Co-Design Disaster Management Chatbot with Indigenous Communities

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ABSTRACT

Indigenous communities are disproportionately impacted by rising disaster risk, climate change, and environmental degradation due to their close relationship with the environment and its resources. Unfortunately, gathering the necessary information or evidence to request or co-share sufficient funds can be challenging for indigenous people and their lands. This paper aims to co-design an AI-based chatbot with two tribes and investigate their perception and experience of using it in disaster reporting practices. The study was conducted in two stages. Firstly, we interviewed experienced first-line emergency managers and invited tribal members to an in-person design workshop. Secondly, based on qualitative analysis, we identified three themes of emergency communication, documentation, and user experience. Our findings support that indigenous communities favored the proposed *Emergency Reporter* chatbot solution. We further discussed how the proposed chatbot could empower the tribes in disaster management, preserve sovereignty, and seek support from other agencies.

Keywords

Native American, Emergency Management, Artificial intelligence, Conversational Agent, Human-Centered Computing

INTRODUCTION

Indigenous populations in the United States have faced significant challenges from both natural and man-made disasters. Over the last decade, more than 70 natural disasters have occurred on tribal lands, and some communities have experienced multiple disasters in a single year (Herrera 2019). The COVID-19 pandemic has also had a devastating impact on tribal communities, as they faced a lack of resources to combat the disease and provide effective support to those living on Indian reservations. As of mid-May 2020, American Indians accounted for 18 percent of COVID-19-related deaths and 11 percent of SARSCoV-2 cases in Arizona, compared to 4 percent of the total population. In New Mexico, they accounted for 57 percent of cases, compared to 9 percent of the total

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population, and in Wyoming, they accounted for 30 percent of cases, compared to 2 percent of the total population (Manson and Buchwald 2021; Artiga and Orgera 2021).

Insufficient funds from state and federal government entities make it challenging for indigenous people and their lands to gather necessary evidence of losses due to disasters, which would support their cause (Cordova 2022). The emergence of Artificial Intelligence (AI) and intelligent user interfaces offer opportunities to help tribes file for funds from agencies like FEMA (Federal Emergency Management Agency) with sufficient proof and documentation. We argue that AI-based chatbots can ease some of the difficulties faced by tribal citizens and emergency managers in documenting and reporting damages incurred through effective communication and real-time data storage. For instance, tribal nations can use the AI application to file a report without calling the emergency manager's phone and list what they lost during the disaster and their situation concerning repairs and restoration of damaged property. Moreover, emergency managers can store the same images and information obtained from the chatbot, using them to file reports and prioritize their work based on who needs immediate assistance and help.

As noted in a prior co-design project with an indigenous community (Harding et al. 2021), the primary focus is not on the technology solution, but rather on community engagement, with the co-design outcome determined by the tribal members. These findings inspired our study design, which seeks to define and redefine project goals and assess whether a chatbot is the most suitable solution for tribal disaster management. Specifically, this paper proposes to co-design an AI chatbot to investigate whether this solution would assist tribal people and emergency managers during, before, and after disasters. Two research questions guide our work: *1) Can an AI-based chatbot be co-designed to empower tribe members in natural disaster reporting? 2) What are the user perceptions and experiences of using the proposed AI-based chatbot in indigenous communities?* We adopt a participatory design method to co-design the chatbot with two Midwest tribes in the United States, which facilitates and streamlines the process of applying for FEMA and other grant funds by saving and sharing information related to cost, expense, time, and effort with emergency managers (Peters et al. 2018).

This paper describes two rounds of co-design stages. Firstly, we conducted semi-structured interviews with four emergency managers, including two who held official emergency manager positions in their respective tribes. We refined and improved the initial chatbot design based on the feedback received. Secondly, we presented the updated chatbot design at a design workshop at the University of Nebraska at Omaha (N=28). The proposed chatbot is named *Emergency Reporter*, an AI-based chatbot that allows users to report flood damage. The workshop was attended by tribal council members and regular members of two tribes in and around Nebraska. All participants were invited to test the proposed chatbot and join a group discussion to share their suggestions, concerns, and experiences. The co-design process yielded insights into the user perception and experience of our proposed chatbot.

