WhatsApp-Based Cloud Service Chatbot Application for Emergencies or Disasters

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***Abstract*—Climate change and its effects have led to the presence of disruptive and dynamic climate events. Piura is geographically the most affected region of Peru by the El Niño phenomenon. The limited technological means of communication between the local authority and the community have generated decisions that are not very acceptable to the population. The purpose of the study was to develop a Chatbot focused on WhatsApp, ManyChat, and Google Sheets services to facilitate the referral and consultation of relevant information in emergency or disaster situations considering the particularities and limitations of the population of Piura, Peru. To achieve this objective, the following phrases were proposed: (1) defining and establishing the types of conversations using a logical, intuitive, and friendly approach; (2) designing and implementing the specific functionalities required by users to send and consult information through the Whatsapp platform service; and 3) evaluating and refining the Chatbot in terms of its effectiveness and acceptance during emergency or disaster situations. The results highlight the solution as a digital alternative that improves communication and coordination during emergency or disaster in Piura. The Chatbot optimizes incident management and provides efficient responses to users with acceptable levels of satisfaction.**

***Keywords*—population, emergency, disaster, alert system, chatbot**

I. Introduction

Peru has recurrently experienced extreme weather events and disasters. The El Niño Phenomenon (FEN) is one of the events that has wreaked havoc with great impact. Piura region witnessed the Coastal FEN in 2017. Its occurrence led to the destruction of homes, human losses, disruption of livelihoods, and the continuous interruption of basic services.

Nowadays, local governments must have effective and timely communication to help manage emergencies and coordinate efforts to provide an efficient response. However, the availability of reliable and accessible communication channels are challenges that limit the responsiveness of authorities and organizations to gather information that will enable them to provide assistance effectively. Given this reality, Piura requires modern technological means to strengthen disaster risk management and face contexts such as those mentioned before.

When a catastrophe occurs, the immediate acquisition and distribution of accurate information becomes essential as timely evacuation of the population is an effective measure to minimize the human impacts caused by a disaster [1]. The availability of up-to-date and reliable data enables authorities and response organizations to quickly assess the situation, identify the most affected areas, and make informed decisions to protect the lives of people at risk.

Current technologies such as Artificial Intelligence (AI) have deepened knowledge on a massive scale in areas such as health, education, security, commerce, and food, however, there are still gaps in the development of prospective proposals related to emergencies or disasters to improve communication and coordination management in the response phase. One of the alternatives to collaboration in this process is chatbots, which are characterized by being an AI-centric application designed to interact with users in a conversational manner that simulates a human conversation [2].

Currently, there are several available chatbots with different levels of sophistication, ranging from more advanced models, such as robots, holograms, or avatars, to simpler forms, such as chatterboxes. The latter allow the user to interact with an artificial intelligence using a written or typed language, while maintaining a fluid conversation through an interface that generates conversational parameters and natural responses. These advances in chatbot technology have made it possible to offer a wide range of solutions for different contexts and needs, which has boosted their use in various fields, including emergency and disaster management. The versatility and adaptability of these chatbots make them powerful tools for improving communication, coordination, and decision-making in critical situations [3].

The main challenges facing this type of conversational media are integration with systems and subsystems, personalization of the interaction environment, empathy

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according to the user's scenario or context, and how to measure the success of a chatbot. When we talk about integrating chatbots into systems and processes focused on a user's urgencies from a technical perspective, it is essential to ensure compatibility between existing software infrastructures and the chatbot architecture. This includes developing efficient and secure application programming interfaces for communication between the chatbot and other systems which can require careful software engineering and significant resources.

While the personalization of a chatbot must be able to adapt to individual user preferences and needs, we believe that successful personalization can significantly improve the user experience and usefulness of a chatbot in different contexts.

Another challenge is to design and develop chatbots with an empathetic approach that focuses on the user's priority needs. Establishing conversational communications in a peacetime scenario is not the same as in an emergency or disaster context. This shows that providing support services through chatbots requires a more careful path that involves and values the criticality of the user. These gaps can be overcome, or at least corrected by evaluation metrics, but we believe that measuring the success of a chatbot is not an easy task. Often, traditional metrics may not be sufficient to assess the usefulness and effectiveness of a chatbot, so it's essential to establish clear and specific metrics that align with solution goals and user expectations. These metrics can include query resolution rate, satisfaction, and user service efficiency.

If we ask ourselves why it is important to address these challenges, the answer would be to maximize their usefulness, ethics, and effectiveness in a variety of contexts where the user has greater opportunities to resolve their queries without obstacles or limitations that weaken the quality of service and user satisfaction.

In this context, the purpose of this study is to explore the development of a chatbot centered on the WhatsApp, ManyChat, and Google Sheets services as a technology model to address the above challenges. The integration of these services will make it possible to send and consult information in emergency or disaster situations, considering the specificities and limitations of the population of the city of Piura, Peru. The specific objectives are: (1) defining and establishing the types of conversations with a logical, intuitive, and friendly approach, (2) designing and implementing the specific functionalities that lead to the sharing and consultation of information through the WhatsApp, ManyChat and Google Sheets platforms, and (3) evaluating and refining the chatbot in terms of effectiveness, acceptance and satisfaction during the user interaction in emergency or disaster situations.

Achieving these goals will promote and consolidate emergency management-oriented systems and technology architectures, leading to highly efficient and secure results. These advances will result in rapid, coordinated, and comprehensive responses to extreme weather events.

