation and management.
6. SLA management and escalation.
7. Incident resolution.
8. Incident closure.

In stage 3, we have module 3, CRG response generator, this module has 3 components: neural policy agent (NPA), natural language generator (NLG), and neural variation interface network (NVI). These components are in charge of processing the information contained in the knowledge base, where the NPA determines the type of decisión-related to the current dialogue, NLG helps to create conversational responses in the context identified in stage 1. These first 2 components are created to work together synchronously. The common synchronization data are updated by a neural variational inference neural inference network NVIN. This generates a conversational response from the end user.

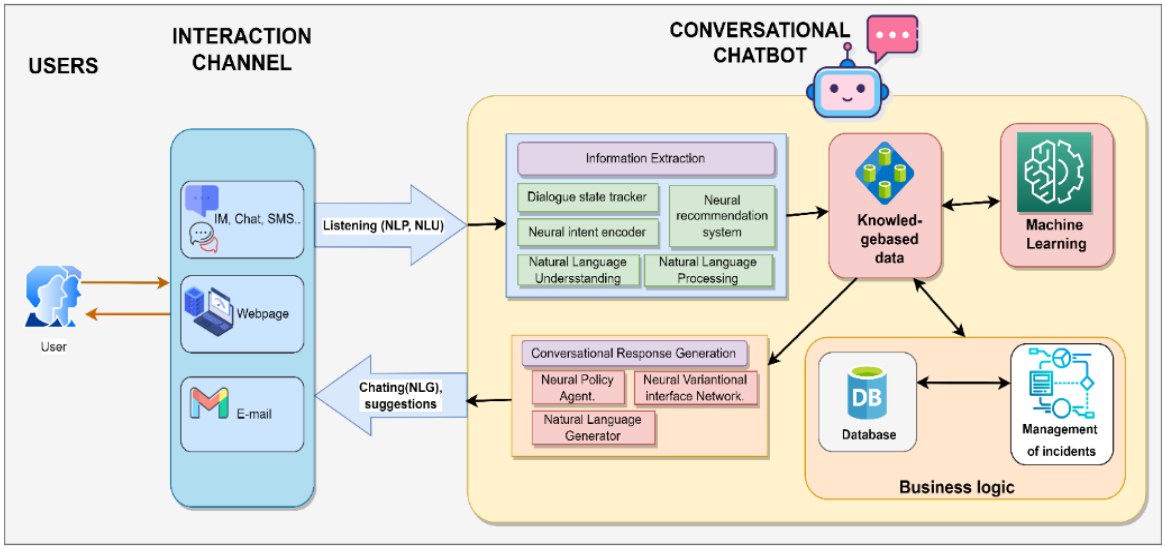

Figure 7. LUWI architecture for incident management generated after manuscript review

6. CONCLUSION

In this SLR where research papers from 2019 to 2022 have been analyzed, an initial set of 657 manuscripts were found, and 47 manuscripts were carefully selected based on inclusion/exclusion criteria using PRISMA methodology. This review provides the reader with insights into the benefits, types of conversational bots, and processes that improve after the use of these bots. The research questions focus on 3 main points. Firstly, we identified the benefits of conversational bots where 2/19 very important benefits were obtained such as: "helping to obtain information" and "Facilitating customer service" with a total of 6 manuscripts referring to it. Secondly, in the types of conversational bots, a total of 9 types of conversational bots were found, of which 2 are the most used: "Conversational agents" and "Chatbots with AI". Thirdly, 3/5 processes that optimize conversational bots were found, where the most prominent ones are: "Teaching process", "Health processes" and "Customer service processes". Conversational bots can be applied in any sector, both in public entities and private companies, to improve their productivity by streamlining customer service processes, personalized recommendations, and teaching, among others, through communicative interaction. Finally, the results of this study will help future researchers to take as a basis the knowledge of conversational automated systems and be able to develop them in companies to efficiently manage the incidents that may arise. In this way, this study proposes an architecture model (LUWI) that allows the conversational chatbot to adapt to different process environments where interactivity and communication are very relevant features accompanied by the personalization of learning and understanding of natural language through ML, focused on the framework of ITIL best practices to manage incidents.