We conducted a qualitative thematic analysis and identified three themes: emergency communication, documentation, and usability. Emergency managers were enthusiastic about the chatbot as it enables people to report damage directly through text and document everything with photos rather than calling and overwhelming their phone lines. They also highlighted that chatbots could efficiently facilitate two-way communication, particularly during and before disasters, to disseminate accurate information on weather, surrounding conditions, and alerts. At the workshop, tribal people recognized the value of using the chatbot to report an individual's or family's condition and their neighbor's well-being after a disaster. This information would allow emergency managers to know their current location and condition and prioritize immediate assistance and promptly share relevant information. The chatbot interaction could streamline documentation difficulties, enhancing and facilitating the fund acquisition and reimbursement process. We also gained insights into design implications based on feedback on usability and functionality.

The main contribution of this paper is three-fold. First, we introduced a co-design process that concentrates on information system design in Emergency Management, which is an important emerging research area in the ISCRAM community. Second, we conducted a design workshop in a real-world setting, inviting indigenous communities to discuss and refine the proposed design. This approach fosters the understanding of the implications of ICT for under-represented communities in emergency management and uncovers how technology can help remove barriers. Third, we presented our experience working with traditionally underrepresented communities and provided design implications for future AI-based solutions for tribal disaster management. These contributions enhance our understanding of how technology can support underrepresented communities in emergency management, emphasizing the importance of considering social and cultural contexts when designing ICT solutions.

BACKGROUND

Tribal Sovereignty and Emergency Management

Tribes maintain a government-to-government relationship with the United States Federal Government and have always been sovereign. Since the beginning, tribal nations have owned land and enjoyed their form of governance.

The United States has made treaties with separate tribes, as recognized in Cherokee Nation v. Georgia and Worcester v. Georgia. Chief Justice John Marshall wrote concerning treaties made by the Cherokee Nation that it was "*explicitly recognizing the national character of the Cherokees and their right to self-government, thus guarantying their lands. . .* "[1] He further clarified that "*The Indian nations had always been considered as distinct, independent political communities retaining their original natural rights as undisputed possessors of the soil, from time immemorial. . .* " In the Worcester case, a state infringed upon the rights of a Tribal nation to govern itself and to impose upon the Tribe's land. The ruling declared the Tribe to be a distinct community, occupying its territory and having boundaries laid out. It also stated that state laws where the Tribe occupied land could have no authority. Therefore, the honor of working with Tribes goes to the Federal Government. Article I, Section 8 of the Constitution explicitly states that "*Congress shall have Power. . . To regulate Commerce with foreign Nations, and among the several States, and the Indian Tribes.*"

The current era of Federal Indian Policy is focused on *Self-Determination* and a *Government-to-Government relationship* between Tribal Nations and the Federal Government. Under this policy, most tribal governance is carried out through 638 Contracting, which allows Tribes to receive funding for Courts, and then set up their own Courthouses, Judges, and other legal infrastructure. However, this policy diverges when it comes to declaring disasters and receiving funds from FEMA. Historically, Tribes have had to go through the states where they have land to receive funding after a disaster event. In response to Hurricane Sandy in 2012, the Federal Government started the Pilot Program, which allowed Tribes to declare a disaster and directly petition for Federal Disaster funds and assistance. However, this process was not without its challenges. The Tribal Chief Executive is required to declare a disaster after an event, and then the Tribe must contact the local FEMA office to initiate the disaster declaration process (FEMA 2023). At that time, the Tribe's Emergency Plan should be activated, which details the Tribe's response in the event of a disaster, including the assistance it can provide and other agencies it can call upon for support. The Emergency Plan instructs on the four phases of a disaster: Mitigation, Preparedness, Response, and Recovery. Mitigation Plans are also created to help Tribes (and other governments) understand the hazards and risks in their area and develop ways to reduce or mitigate the impacts of those hazards or risks, especially in the case of a disaster.