Their relevance in the context of emergencies and disasters lies in their ability to facilitate the receipt of crucial information quickly and effectively. On the other hand, chatbots allow people to communicate in a simple and accessible way using natural language, which is especially important in crisis situations where speed and clarity in the data transition can make the difference between life and death. This technological tool plays a fundamental role as an alternative communication channel through which citizens can report risk situations, request help and access relevant information during emergencies or disasters, thus contributing to a more agile and coordinated response by authorities and response organizations [4].

In this context, the development of a chatbot using the WhatsApp platform is presented as an innovative solution to improve communication and response during emergency situations in Piura region. The implementation of this technology aims to fill the existing gaps in emergency management by allowing society to send relevant information before, during and after emergency or disaster events, according to their possibilities.

The objective of the project is to develop a chatbot focused on WhatsApp services that allows users to send and consult information in emergency or disaster situations, considering the specificities and limitations of the population of Piura city, Peru. The specific objectives are: (1) defining and establishing the types of conversations with a logical, intuitive, and friendly approach; (2) designing and implementing the specific functionalities that lead to the referral and consultation of information through the WhatsApp platform service; and (3) evaluating and refining the chatbot's effectiveness and acceptance in emergency or disaster situations. In this way, citizens and emergency management authorities will be able to communicate with each other, facilitating the transfer information about hazards, requests for assistance, and available resources. It is hoped that this research will contribute to strengthening emergency management systems in Piura, Peru, enabling a rapid, coordinated, and efficient response to extreme weather events.

II. Related Works

The growing popularity of mobile devices and conversational technology services, such as chatbots, has permeated people's daily lives. Chen *et al.* [5] describe that conversation-based systems are widely used to help users access the data they need in an intuitive way. He also points out that users rely on this type of system to relay information, which makes this type of solution a promising and stable direction for managing highly complex data due to its intuitive process of accessing and sending data.

Ghosh *et al.* [6] mentioned that the use of chatbots corresponds to a new era of modern technology. A chatbot system cannot replace a human agent, but it can provide initial support at any time. This kind of immediate support can efficiently help a victim during a disaster. It can also help reduce damage. Some alternative tools for developing a chatbot are Chatfuel and Dialogflow. These means lead to the creation of a programming interface system that uses intentions, entities, and text responses by implementing natural language processing systems, cloud storage, and

JSON. As a result, chatbots are becoming increasingly popular in society and have sparked heated debates in academia. To date, few studies have explored the applications of AI-powered mental health chatbots in the context of a disaster [7].

At the University of Shikoku, Japan, Ueno *et al*. [8] launched a plan to improve academic support for all students, especially those who need reasonable accommodations for their disabilities, so that they can spend their time in college meaningfully and with peace of mind. They proposed the use of an AI chatbot via LINE as a learning support plan in emergency situations such as COVID-19 and disasters. On the other hand, Boné *et al*. [9] designed DisBot, the first Portuguese-speaking chatbot that uses knowledge retrieved from social networks to support citizens and first responders in disaster situations to improve community resilience and decision-making. DisBot uses a state-of-the-art DIET (Dual Intent Entity Transformer) architecture to classify user intentions and makes use of various dialogue policies to manage user conversations and store relevant information to be used in subsequent dialogue turns. To generate responses, it uses real-world security knowledge and infers a dynamic knowledge graph that is dynamically updated in real time using a disaster-related knowledge extraction tool presented in previous work. Throughout its development iterations, DisBot has been validated by experts in the field, who have found it to be an asset in risk and disaster management.

Tsai *et al.* [10] developed a chatbot to improve the efficiency of government activation of mining safety procedures during natural disasters. Taiwan has a comprehensive government system for responding to frequent natural disasters. In this solution, a system framework for disaster-related information retrieval and immediate notifications was proposed to support the execution of mine safety procedures. The framework uses instant messaging applications as a user interface to search for information and send messages to announce the occurrence of disasters. The results indicate that it has demonstrated the feasibility of adopting novel techniques for decision-making and ensured improved efficiency and effectiveness in activating emergency and disaster procedures.

However, the planning and execution of disaster response operations are complex and multifaceted tasks that must be considered and coordinated with personnel and other resources while monitoring the unfolding event. Konstantoudakis *et al.* [11] implemented a chatbot to collect information from volunteers and citizens and a mission management module to coordinate it all. Many people face death every day due to serious medical emergencies; however, basic knowledge on how to handle with these situations could save several human lives. In order to prevent the deterioration of the victim's condition and to maintain their physical integrity, the goal of the study conducted by Ouerhani *et al.* [12] was to develop an intelligent ubiquitous healthcare-based chatbot to help victims or incident witnesses to correctly perform first aid in a medical emergency situation until help arrives. A person with no first aid knowledge could help a victim survive by providing the first aid suggested by the virtual assistant. This assistance makes ordinary people more confident in using technology to help in such events.

When a disaster occurs, early evacuation of residents is one of the most effective ways to reduce human damage. Therefore, it is essential to quickly gather and provide accurate information about the disaster. In the study by Ahmady and Uchida [13], a chatbot application was proposed as a complement to the Telegram platform interface. This chatbot provided emergency information to foreigners in Japan during disasters. Information provided by the app includes nearby evacuation points, such as evacuation centers and train stations, and real-time disaster information based on the user's current location. Users can also share disaster-related images through the proposed application. These images can be useful not only for people affected by the disaster but also for government agencies to better understand the current conditions and help them make informed decisions.