REFERENCES

[1] BBVA México, "¿What is productivity in a company?? (In Spanish: ¿Qué es la productividad en una empresa?)," 2022. https://www.bbva.mx/educacion-financiera/blog/que-es-la-productividad-en-una-empresa.html (accessed Apr. 23, 2022).

[2] D. Belanche, L. V Casaló, C. Flavián, and J. Schepers, "Service robot implementation: a theoretical framework and research agenda," *The Service Industries Journal*, vol. 40, no. 3–4, pp. 203–225, Oct. 2019, doi: 10.1080/02642069.2019.1672666.

[3] A. Keller, "Challenges and directions in service management automation," *Journal of Network and Systems Management*, vol. 25, no. 4, pp. 884–901, Oct. 2017, doi: 10.1007/s10922-017-9437-9.

[4] S. Kallou and and Aikaterini Kikilia, "A transformative educational framework in tourism higher education through digital technologies during the COVID-19 pandemic," *Advances in Mobile Learning Educational Research*, vol. 1, no. 2, pp. 37–47, 2021, doi: 10.25082/amler.2021.01.005.

[5] A. Carbajal-Torres, J. Ninaquispe-Florez, and M. Cabanillas-Carbonell, "Business intelligence in strategic business decision making in times of COVID-19: A systematic review of the literature," in *Proceedings of Seventh International Congress on Information and Communication Technology*, Springer Nature Singapore, 2022, pp. 425–435.

[6] G. P. Piedra-Illescas and D. M. Cordero-Guzmán, "Chatbot as a tool to reduce human intervention in the resolution of office automation incidents in zonal coordination 7 - health (In Spanish: Chatbot como herramienta de disminución de la intervención humana en la resolución de incidencias de ofimática en," *Dominio de las Ciencias*, vol. 5, no. 2, p. 376, Apr. 2019, doi: 10.23857/dc.v5i2.907.

[7] B. P. Wicaksono and A. Zahra, "Design of the use of chatbot as a virtual assistant in banking services in Indonesia," *IAES International Journal of Artificial Intelligence*, vol. 11, no. 1, pp. 23–33, Mar. 2022, doi: 10.11591/ijai.v11.i1.pp23-33.

[8] N. Belhaj, A. Hamdane, N. E. H. Chaoui, H. Chaoui, and M. El Bekkali, "Engaging students to fill surveys using chatbots: University case study," *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 24, no. 1, pp. 473–483, Oct. 2021, doi: 10.11591/ijeecs.v24.i1.pp473-483.

[9] ISO, "ISO 9001:2008(es), quality management systems - requirements," 2008. https://www.iso.org/obp/ui/#iso:std:iso:9001:ed-4:v2:es (accessed Apr. 23, 2022).

[10] Banco Interamericano de Desarrollo, "SGIS | code for development (In Spanish: SGIS | código para el desarrollo)," 2021. https://code.iadb.org/es/herramientas/sgis.

[11] X. Quiñonez-Ku, "Implementation of the ITIL- based incident management process first edition," 2019, doi: 10.13140/RG.2.2.28094.33601.

[12] IBM, "Incident management - IBM documentation," 2021. https://www.ibm.com/docs/es/guardium/11.1?topic=protect-incident-management (accessed Jul. 16, 2022).

[13] J. Pérez and J. Ramos, "Chatbot with artificial intelligence for the customer service process in the urology Service of a health facility," 2021.

[14] K. Sánchez, "Development and implementation of a web page with chatbot, for the company's laboratory test request process 'SANLAC S.A.," 2021.

[15] V. Kasinathan, A. Mustapha, M. F. C. A. Rani, and S. A. Mostafa, "The role of chatterbots in enhancing tourism: a case study of Penang tourism spots," *IAES International Journal of Artificial Intelligence*, vol. 9, no. 4, pp. 569–575, Dec. 2020, doi: 10.11591/ijai.v9.i4.pp569-575.