Presently, there are 574 Federally Recognized Indian tribes in the United States, which refers to tribes that have made treaties and have a political status and relationship with the Federal Government [2]. Each is interested in retaining sovereignty, rights over land, and protecting their people. In addition to these overarching principles are the day-to-day activities of government, such as protection, law enforcement, healthcare, infrastructure, and education responsibilities. Emergency Operations Plans and Mitigation Plans are mandatory for FEMA disaster declarations. However, Tribes face challenges in obtaining and maintaining these plans, which can be costly and time-consuming. An Initial Damage Assessment is also necessary to determine the extent of the damages incurred, which can be difficult to conduct due to limited resources and the time it takes to gather data and travel to affected areas. This is followed by a Joint Preliminary Damage Assessment by FEMA, which can be challenging for tribes with limited funds and technology. As a result, many Tribes rely on state declarations and may not declare disasters themselves, which can impact their ability to receive FEMA funds. Additionally, managing expenses, paying a minimum of 10% of damages, and tracking in-kind payments remain barriers for Tribal Governments. Therefore, it is crucial for FEMA, the government, and individuals to understand tribal governance, sovereignty, and how to work with tribal communities during all phases of disasters to minimize risks and vulnerabilities.

Co-Designing an AI-based Chatbot for Tribal Emergency Management

Disaster and emergency management in indigenous communities require a unique approach that takes into account their distinct ways of coping and recovering from disasters. In the United States, leaders need to improve emergency operations to better serve tribal populations and integrate their unique cultural and social constructs (Barnosky et al. 2022). The role of ethnicity and race cannot be ignored when developing effective disaster response plans for indigenous communities. Studies suggest that disadvantaged groups are more likely to accept decisions made by individuals who share their demographic traits (Lucero et al. 2022). While AI and cloud computing offer new possibilities for designing solutions for indigenous populations, ethical considerations in technology design must be considered to ensure their acceptance and benefit. Incorporating indigenous knowledge systems into discussions around AI and society can lead to alternative approaches that address the unique challenges faced by these communities (Lewis et al. 2020).

The current body of literature on applying ethical principles to technology design for disaster recovery and management is insufficient. Culturally sensitive research incorporates the historical context and cultural experiences,

[1] See Cherokee Nation v. Georgia, 30 U.S. (5 Pet.) 1 (1831) and Worcester v. Georgia, 31 U.S. 515 (1832) at 516, respectively
[2] 87 FR 4636 (Jan. 28, 2022)

norms, values, beliefs, and behaviors of a distinct ethnic or cultural group into its design and implementation (Burnette et al. 2014). A few studies have utilized culturally sensitive approaches while conducting research with indigenous communities, with some exceptions such as co-designing health programs, technical documentation, and indigenous museums (Harding et al. 2021; Kelly and Taffe 2022; Gonzales et al. 2022). Research conducted in tribal settings could be detrimental to indigenous communities, as researchers could approach it from the perspective of European colonization (Gilbert et al. 2021). Hence, there is a pressing need to be more culturally humble and learn from indigenous tribes' epistemology. In the academic literature, research ethics as a development framework for collaborating with indigenous populations remains an ongoing topic of discussion. Review boards at universities do not sufficiently incorporate all protectionist values while researchers work with indigenous populations. One study states that tribal people have the right to self-determination in all aspects of their lives, including the establishment of research ethics protocols (Hayward et al. 2021).

Studies have shown that including a member from an indigenous community as a co-participant in the research team can improve the overall research initiative by understanding and applying indigenous knowledge sharing and practices, making it more representative of tribal culture and way of doing things (Peters et al. 2018). Instead of data collection and argument, research proceeds can focus on storytelling and reflection to acknowledge local epistemologies in HCI research and prioritize harmony and humanness as primary values guiding community-based interactions (Ostashewski et al. 2020). Co-designing a solution with indigenous people can be a useful mechanism not only to include tribal knowledge sharing but also to make them feel ownership of the work they are doing and see the benefits they can produce for their own community. Co-design approaches place end-user value at their core, with implementation and broader dissemination part of their design from inception (Parsons et al. 2016). However, information dissimilarities may arise when indigenous people have a knowledge mismatch with researchers on a topic. To overcome this misunderstanding, research team members can unlearn from Eurocentric epistemology and re-learn tribal ontological ways of thinking to become embedded participants in relational and collaborative research. Additionally, research ethics frameworks need to be established that prioritize the right of tribal people to self-determination, including the establishment of research ethics protocols (Hayward et al. 2021).