The review article by Ives *et al.* [14] on chatbots generally determines that current studies in this area of expertise provide positive or mixed evidence on the effectiveness, ease of use, and satisfaction of the conversational agents investigated. Also, Ghézela *et al.* [15] shows that it is possible to develop a ubiquitous intelligent chatbot for emergency case assistance based on Cloud Computing that assists the victims or witnesses of the incident to help prevent the deterioration of the subject's condition and maintain their physical integrity. he sentences does not flow smoothly

Shinde *et al.* [16] presented a Health Chatbot using Artificial Intelligence that can perform human-system interaction to solve basic queries about health parameters before consulting a doctor. The chatbot works from the information provided by the user, takes the keywords from the sentence, makes decisions to solve the user's query, and responds accordingly. The system allowed users to create their own profile to specify their symptoms, suggest doctors, and receive dose reminders. This chatbot can be used by normal humans in any kind of emergency where it can play the role of advising people about primary care before consulting a doctor, or sometimes it will function as a doctor for minor and short-term health problems like colds, headaches, etc., This chatbot will provide support to those in need who require urgent solutions.

In times of crisis, when many people experience insecurity, fear, and uncertainty, the government plays a key role in terms of civil protection and the distribution of vital information. However, in many cases, misleading or contradictory information is disseminated by different sources, which exacerbates the desperation of the local population and leads to erroneous decisions, which can worsen the situation. To address this problem, it seems reasonable to have a single system that is highly reliable and helps citizens gather high-quality information tailored to overcome the crisis.

Staegemann *et al.* [17] presented a conceptual approach that provides an interaction combining chatbots, robotic automation of processes, and data analytics for personalized delivery of important information. This measure not only ensures the highest possible degree of information quality and, thus, acceptance by the potential user base, but also enables rapid dissemination of new findings.

Zaman *et al.* [18] proposed a microservice-centric safe rescue architecture where integrates a geographic information system with a K-means clustering algorithm to identify flood-prone areas. Microservices include fleet management, cloud computing, and data security. The solution would be an excellent addition to a smart city, helping to mitigate the negative effects or disasters. This strategy could be applied to other natural disasters that require search and rescue. Effectively designing communication between components or services ensures that critical information is shared smoothly and securely, improving responsiveness in times of crisis. Protocol, security, error handling, and scalability issues are critical to ensuring that these systems operate reliably. Ultimately, well-planned and executed communication between components contributes significantly to a system's ability to save lives and minimize damage in disaster situations.

Also, Gorski *et al.* [19] explored an architectural view of integrated services and two flow modeling methods that allow modeling communication between systems and services at the message delivery level. Integration flows can be diverse and quite complex. However, we must try to make communication between systems or services as simple as possible. These types of methods are generic and not limited to a single technology or architecture. We believe that the design of the method for generating executable integration flows for messaging patterns also contributes to the interoperability of the tasks that may be required by a conversational agent to satisfy and supplement the information requested by a user according to an emergency or disaster scenario.

In the field of disaster management, some institutions have implemented chatbot-based solutions to support decision making. An example is Tsai *et al.* [20], who developed a chatbot for decisionmakers in water-related catastrophes. This chatbot gives users instant access to the relevant information needed for -making decisions. The effectiveness of the system was validated through a six-month field test, demonstrating its ability to deliver information effectively. Chan *et al.* [21] implemented a solution that allows decision makers in disaster situations to access static and real-time information directly in natural language. This solution was achieved by integrating semantic and temporal term types, which significantly improved the ability to analyze queries made by users. Taken together, these studies demonstrate the relevance and effectiveness of chatbots as management tools in emergency and disaster situations. These technology solutions help improve communication, coordination, and efficient response by providing accurate and timely information to users and empowering society to take appropriate action at critical moments. However, it is necessary to continue researching and developing new solutions to maximize the usefulness and effectiveness of chatbots in emergency and disaster management.

III. MATERIALS AND METHODS

A. Design of Conversation Types for the Chatbot

The conversational design of a chatbot is fundamental to providing an empathetic and acceptable experience for users. Key features include a logical, intuitive, and user-friendly approach. To this end, tasks such as the following are proposed: (1) conduct a detailed analysis of the needs and characteristics of Piura-Peru users in emergency or disaster situations; (2) design chatbot conversation flows in a logical manner, considering the sequence of interactions and the nature of the relevant information to be collected; (3) implement an intuitive and friendly user interface, considering the particularities and limitations of the population as well as the linguistic diversity and limited access to technology. This strategic approach not only seeks to optimize the chatbot's functionality but also to ensure that its interaction is accessible and understandable to all users in difficult moments.

B. Specific Functionalities for Referral and Consultation

The functionalities of a chatbot are essential for the user. Especially to know if the user is at ease during the information referral and consultation process. To ensure a good service, we proposed tasks that start with identifying the necessary functionalities for users to send and consult relevant information during emergency or disaster situations in Piura-Peru and develop the chatbot's ability to receive and process different types of information, such as incident reports, help requests, and status updates.

These functionalities are not only limited to receiving incident reports, help requests, and status updates but are also aimed at ensuring that the user feels comfortable and supported throughout the process. The key lies in the chatbot's ability to adapt and process different types of information in an agile manner, thus guaranteeing a comprehensive and effective service during critical situations in the region.

C. Evaluation and Refinement of the Chatbot

The evaluation and refinement of the chatbot consist of four phases: (1) conduct extensive testing to evaluate its functionality and performance in real emergency or disaster situations; (2) collect data on the effectiveness of the chatbot in receiving relevant information, speed of response, and coordination with authorities and response organizations in Piura-Peru; (3) evaluate the acceptance and satisfaction of users in relation to the chatbot usage experience by applying questionnaires, receiving feedback, and 4) identify areas for improvement and make necessary adjustments to the chatbot in order to ensure its effectiveness and acceptance in the context of Piura, Peru.

We believe this vision ensures that the chatbot evolves adaptively and continuously meets the changing needs of the community.