[16] S. Santhanam, T. Hecking, A. Schreiber, and S. Wagner, "Bots in software engineering: a systematic mapping study," *PeerJ Computer Science*, vol. 8, p. 866, Feb. 2022, doi: 10.7717/peerj-cs.866.

[17] BBC, "The google engineer who claims that an artificial intelligence program has become self-aware and feels - BBC news mundo," 2022. https://www.bbc.com/mundo/noticias-61787944.

[18] Z. Xing *et al.*, "Conversational interfaces for health: Bibliometric analysis of grants, publications, and patents," *Journal of Medical Internet Research*, vol. 21, no. 11, p. e14672, Nov. 2019, doi: 10.2196/14672.

[19] E. M. Boucher *et al.*, "Artificially intelligent chatbots in digital mental health interventions: A review," *Expert Review of Medical Devices*, vol. 18, no. 1, pp. 37–49, Dec. 2021, doi: 10.1080/17434440.2021.2013200.

[20] S. Borsci *et al.*, "The chatbot usability scale: The design and pilot of a usability scale for interaction with AI-Based conversational agents," *Personal and Ubiquitous Computing*, vol. 26, no. 1, pp. 95–119, Jul. 2021, doi: 10.1007/s00779-021-01582-9.

[21] I. H. Sarker, "AI-based modeling: Techniques, applications and research issues towards automation, intelligent and smart systems,"