In terms of the broader implications for HCI research, there are only a few studies available that can help us understand how to align the design field with indigenous knowledge-sharing practices and design epistemology. One study suggests that successful intercultural HCI design requires a departure from the typical design process and should take into account different mentalities, thought patterns, and problem-solving strategies that are anchored in different cultures. This includes considering attitudes towards authority or social etiquette that may differ across cultures (Abdelnour-Nocera et al. 2013). Tribal culture and ways of thinking will continue to play a role in shaping how HCI research is conducted in indigenous settings in the years to come. Co-design will also be an essential part of any research design initiative. While previous research has acknowledged the importance of incorporating the values of indigenous communities, there are limited examples of holistic co-design products and processes that involve the target users, particularly in emergency management.

METHODOLOGY

Study Design and Participant Recruitment

In order to address the research questions, we utilized a participatory design approach to collaboratively design an AI-based smart chatbot with the local indigenous communities. Participatory design approaches aim to establish a more equitable partnership between users and designers during the design process (Simonsen and Robertson 2013). While designers and researchers still lead the design process, stakeholders and target users are invited to participate as equal partners. We adopted the participatory design process to co-design the proposed chatbot, allowing stakeholders to not only participate in the design but also maintain control and leadership over the process (Peters et al. 2018).

The co-designed chatbot was created with the aim of assisting tribal members in reporting natural disaster damage to FEMA. A conversational-based design was chosen over traditional WIMP (Windows, Icons, Menus, and Pointers) interfaces because it offers several advantages (Luger and Sellen 2016). The conversational interface is a natural and familiar way for users to interact with the system, improving its usability and updating the user's mental model of the system. This interface design is flexible like a dialogue (Traum 2017) and can accommodate diverse user requests without requiring users to follow a fixed path, such as controllable interfaces (Tsai and Brusilovsky 2020). Additionally, the design can be augmented by a personified persona, using anthropomorphic features to attract user attention and gain user trust (Sproull et al. 1996). The chatbot was implemented and hosted using *Google Dialogflow*, a platform that supports both web and voice interfaces, allowing users to interact with the chatbot through web browsers or dialing a phone gateway [3].