D. Chatbot Architecture for Emergencies or Disasters

In this architecture, WhatsApp is used as the main messaging platform for interacting with users, providing a familiar and accessible interface. ManyChat is used as a tool to design and configure the chatbot conversation flow, enabling intuitive and logical interaction. This service design and integration platform has a deep learning NLP engine that can capture natural language and answer questions in real time based on an organization's defined knowledge base. The algorithm that performs this task is Recurrent Neural Networks (RNN).

The choice of RNN is based on its ability to capture the sequence and time dependency of words and characters in text [22], which is essential for understanding the context and user intent in emergencies [23]. On this occasion, the dataset consisted of 1,500 records. The outputs are classified by determining the type of conversation or context, which can be an emergency, a request for information, or a normal conversation. Seventy 70% of the data was used for training and 30% for testing. The accuracy rate was 77.78%, precision 86.96%, and recall 74.07%.

The results are broken down based on True Positive (TP), True Negative (TN), False Positive (FP), and False Negative (FN) values. In the case of TP, 200 cases were recorded in which the algorithm accurately identified requests for help in emergency situations. On the other hand, TN accounts for 150 cases in which it got it right in recognizing that no help was required in non-emergency conversations. In contrast, FP refers to 30 cases in which it misidentified requests for help in non-emergency conversations. Finally, FN records 70 cases in which it failed to identify requests for help in emergency situations [24]. For a better visualization of the content, Fig. 1 illustrates the confusion matrix.

In short, users could ask any question related to their anticipated concerns and receive answers as if they were being asked by a live agent. In addition, ManyChat facilitates integration with services such as Google Sheets, which acts as a database for storing and managing relevant information about emergencies and disasters. Integration with existing services such as ChatGPT is also possible. This platform offers integration with over 2,000 enterprise tools.

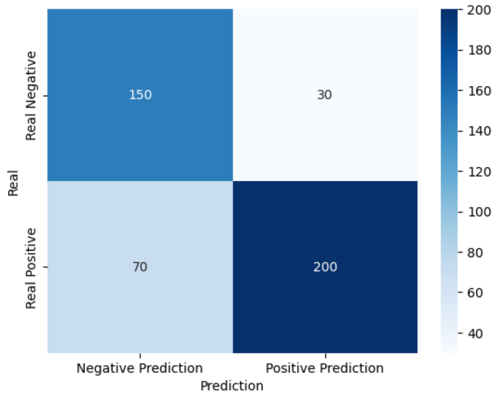

Fig. 1. Confusion matrix.

This integration allows information provided by users, such as incident reports or requests for help, to be collected and recorded in real time and in a structured manner in Google Sheets. The demand of users that may exist in front of the use of chatbot is not a limitation, because the services offered by WhatsApp Enterprise and ManyChat adopt employability features for large enterprises that can exceed one million users. In this case study, the Google Sheets service is used to generate automated and customized responses. These responses provide safety instructions, shelter locations, and real-time updates based on the specific situation. Economically, the solution requires the payment of a monthly subscription to ManyChat, which is a one-time payment that for the case study was $15.00. As for the WhatsApp Business API, it depends on the number of interactions you have monthly. For interactions that exceed 10,000 conversations, the cost is $0.0459. Fig. 2 represents the working architecture to be used.

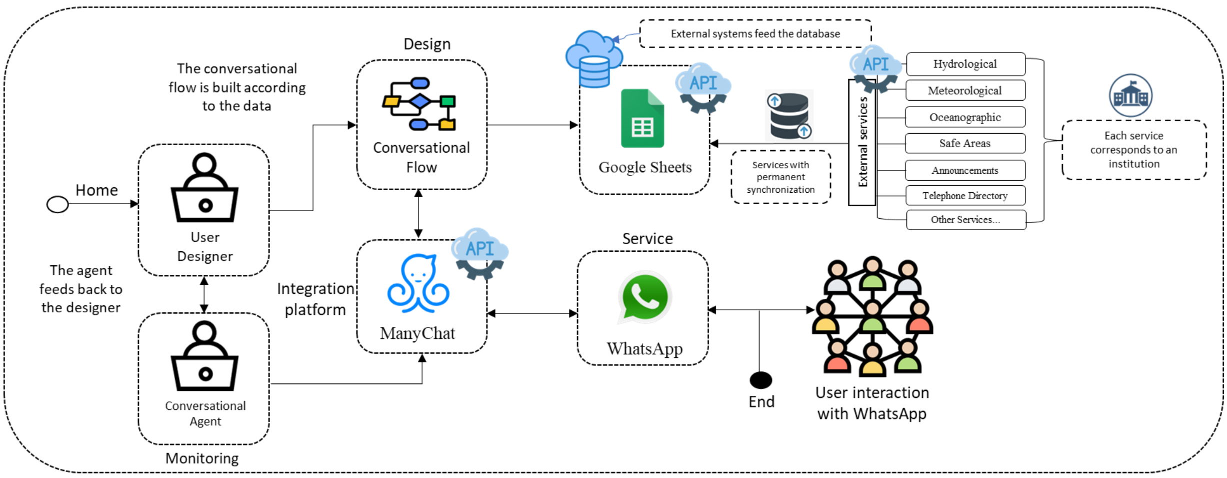

Fig. 2. Architecture of the chatbot solution.

This working architecture efficiently combines the capabilities of WhatsApp, ManyChat and Google Sheets, enabling the emergency or disaster chatbot to provide relevant and timely information, improve communication and coordination in critical situations, and facilitate decision making and appropriate response in times of emergency or disaster. On the other hand, the advantages of WhatsApp, ManyChat and Google Sheets platforms in the context of emergencies or disasters include their wide adoption and accessibility, intuitive interfaces, real-time interaction capabilities, integration with data management systems, and the ability to scale and customize the chatbot according to the needs of the situation. By implementing these procedures, the goal is to have a successful development with relevant information during emergency or disaster situations, thus improving communication and coordination [25].