SN Computer Science, vol. 3, no. 2, Feb. 2022, doi: 10.1007/s42979-022-01043-x.
[22] M. J. Page *et al.*, "PRISMA 2020 statement: An updated guide for the publication of systematic reviews (In Spanish: PRISMA 2020: Una guía actualizada para la publicación de revisiones sistemáticas)," *Revista Española de Cardiología*, Sep. 09, 2021. .
[23] T. Um, T. Kim, and N. Chung, "How does an intelligence chatbot affect customers compared with self-service technology for sustainable services?," *Sustainability*, vol. 12, no. 12, p. 5119, Jun. 2020, doi: 10.3390/su12125119.
[24] F. Alloatti, A. Bosca, L. Di Caro, and F. Pieraccini, "Diabetes and conversational agents: The AIDA project case study," *Discover Artificial Intelligence*, vol. 1, no. 1, Sep. 2021, doi: 10.1007/s44163-021-00005-1.
[25] T. Kowatsch *et al.*, "Conversational agents as mediating social actors in chronic disease management involving health care professionals, patients, and family members: Multisite single-arm feasibility study," *Journal of Medical Internet Research*, vol. 23, no. 2, p. 25060, Feb. 2021, doi: 10.2196/25060.
[26] S. Stieglitz, M. Mirbabaie, N. R. J. Möllmann, and J. Rzyski, "Collaborating with virtual assistants in organizations: Analyzing social loafing tendencies and responsibility attribution," *Information Systems Frontiers*, vol. 24, no. 3, pp. 745–770, Oct. 2021, doi: 10.1007/s10796-021-10201-0.
[27] J. Berka, J. Balata, C. M. Jonker, Z. Mikovec, M. B. van Riemsdijk, and M. L. Tielman, "Misalignment in semantic user model elicitation via conversational agents: A case study in navigation support for visually impaired people," *International Journal of Human Computer Interaction*, vol. 38, no. 18–20, pp. 1–17, Apr. 2022, doi: 10.1080/10447318.2022.2059925.
[28] J. L. Z. Montenegro and C. A. da Costa, "The HoPE model architecture: A novel approach to pregnancy information retrieval based on conversational agents," *Journal of Healthcare Informatics Research*, vol. 6, no. 3, pp. 253–294, Apr. 2022, doi: 10.1007/s41666-022-00115-0.
[29] B. D. Johnson, M. W. Shui, K. Said, A. Chavez, and D. D. Sachdev, "Prioritizing COVID-19 contact tracing during a surge using chatbot technology," *American Journal of Public Health*, vol. 112, no. 1, pp. 43–47, Jan. 2022, doi: 10.2105/ajph.2021.306563.
[30] P. Temniranrat, K. Kiratiratanapruk, A. Kitvimonrat, W. Sinthupinyo, and S. Patarapuwadol, "A system for automatic rice disease detection from rice paddy images serviced via a chatbot," *Computers and Electronics in Agriculture*, vol. 185, p. 106156, Jun. 2021, doi: 10.1016/j.compag.2021.106156.
[31] M.-H. Tsai, J. Chen, and S.-C. Kang, "Ask Diana: A keyword-based chatbot system for water-related disaster management," *Water*, vol. 11, no. 2, p. 234, Jan. 2019, doi: 10.3390/w11020234.
[32] J.-H. Chen *et al.*, "Online textual symptomatic assessment chatbot based on a weighted scoring for female breast cancer prescreening," *Applied Sciences*, vol. 11, no. 11, p. 5079, May 2021, doi: 10.3390/app11115079.
[33] H. Lee, J. Kang, and J. Yeo, "Medical specialty recommendations by an artificial intelligence chatbot on a smartphone: Development and deployment," *Journal of Medical Internet Research*, vol. 23, no. 5, p. 27460, May 2021, doi: 10.2196/27460.
[34] C. Blanc *et al.*, "FlauBERT vs. CamemBERT: Understanding patient's answers by a French medical chatbot," *Artificial Intelligence in Medicine*, vol. 127, p. 102264, May 2022, doi: 10.1016/j.artmed.2022.102264.
[35] S. Varitimiadis, K. Kotis, D. Pittou, and G. Konstantakis, "Graph-based conversational AI: Towards a distributed and collaborative multi-chatbot approach for museums," *Applied Sciences*, vol. 11, no. 19, p. 9160, Oct. 2021, doi: 10.3390/app11199160.
[36] D. A. G. Jáuregui, T. Giraud, B. Isableu, and J.-C. Martin, "Design and evaluation of postural interactions between users and a listening virtual agent during a simulated job interview," *Computer Animation and Virtual Worlds*, vol. 32, no. 6, May 2021, doi: 10.1002/cav.2029.