(a) Chatbot Screenshot **(b) Sample Conversation**

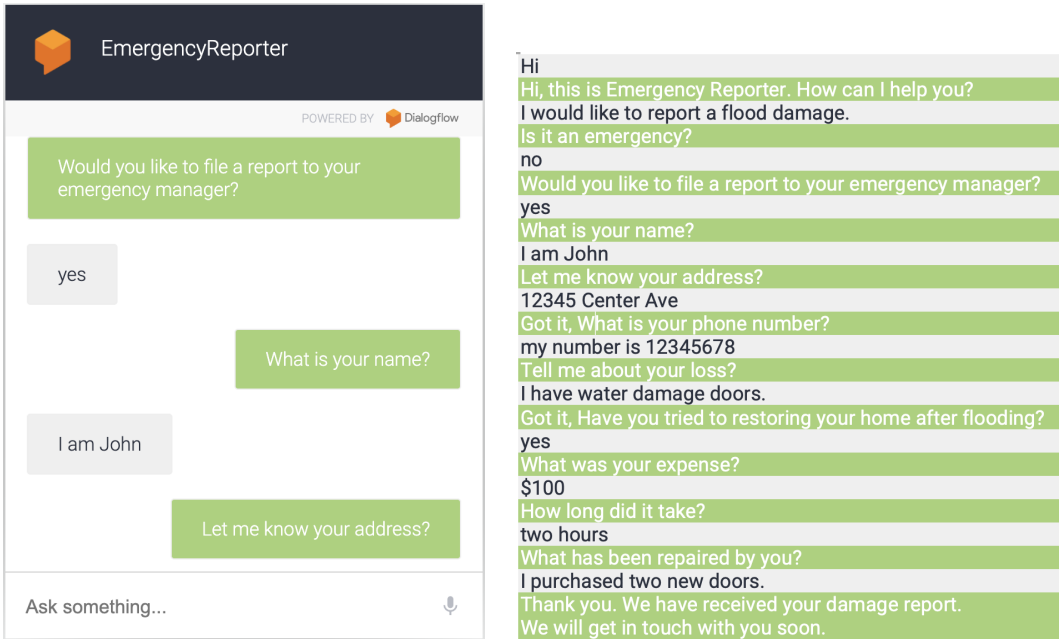

Figure 1. (a) Screenshot of *Emergency Reporter* and (b) a sample conversation showing how tribal members could file a flood damage report to their emergency managers. The user inputs were labeled in grey and the agent responses were highlighted in green.

This is Tribal Emergency Reporting Dashboard, we have 29 reports now.

ID	Name	Phone	▲ Address	Situation	Labor	Cost	Repair	Score	Int.	Time	Form
webdemo-d9d48b7c-715a-33a4-585c-76a9735f80df	my name is Jack	402123456	my address is 123 centre ave	the front door was broken	2 hours	100 dollar	thank you	0.10	14	2022-11-15 13:26:57	PDF
webdemo-2c2c312c-6368-88c9-e4d8-5ba09747e39f	Jack	402123456	412233 centree ave	my front door was broken also the windows	2 hours	100 dollar	thank you	0.12	13	2022-11-15 13:35:33	PDF
webdemo-7cd96ef8-2feb-cf2b-64b3-337a05f084b9	my name is john	523524542	omaha	water all over my house				-0.03	9	2022-11-15 17:07:41	PDF
webdemo-db13c118-23f5-7ab7-604d-02f1d43a6db4	john	124134425	377 centre ave	my house was water all over the place....	2 hours	$500	I tried remove the water myself...	0.03	20	2022-11-15 17:14:10	PDF

Figure 2. All submitted flood reports were stored in the database and could be presented in a table-style dashboard.

Our study consisted of two stages. In the first stage, we invited four first-line tribal emergency managers to gain an understanding of their duties and receive their reflections on the proposed chatbot design. The emergency managers' responsibilities include providing information to the tribes they serve and communicating about threats, hazards, and associated risks or losses in their area (Combs 2021). All four participants had at least one year of experience in coordinating tribal emergency business, such as setting up plans and procedures for responding to natural disasters and other emergencies for local tribes. The aim of this stage was to co-design a disaster management chatbot through semi-structured interviews. During the interviews, a generic version of the chatbot was presented, which could engage in basic conversations such as "*What is FEMA?*", "*My house was damaged, what can I do?*", etc. All the responses were retrieved from the FEMA website [4]. The chatbot was used to demonstrate how it could be used in emergency management and to elicit feedback from the participants. All interviews were conducted virtually through Zoom and lasted for approximately 1 hour.

After receiving feedback from stage 1, we proposed *Emergency Reporter*, an AI-based chatbot that allows users to report flood damage (as shown in Figure 1(a)). We chose the flooding scenario because it is the most common natural disaster that occurs in the tribes (as identified by the stage 1 participants). Figure 1(b) presents a sample

[3]https://cloud.google.com/dialogflow/docs
[4]https://www.fema.gov/

Table 1. Participants Demographic Information

Code	Gender	Race	Education Level
P1-1	Male	Native American	
P1-2	Male	Native American	Graduate
P1-3	Male	Native American	Undergraduate
P1-4	Male	Hispanic/ Latino	
P2-1	Female	Native American	Doctoral
P2-2	Male	Native American	Graduate
P2-3	Female	Native American	Graduate
P2-4	Female	Native American	
P2-5	Male	Native American	
P2-6	Male	Native American	
P2-7	Male	Native American	Doctoral
P2-8	Male	Asian	Doctoral
P2-9	Female	Native American	Juris Doctorate
P2-10	Female	Native American	
P2-11	Male	White	Doctoral
P2-12	Male		Graduate