IV. DESIGN AND CHARACTERIZATION OF CHATBOT

This section describes the conversational types, features, functionalities, and evaluation tools for user's use of the Chatbot.

A. *Types of Conversation with a Logical, Intuitive, and Friendly Approach*

In recent years, human beings have experienced different ways of receiving and consulting information. However, interactions must adopt logical principles with intuitive and friendly properties that allow the user to have a clear and secure understanding. Table I represents the analysis of the identification of needs and urgencies required by users in the city of Piura, Peru, in the event of emergencies or disasters.

After clarifying the user's needs, the next step is to design of the conversational flows between the chatbot and the citizen. In this case, the ManyChat platform was used, which allowed the charting of each of the services mentioned above. Fig. 3 represents a sample of what was characterized by this powerful service.

TABLE I. CONVERSATIONAL NEEDS FOR USERS

N	Service	Type of conversation	Action
1	Hydrology	Information by locality describing the level of the Piura River channel. Alert status of the Piura River according to locality. Alert status of streams (contributions to the Piura riverbed) according to locality.	Consult
2	Meteorology	Report by location describing the: 1) Ambient Temperature 2) Solar Radiation 3) Relative Humidity 4) Atmospheric Pressure 5) Rainfall Precipitation 6) Weather/Climate Forecasts	Consult
3	Oceanographic	Report by coastal location describing the: 1) Sea Surface Temperature 2) Sea Surface Temperature Anomaly 3) Sea Level	Consult
4	Notices	Information on official communications from technical-scientific entities and local governments.	Consult
5	Secure areas	Description of the safe zones in case of a Piura River overflow or earthquake according to the user's locality.	Consult
6	Formation	It provides guidelines on how a family or citizen should act or respond in the event of an emergency or disaster. This service can also be used by community groups or boards.	Consult
7	Telephone Directory	Contact information for specialists in emergencies or disasters. First response institutions as well as local government authorities.	Consult
8	Report emergency	The user submits information reporting an emergency event. This may describe properties such as life, materials, livelihood, and patrimony. It is also considered the report of power outages, falling trees, or lighting poles. Sewer collapse.	Submit information
9	Consult emergency report	The user consults the status of the reported emergency and the treatment provided by local authorities.	Consult

As part of the linguistic facility of the chatbot, we have considered welcoming and closing terms with empathic properties of cultural scope that adapt to the reality of the population of the city of Piura, Peru. The linguistic terms were considered according to the moment of interaction. They are described in the following Table II.

TABLE II. CONVERSATIONAL TERMS

N	Moment of interaction	Conversational terms
1	Key terms for conversation initiation	"hello", "good morning", "good day", "good afternoon", "good evening", "good night", "need information", "information", "help", "emergency", "relief", "support", "urgency", "death", "disaster", "collapse", "housing".
2	Conversational start	Welcome, I am the El Niño Chatbot, and my purpose is to provide you with information related to emergencies or disasters. I hope I can help you.
3	Conversational outcome	According to the service required by the user: Example: Dear citizen, if you wish to communicate with a person in charge of the Civil Defense or Disaster Risk Management office of any locality in the Province of Piura.
4	Conversational closure	Thank you for communicating with me through this medium. I hope I have helped you. Share the information you have received and help us so that more users are informed. We want to see you soon!

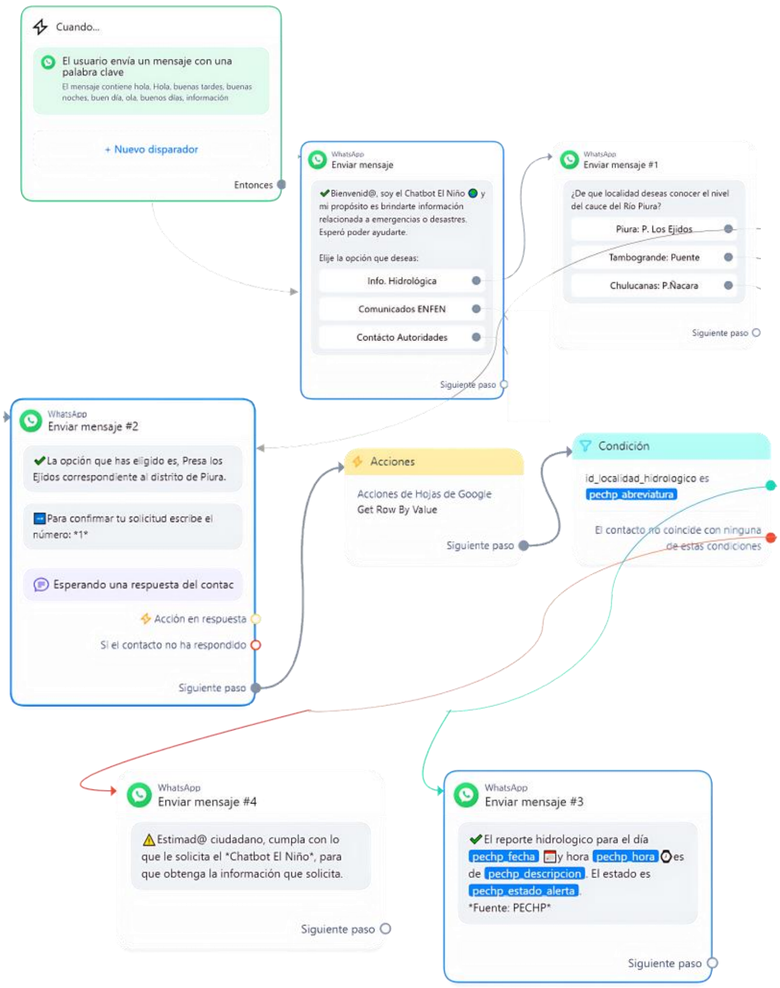

Fig. 3. Conversational flows through ManyChat.