[37] H.-M. Chuang and D.-W. Cheng, "Conversational AI over military scenarios using intent detection and response generation," *Applied Sciences*, vol. 12, no. 5, p. 2494, Feb. 2022, doi: 10.3390/app12052494.
[38] J. A. Kumar, "Educational chatbots for project-based learning: Investigating learning outcomes for a team-based design course," *International Journal of Educational Technology in Higher Education*, vol. 18, no. 1, Dec. 2021, doi: 10.1186/s41239-021-00302-w.
[39] F. de Arriba-Pérez, S. Garc\'\ia-Méndez, F. J. González-Castaño, and E. Costa-Montenegro, "Evaluation of abstraction capabilities and detection of discomfort with a newscaster chatbot for entertaining elderly users," *Sensors*, vol. 21, no. 16, p. 5515, Aug. 2021, doi: 10.3390/s21165515.
[40] M. Hardalov, I. Koychev, and P. Nakov, "Machine reading comprehension for answer re-ranking in customer support chatbots," *Information (Switzerland)*, vol. 10, no. 3, p. 82, Feb. 2019, doi: 10.3390/info10030082.
[41] O. Octavany and A. Wicaksana, "Cleveree: An artificially intelligent web service for Jacob voice chatbot," *TELKOMNIKA (Telecommunication Computing Electronics and Control)*, vol. 18, no. 3, p. 1422, Jun. 2020, doi: 10.12928/telkomnika.v18i3.14791.
[42] A. Pradhan, A. Lazar, and L. Findlater, "Use of intelligent voice assistants by older adults with low technology use," *Association for Computing Machinery Transactions on Computer-Human Interaction*, vol. 27, no. 4, pp. 1–27, Aug. 2020, doi: 10.1145/3373759.
[43] D. Calvaresi *et al.*, "EREBOTS: Privacy-compliant agent-based platform for multi-scenario personalized health-assistant chatbots," *Electronics*, vol. 10, no. 6, p. 666, Mar. 2021, doi: 10.3390/electronics10060666.
[44] I.-C. Hsu and C.-C. Chang, "Integrating machine learning and open data into social Chatbot for filtering information rumor," *Journal of Ambient Intelligence and Humanized Computing*, vol. 12, no. 1, pp. 1023–1037, Jan. 2021, doi: 10.1007/s12652-020-02119-3.
[45] J. J. Bird, A. Ekárt, and D. R. Faria, "Chatbot interaction with artificial intelligence: Human data augmentation with T5 and language transformer ensemble for text classification," *Journal of Ambient Intelligence and Humanized Computing*, vol. 14, no. 4, pp. 3129–3144, Aug. 2021, doi: 10.1007/s12652-021-03439-8.
[46] E. Vázquez-Cano, S. Mengual-Andrés, and E. López-Meneses, "Chatbot to improve learning punctuation in Spanish and to enhance open and flexible learning environments," *International Journal of Educational Technology in Higher Education*, vol. 18, no. 1, Jun. 2021, doi: 10.1186/s41239-021-00269-8.
[47] X. Ren *et al.*, "CRSAL," *Association for Computing Machinery Transactions on Information Systems*, vol. 38, no. 4, pp. 1–40, Jun. 2020, doi: 10.1145/3394592.
[48] R. Matic, M. Kabiljo, M. Zivkovic, and M. Cabarkapa, "Extensible chatbot architecture using metamodels of natural language understanding," *Electronics (Switzerand)*, vol. 10, no. 18, p. 2300, Sep. 2021, doi: 10.3390/electronics10182300.
[49] L. Zhou, J. Gao, D. Li, and H.-Y. Shum, "The design and implementation of XiaoIce, an empathetic social chatbot," *Computational Linguistics*, vol. 46, no. 1, pp. 53–93, Mar. 2020, doi: 10.1162/coli_a_00368.
[50] S. Weiler, C. Matt, and T. Hess, "Immunizing with information – inoculation messages against conversational agents' response failures," *Electronic Markets*, vol. 32, no. 1, pp. 239–258, Mar. 2022, doi: 10.1007/s12525-021-00509-9.
[51] Y. Wu, W. Wu, C. Xing, C. Xu, Z. Li, and M. Zhou, "A sequential matching framework for multi-turn response selection in retrieval-based chatbots," *Computational Linguistics*, vol. 45, no. 1, pp. 163–197, Mar. 2019, doi: 10.1162/coli_a_00345.
[52] R. De Cicco, S. C. L. da C. e Silva, and F. R. Alparone, "'It's on its way': Chatbots applied for online food delivery services, social