Code	Gender	Race	Education Level
P2-13	Male	Native American	Undergraduate
P2-14	Female	Native American	Doctoral
P2-15	Male		Graduate
P2-16	Male	White	Doctoral
P2-17	Male	White	Doctoral
P2-18	Male	Native American	Undergraduate
P2-19	Female	Native American	Undergraduate
P2-20	Male	Native American	Undergraduate
P2-21	Male		Undergraduate
P2-22	Male		Undergraduate
P2-23	Male		Undergraduate
P2-24	Male	Asian	Undergraduate
P2-25	Female	Native American	
P2-26	Male	Native American	
P2-27		Native American	
P2-28	Male	White	Doctoral

conversation that demonstrates how a tribal member could use the chatbot to report flood damage. All user inputs are stored in a back-end database for later use or query. Figure 2 illustrates how the submitted reports could be stored and presented to the emergency managers. The proposed system will be used and demonstrated in the next stage.

During the second stage, we invited two indigenous communities based in Nebraska - the Ponca Tribe of Nebraska and the Omaha Tribe of Nebraska - to participate in a design workshop where we gathered their feedback and experience using the proposed system, as well as design implications. A total of 28 participants joined the design workshop, which was part of a full-day conference hosted by the Tribal Management and Emergency Services Program at the University of Nebraska at Omaha. The conference aimed to investigate the technical challenges faced by tribal members when communicating with FEMA for disaster resource applications and funding allocation. We reserved a slot in the conference to invite all attendees to our one-hour design workshop. During the workshop, two authors of the paper presented the idea of using an AI chatbot for nature disaster reporting (approximately 15 minutes). We then introduced our proposed chatbot (Figure 1 and 2) and invited all attendees to use and test the chatbot on their personal devices, such as laptops or cellphones (about 15 minutes). We encouraged them to submit a flood damage report. After the presentation and hands-on session, we joined as a group to discuss and share the experience of using the proposed app (about 30 minutes).

Data Collection and Analysis

Qualitative data were gathered from one-on-one semi-structured interviews in stage 1 and a group discussion in stage 2. An inductive, qualitative thematic analysis was utilized to open-code the transcribed recordings of the semi-structured interviews, identifying emergent themes (Braun and Clarke 2006). Three authors of this paper then discussed and iterated on these themes to develop key and high-level themes related to chatbot design, emergency management, and user experience, primarily from the design workshop with the indigenous participants. After data collection, each researcher read the dataset to obtain an initial understanding of its content. Frequent meetings were held during the first two weeks (once every three or four days) to discuss impressions of the dataset and what was learned from the co-design process. Initial codes were developed for all transcripts, and in the findings section, stages 1 & 2 data were reported together since many responses were related, although stage 1 participants had not yet interacted with the completed chatbot version. Moreover, three out of four stage 1 participants attended the stage 2 workshop.

Privacy, Ethics, and Disclosure.

During the preparation and conduct of the study, we were mindful of the ethical sensitivity involved when working with vulnerable populations. Two of the authors of this paper are American Indian and have personal connections to the local emergency managers and tribal members. We relied on their referrals to recruit participants for the study. Demographic data for all participants are presented in Table 1. As the race and education level data is collected on a voluntary basis, some data may be missing. Before recruitment, we obtained approval from the human subjects research review board. To protect participants' privacy, all identifiable personal information was removed.

FINDINGS

In this section, we present our findings on the implementation of an AI chatbot in the tribal emergency management practice of indigenous communities. We report three thematic themes and design implications resulting from the co-design process with the indigenous communities.

Theme 1: Emergency Communication

Our findings suggest that the proposed chatbot can facilitate emergency communication between tribal members and their local emergency managers. Prior to a disaster, the chatbot could be used to keep tribal members informed, reducing communication costs, especially during and after a disaster.