B. *Graphical Functionalities for Information Referral and Consultation*

Graphical functionalities are one of the biggest advantages for users. It is well known that graphical elements are more accurate than textual ones due to their ambiguity. With this solution, we aim for an interaction that leads to ease of use and learning. In this sense, the solution adopts all the intuitive elements and components provided by the WhatsApp platform. The existence of icons and buttons helps users make better choices about the services they require. Fig. 4 illustrates the graphical elements considered.

After characterizing the elements and components that are integrated in the solution. Data processing is one of the main principles of the chatbot. This is because the information must be provided in a complete way at acceptable times so that users can be informed 24 h a day.

To achieve and provide consistent information, it has been required to use the services of Google Sheets. By creating spreadsheets that act as data storage sheets and that can be integrated with the ManyChat platform to send the information according to the user's request. In this case, a spreadsheet has been created for each service. Its appearance is described in Fig. 5.

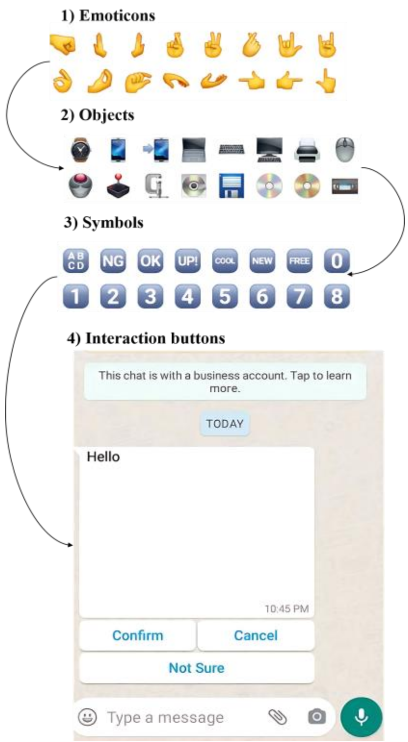

Fig. 4. Graphical interaction elements and components.

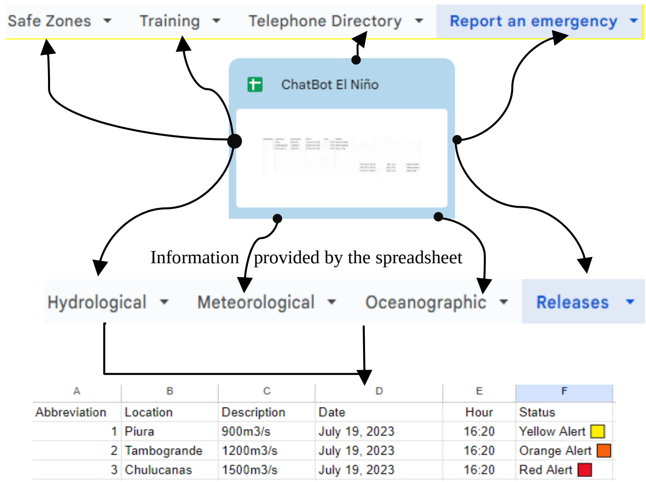

Fig. 5. Excel workbook storing spreadsheets of all services.

C. *Chatbot Evaluation and Refinement*

The chatbot evaluation was done in two phases. First, with users in a state of peace. That is, with users free to face an emergency or disaster. The second group of users simulated an emergency scenario in the event of a possible overflow of the Piura River. Both groups have a sample of 20 participants from the districts of Piura and Castilla.

The instruments used were a questionnaire and an observation form. Table III describes the 20 questions of the questionnaire that were applied to both groups of participants. The assessment was made using a 4-point Likert scale, so the score ranged from 0 to 4 points. Totally agree (4), agree (3), neither agree nor disagree (2), and disagree (1).

TABLE III. EVALUATION QUESTIONNAIRE

N	Evaluation indicator	Questions
1	Accuracy of the Chatbot's responses in relation to the forwarding of information and user queries.	1) Are you satisfied with the feedback you provide and the quality of the answers you get? 2) Would you recommend using the Chatbot to others? 3) Do you feel that the Chatbot has improved your experience getting information or solving problems? 4) Do you find that the Chatbot meets your expectations as a user? 5) Do you feel that the Chatbot is a valuable and useful tool for your information referral or inquiry needs?
2	Coherence and fluency of the language used by the Chatbot during the conversation.	6) Does the Chatbot use natural and understandable language? 7) Does the Chatbot adapt its communication style to your preferences or level of unfamiliarity? 8) Are the Chatbot's responses easy to understand and follow during the conversation? 9) Does the Chatbot avoid using technical or confusing terms in its responses? 10) Do you feel that the Chatbot maintains a smooth and consistent conversation?
3	Clarity and accessibility of the Chatbot navigation options.	11) Is the Chatbot interface easy to use and understand? 12) Does the Chatbot adequately guide you through the conversation and navigation? 13) Are the menu options and available actions clear and accessible? 14) Does the Chatbot provide intuitive interaction patterns? 15) Do you feel that the Chatbot facilitates a smooth and seamless interaction?
4	Level of satisfaction expressed by users regarding the overall experience of using the Chatbot.	16) Are you satisfied with the feedback you provide and the quality of the answers you get? 17) Would you recommend using the Chatbot to others? 18) Do you feel that the Chatbot has improved your experience getting information or solving problems? 19) Do you find that the Chatbot meets your expectations as a user? 20) Do you feel that the Chatbot is a valuable and useful tool for your information referral or inquiry needs?