or task-oriented interaction style?," *Journal of Foodservice Business Research*, vol. 24, no. 2, pp. 140–164, Mar. 2021, doi: 10.1080/15378020.2020.1826268.
[53] K.-L. Chen and M.-H. Tsai, "Conversation-based information delivery method for facility management," *Sensors*, vol. 21, no. 14, p. 4771, Jul. 2021, doi: 10.3390/s21144771.
[54] S. Cobos-Guzman, S. Nuere, L. De Miguel, and C. König, "Design of a virtual assistant to improve interaction between the audience and the presenter," *International Journal of Interactive Multimedia and Artificial Intelligence*, vol. 7, no. 2, p. 232, 2021, doi: 10.9781/ijimai.2021.08.017.
[55] S. Stieglitz, L. Hofeditz, F. Brünker, C. Ehnis, M. Mirbabaie, and B. Ross, "Design principles for conversational agents to support emergency management agencies," *International Journal of Information Management*, vol. 63, p. 102469, Apr. 2022, doi: 10.1016/j.ijinfomgt.2021.102469.
[56] L. Wang *et al.*, "CASS: Towards building a social-support chatbot for online health community," *Proceedings of the ACM on Human-Computer Interaction*, vol. 5, no. 1, pp. 1–31, Apr. 2021, doi: 10.1145/3449083.
[57] K. Katchapakirin, C. Anutariya, and T. Supnithi, "ScratchThAI: A conversation-based learning support framework for computational thinking development," *Education and Information Technologies*, vol. 27, no. 6, pp. 8533–8560, Mar. 2022, doi: 10.1007/s10639-021-10870-z.
[58] J. Chen, O. Agbodike, and L. Wang, "Memory-based deep neural attention (mDNA) for cognitive multi-turn response retrieval in task-oriented chatbots," *Applied Sciences*, vol. 10, no. 17, p. 5819, Aug. 2020, doi: 10.3390/app10175819.
[59] M. Zubani, L. Sigalini, I. Serina, L. Putelli, A. E. Gerevini, and M. Chiari, "A performance comparison of different cloud-based natural language understanding services for an Italian e-learning platform," *Future Internet*, vol. 14, no. 2, p. 62, Feb. 2022, doi: 10.3390/fi14020062.
[60] P. Helo and Y. Hao, "Artificial intelligence in operations management and supply chain management: An exploratory case study," *Production Planning and Control*, vol. 33, no. 16, pp. 1573–1590, Apr. 2021, doi: 10.1080/09537287.2021.1882690.
[61] A. A. Abdelhamid and S. R. Alotaibi, "Adaptive multi-agent smart academic advising framework," *IET Software*, vol. 15, no. 5, pp. 293–307, Apr. 2021, doi: 10.1049/sfw2.12021.
[62] A. G. Mirnig *et al.*, "Suppose your bus broke down and nobody came," *Personal and Ubiquitous Computing*, vol. 24, no. 6, pp. 797–812, Oct. 2020, doi: 10.1007/s00779-020-01454-8.
[63] E. Mogaji, J. Balakrishnan, A. C. Nwoba, and N. P. Nguyen, "Emerging-market consumers' interactions with banking chatbots," *Telematics and Informatics*, vol. 65, p. 101711, Dec. 2021, doi: 10.1016/j.tele.2021.101711.
[64] O. Budzinski, V. Noskova, and X. Zhang, "The brave new world of digital personal assistants: Benefits and challenges from an economic perspective," *NETNOMICS: Economic Research and Electronic Networking*, vol. 20, no. 2–3, pp. 177–194, Dec. 2019, doi: 10.1007/s11066-019-09133-4.
[65] F. Brachten, F. Brünker, N. R. J. Frick, B. Ross, and S. Stieglitz, "On the ability of virtual agents to decrease cognitive load: An experimental study," *Information Systems and e-Business Management*, vol. 18, no. 2, pp. 187–207, Jun. 2020, doi: 10.1007/s10257-020-00471-7.
[66] G. Ovando-Leon, L. Veas-Castillo, V. Gil-Costa, and M. Marin, "Bot-based emergency software applications for natural disaster situations," *Future Internet*, vol. 14, no. 3, p. 81, Mar. 2022, doi: 10.3390/fi14030081.
[67] D. A. Dhinagaran, T. Sathish, T. Kowatsch, K. Griva, J. D. Best, and L. T. Car, "Public perceptions of diabetes, healthy living, and conversational agents in Singapore: Needs assessment," *JMIR Formative Research*, vol. 5, no. 11, p. 30435, Nov. 2021, doi: 10.2196/30435.
[68] D. G. M. Schouten, A. A. Deneka, M. Theune, M. A. Neerincx, and A. H. M. Cremers, "An embodied conversational agent coach to support societal participation learning by low-literate users," *Universal Access in the Information Society*, Apr. 2022, doi: 10.1007/s10209-021-00865-5.
[69] D. Rooein, D. Bianchini, F. Leotta, M. Mecella, P. Paolini, and B. Pernici, "aCHAT-WF: Generating conversational agents for teaching business process models," *Software and Systems Modeling*, vol. 21, no. 3, pp. 891–914, Jun. 2022, doi: 10.1007/s10270-021-00925-7.
[70] J. D. Engel, V. J. L. Engel, and E. Mailoa, "Interaction monitoring model of logo counseling website for college students' healthy self-esteem," *International Journal of Evaluation and Research in Education ({IJERE})*, vol. 9, no. 3, p. 607, Sep. 2020, doi: 10.11591/ijere.v9i3.20525.
[71] D. C. Tran, D. L. Nguyen, and M. F. Hassan, "Development and testing of an FPT.AI - based voicebot," *Bulletin of Electrical Engineering and Informatics*, vol. 9, no. 6, pp. 2388–2395, Dec. 2020, doi: 10.11591/eei.v9i6.2620.
[72] CWTS, "CWTS - centre for science and technology studies - Leiden University," 2022. https://www.cwts.nl/ (accessed Jun. 14, 2022).