> **P1-1:** "*I need about six of me to make that process easy. Okay, communication would probably be, seems to be the hardest part, because in the phone or my phone's always ringing. It's Councils calling me basically You know it's It's communication, communication is always going to be an issue...(For example,) Hey, I have damage. I'm going to need some resources. This is the resources I need. Instead of making four or five phone calls, it just sends it to them, and then resource can start coming.*"

> **P1-2:** "*Yeah, I mean, I could see some people expecting damages trying to like, you know. Okay, we're gonna have damages. What do I need to be aware of after the storm? Um! I can see people uh during the storm. Who do I call to get help? And then, of course, afterward, everybody trying to file plans and get cleaned up. Okay, Yeah, It seems like they need a different kind of information.*"

P1-1 stated the importance of sharing accurate information through the chatbot from the emergency manager and department to the public before a disaster, such as weather alerts. Both P1-1 and P1-2 expressed that using the chatbot to report damage and provide updates during and after a disaster would be beneficial to alleviate the issue of multiple people calling the emergency manager's cell phone at once. P1-2 suggested that allowing people to share images during and after an emergency would enable the emergency manager to quickly locate the damage and people's whereabouts. Additionally, P1-2 emphasized the importance of keeping people informed through the chatbot before a disaster strikes, to ensure prompt reporting of damage and preparedness.

> **P2-28:** "*...maybe (adding) a question about how their neighbors are looking. Like if this situation whether they can see whether then the neighbors are in similar kind of as similar situation and maybe the other people on the block if they are able to assist there. Just to kind of expand the reach beyond that individual household even just to the people either side it might just help get a better picture of how the whole community is looking.*"

P2-28, a faculty member and participant in the design workshop, suggested adding a question to inquire about the status of neighbors to users. This would allow emergency managers to better assess the situation and get a comprehensive understanding of how the entire community is doing, potentially preventing anyone from being overlooked and in need of immediate assistance.

> **P2-18:** "*Yeah, it is more efficient than having someone on the call like talk to another person that they can give us all the information right away through text*"

During the workshop, P2-18, an undergraduate student and member of the Omaha tribe, commented on the demo and suggested that it would be more efficient to send all information to the emergency manager via text rather than calling during times of disaster when phone lines may be flooded. A tribal council member also suggested that in addition to floods and tornadoes, the chatbot should include other emergency situations such as blizzards, ice storms, fire, and windstorms, as many people may not know what to do in those situations, making the chatbot a helpful resource for the public.

Theme 2: Documentation and Cost-sharing

Several participants highlighted the chatbot's potential to collect and store critical information from tribal members, including damage reports, financial assistance, and cost-sharing. For example, P1-1, who serves as the tribal emergency manager for the Omaha tribe and was also interviewed for the study, suggested that allowing users to share images of the damage to their property, such as lawns, porches, kitchens, balconies, and yards, would aid in documentation. This documentation could prove useful in situations where the tribe files for cost-sharing or seeks assistance from FEMA or other federal or state emergency agencies, as it would help meet threshold requirements.

> **P1-1:** "*If we didn't document, it didn't happen.... You gotta write things down. Okay. I went to someone to his house at midnight, and I left there at one o'clock that way if you wanted to get um what they call, and administration fees the reimburse your time tracking your time to all It's There's a lot of documentation being document like I said it, it happened*"

P1-1 further suggested that the chatbot could help document the time it takes to complete tasks, such as driving around a community to assess damage or helping a community member restore their property and remove fallen trees. By tracking these activities through the chatbot, it would be easier to keep a record of everything that has been done, which could then be used to submit relevant documents and proofs to FEMA and other emergency funds grant bodies.

> **P1-2:** "*I was in Brown County, and the State of Kansas was looking for flood damage to reach a threshold, and um they couldn't do it without some of the damage that occurred on the reservation. So we went ahead and documented that damage and sent it along with the rest of the county's report... They need to wait until you send the data to them so they can declare an emergency.*"

P1-2 explained that their tribe filed for funds with the state of Kansas through Brown County after documenting the damage on the reservation, which helped them reach the threshold for requesting funds from the state. The chatbot could assist with documentation in this case as well, including documenting the time spent working on the damage, any expenses incurred, and the number of people who worked on it, for cost-share reporting purposes. It is typically difficult to track these details since tribal members may not organize to keep track of their contributions. An interactive system like a chatbot could improve accessibility, enabling stakeholders to report their efforts promptly. P2-7 suggested that the chatbot could be valuable in documenting everything people do, particularly for cost-share purposes, as there is an in-kind cost share that people can contribute to.