TABLE IV. OBSERVATION SHEET FOR EVALUATION OF USE

Questions	Yes	Not
Does the Chatbot on WhatsApp provide agile and quick responses to the queries made?		
Does the Chatbot on WhatsApp send the requested information in a diligent and timely manner?		
Does the Chatbot on WhatsApp take time to respond or transmit the requested information?		
Is the time used to forward information by the chatbot acceptable?		
Does the Chatbot on WhatsApp provide the requested information efficiently?		
Has the navigation and accessibility of the WhatsApp Chatbot for users been straightforward?		
Does the solution present an intuitive and friendly interface to interact with?		
In less than two minutes, interact with the chatbot, forwarding and receiving information.		
Are the commands or keywords needed to interact with the chatbot simple and easy to remember?		
Does the messaging platform provide you with a smooth and user-friendly user experience to interact with the Chatbot?		

Table IV refers to the design of an observation sheet. Its application was focused on determining the learning process through the interaction of the chatbot. In this case, a sample of 20 participants participated on a voluntary basis.

V. RESULTS AND DISCUSSION

After having represented the technological architecture, the conversational characteristics, the functional criteria, and the digital strategies for sending and receiving information, this section describes the most relevant results regarding the performance of the solution. For the questionnaire mentioned in Table V, the SPSS (Statistical Package for the Social Sciences) tool was used to determine the degree of reliability through Cronbach's Alpha. The result was 0.812, which represents one of the highest levels of reliability [26], as shown in Table V.

TABLE V. RELIABILITY OF THE QUESTIONNAIRE INSTRUMENT

Reliability statistics		Level of reliability
Cronbach Alpha	N of elements	
812	20	Very good

The questionnaire was applied to the first group of users who interacted in a normal, peaceful context without the presence of an adverse event such as FEN. The results have been quantified as a percentage in Fig. 6, which shows the capacity for each of the indicators evaluated. The level of satisfaction of the users represents 28.45% as the highest value. While 21.29% describe the coherence and fluency during conversational moments. Another indicator that demonstrates the use is indicator number three, with 27.93%, related to the clarity and accessibility of the navigation options. This is a significant result that demonstrates the existence of adaptability and ease of use in terms of the choice of alternatives. Regarding the second indicator, accuracy of the information referral and queries, the result is centered on 22.33%.

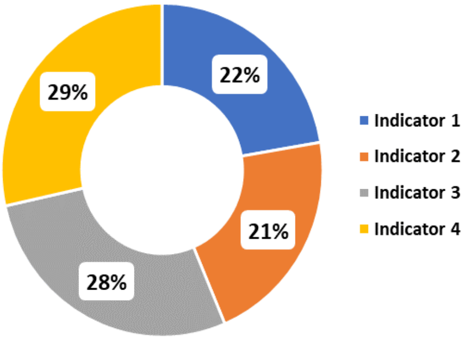

Fig. 6. Chatbot evaluation in a normal peace context.

The interaction of a user with the chatbot in an emergency or disaster context can be so disruptive and abstract. However, in the simulation aimed at 20 users in a Piura River overflow scenario, the results have been significant, with minimal variation in terms of its capabilities. In Fig. 7, the user satisfaction indicator, with 26.85%, leads the four indicators with the best result. While the indicator response accuracy in the issuance and consultation of information is 21.22%. This is due to the fact that in an emergency or disaster scenario, technical-scientific entities and local authorities depend on real time information updates. In this way, better results are expected in the future, especially in times of emergencies.

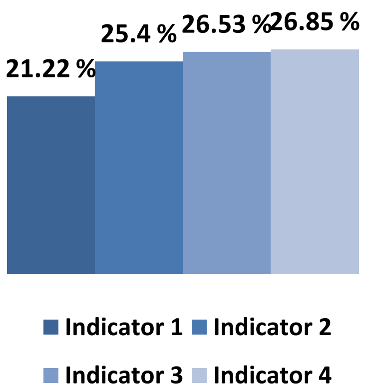

Fig. 7. Chatbot evaluation in an emergency context.

In the case of the observation guide instrument, referred to in Table IV, the KR-20 formula of Kuder Richardson was used to determine the reliability because the response alternatives are dichotomous. The reliability obtained was 0.89. This result is characterized as significant and has good reliability, according to what is specified in [27, 28]. Fig. 8 illustrates the observable behavior of the 20 participants. The highest value corresponds to question Q5, which emphasizes whether the chatbot provides the required information efficiently. While the minimum value is oriented to questions Q3, Q6, Q9, and Q10, these minimum values are remarkable because, in percentage terms, they correspond to 80% of compliance with the chatbot's functionalities and conversational tasks.

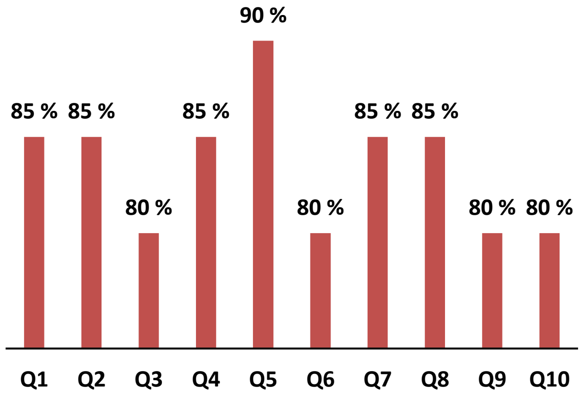

Fig. 8. Results of the observation guide instrument.