BIOGRAPHIES OF AUTHORS

Orlando Iparraguirre-Villanueva Systems Engineer with a master's degree in Information Technology Management, PhD in Systems Engineering from Universidad Nacional Federico Villarreal-Peru. ITIL® Foundation Certificate in IT Service, Specialization in Business Continuity Management, Scrum Fundamentals Certification (SFC). National and international speaker/panelist (Panama, Colombia, Ecuador, Venezuela, Mexico). Undergraduate and postgraduate lecturer in different universities in the country. Advisor and jury of thesis in different universities. Consultant in information technologies in public and private institutions. Specialist in software development, IoT, Business Intelligence, open-source software, Augmented Reality, Machine Learning, text mining and virtual environments. He can be contacted at email: oiparraguirre@ieee.org.

Luz Obregon-Palomino Graduated in Systems Engineering from the School of Engineering and Architecture, Universidad Autónoma del Perú. Scrum Fundamentals Certification (SFCE). She works at the National School of Professional Police Training. She is interested in research on Intelligence, Cybersecurity and Data Science. The author can be contacted through her official email address which is: lobregonp@autonoma.edu.pe.

Wilson Pujay-Iglesias Graduated in Systems Engineering from the Faculty of Engineering and Architecture, Universidad Autónoma del Perú. Scrum Fundamentals Certification (SCRUMstudy). Systems Analyst. Software Developer. He works in the Technological Development Unit at the Municipality of Villa el Sal-vador, His research interests include machine learning, IoT, E-learning, and Al-gorithms. He can be contacted at electrónico: wpujay@autonoma.edu.pe.

Fernando Sierra-Liñan Mg. Fernando Sierra-Liñan has a Bachelor's degree in Education, specializing in Science and Technology at USIL, a Master's degree in Edumatics and University Teaching at UTP, a Bachelor's degree in Systems Engineering and Computer Science at UTP, with a technical specialty in Computer Science and Computer Science. He is currently working as a researcher and thesis advisor in the faculty of Computer Engineering and Systems at the Universidad Privada del Norte, Lima - Peru. He has 20 years of teaching experience. His areas of interest are programming, database, and data analysis. E-mail: fernando.sierra@upn.edu.pe, pfsierra.D02052@gmail.com.

Michael Cabanillas-Carbonell Engineer and Master in Systems Engineering from the National University of Callao - Peru, PhD candidate in Systems Engineering and Telecommunications at the Polytechnic University of Madrid. President of the chapter of the Education Society IEEE-Peru. Conference Chair of the Engineering International Research Conference IEEE Peru EIRCON. Research Professor at Norbert Wiener University, Professor at Universidad Privada del Norte. Advisor and Jury of Engineering Thesis in different universities in Peru. International lecturer in Spain, United Kingdom, South Africa, Romania, Argentina, Chile, China. Specialization in Software Development, Artificial Intelligence, Machine Learning, Business Intelligence, Augmented Reality. Reviewer IEEE Peru and author of more than 25 scientific articles indexed in IEEE Xplore and Scopus. He can be contacted at mcabanillas@ieee.org.