Fig. 9 shows some of the conversational interactions carried out by users requesting the forwarding of prospective communications that can guide the user in the event of an event such as the FEN.

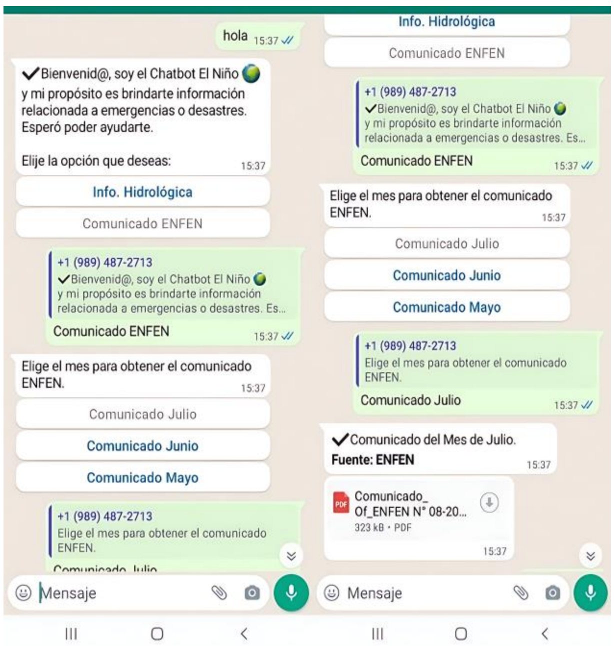

Fig. 9. Interaction with the chatbot from a mobile device.

On the other hand, the interactions executed were verified through mobile devices and accessed through WhatsApp Web. Where the solution adopts an equitable behavior in front of the use of a mobile device, computer, or laptop. Each user determines their preferred method of use according to their possibilities, contexts, and level of criticality. Therefore, Fig. 9 illustrates as an example a conversational fragment using the native language of the chatbot application locale, in this case Spanish, as in Fig. 10.

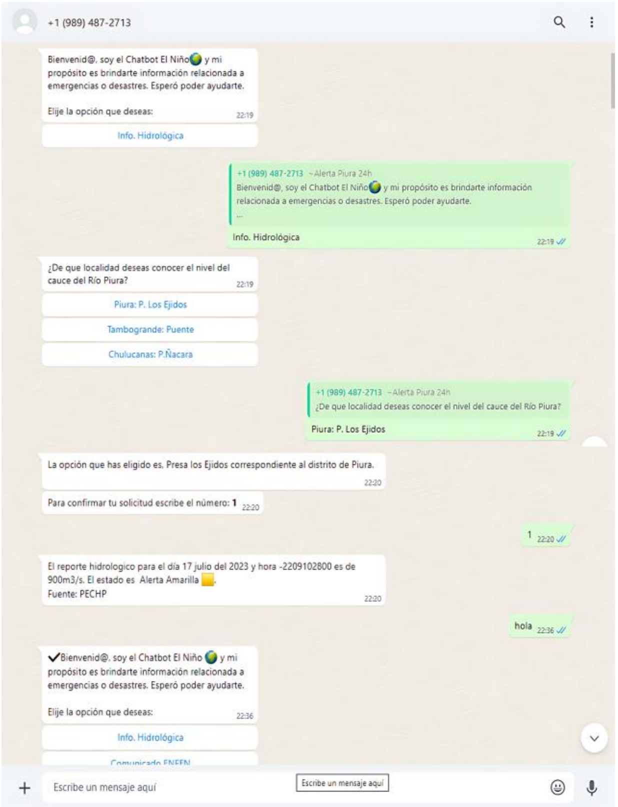

Fig. 10. Chatbot interaction from WhatsApp web platform.

VI. CONCLUSION

This study presents a chatbot to assist citizens that may be encountered before, during, and after an emergency or disaster situation. Also, keep authorities informed to have immediate information available for decision-making. The chatbot is intended to be the first stage of contact between citizens and technical-scientific institutions, support areas, and local governments. To ensure this type of task, the chatbot must have a database with permanently updated information to provide reliable and secure information at any time and place.

One of the salient criteria of the solution is to help participating users stimulate themselves and create resilience principles to create normalcy, affirm identity anchors, maintain, and utilize communication networks, operationalize alternative logic, and de-emphasize negative feelings and foreground positive emotions.

This emergency or disaster chatbot is valuable for governmental entities to help local citizens with questions about emergencies or disasters in an open manner. This solution can integrate multiple services and interconnect information with other institutions. The Chatbot is an amazing tool for human-machine conversation that leads to a quick reaction that infers with no delay and provides the right result for the citizen. It has been determined that the Chatbot is easy to use and can be used by any citizen who has access to the WhatsApp platform.

As a future direction of this research, it is proposed to promote and implement an early warning system for river and stream flooding. In this approach, the chatbot will use the existing service to automatically send alerts to a broad audience that includes users who have previously interacted with the system as well as those in an external directory. This enhancement extends the usefulness of the chatbot by proactively and efficiently addressing critical situations. We believe this action could be taken in close cooperation with the community, local authorities, and emergency management agencies to ensure effective integration into emergency response protocols.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Oscar Peña-Cáceres: Software, Methodology, Writing (original draft), Project Administration, and Funding Acquisition. Anthony Tavara-Ramos: Formal Analysis, Conceptualization, Methodology, and Writing (original draft). Teofilo Correa-Calle: Conceptualization, Research, Methodology, and Validation. Manuel More-More: Formal Analysis, Writing (review & editing); all authors had approved the final version.

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