> **P2-7:** "*One of the things that I think this can would be of value, I think you heard Larry Wright talking about documenting everything that people do. The reason why that's important is that we mentioned cost share and there is an in-kind cost share that we can contribute to that so if the damage is a million dollars, the tribe will only get reimbursed up to 75%.* "

During the design workshop, P2-7, a judge in the tribal court of Omaha, provided an important insight regarding the chatbot. He emphasized the value of documenting everything people do during, before, and after a disaster, stating that better documentation could help with cost sharing and in-kind contributions towards filing reports to organizations such as FEMA for funds. As FEMA only covers 75 percent of the total loss incurred by the tribe, better documentation could maintain tribal sovereignty and governance.

> **P2-8:** "*I think the idea for the extended function notice from this technology would be automatic documentation because when you are handling those emergency situations you can't really ask them to type things or have a sheet of paper there to write up how much and how many hours they spent their material to use if we could have the type of app version of this technology this chatbot or whatever to help them automatically translate to their natural language into the database record what information they have there I think would be very efficient and collect tons of information for the final cost share documentation or whatever could be used for the final reporting.* "

P2-8 suggested an interesting feature that could be added to the chatbot which is automatic documentation. During emergency situations, it can be difficult for people to take notes or jot things down. Technology like a chatbot could be helpful in automatically documenting and translating the information into their natural language and a database record. This would be an efficient way to collect a lot of information for the final cost share documentation or for final reporting. P2-8 suggested that if there could be an app version of this AI technology, then the chatbot could help people automatically translate their voice into natural language and store the information in the database. This would be a more efficient way to collect information for cost share documentation or final reporting.

Theme 3: Chatbot Adoption and User Experience

In this section, we report on the user experience and expectations regarding the use of chatbots for reporting natural disaster damage in the practice of first-line emergency managers and tribes. Overall, the participants expressed optimism about the chatbot design and would like to see more use cases added, such as blizzards, ice storms, fire, and windstorms, to provide more options to people. The members of the two tribes invited expressed a willingness to continue the co-design process in the future. For example, P1-1 suggested designing a chatbot that is usable for tribal members with diverse backgrounds.

> **P1-1:** "*the older, the elders and stuff around your voice will probably be a lot better for them... the voice would help with like looking for this document in it pops up and tells you or I need to. I need to document my time. It is now this time when I leave. Okay, Now it is this so that way. You don't have to type anything down. It's all there. Then I can, later on, get it, and then put it on paper, because Fema wants some papers like put on paper and send it.*"

According to P1-1, the members of the tribe tend to use multiple interfaces across various devices, such as iPads, laptops, mobile phones, and PDAs to report damage and contact emergency management. Thus, embedding the chatbot application in different types of devices would be beneficial in this context. P1-1 also suggested that older tribal members who are not technologically adept may prefer the voice option in the chatbot to communicate their issues to the emergency manager instead of using text-based communication.

> **P1-3:** "*They're posting where you know photos and tornado. Well, they are all GPS-tagged photos, so you can find out exactly where it is. so there are a lot of things that it would, I could see helping as the emergency manager who's already tech savvy, anyways, at least as a user we don't.*"

One of our interviewees, P1-3, who is also an emergency manager at Rubicon, a veteran-run non-profit, suggested that the images shared by people through the chatbot could be tagged with geo-location capabilities, which would help emergency managers locate and assist them more efficiently. Another participant, P2-28, suggested that the chatbot could ask emotional wellness questions such as how the user is feeling and coping, instead of relying solely on automated sentiment analysis as shown in Figure 2 under the column labeled "Score".

> **P1-1:** "*That's an issue there too because a lot of tribal members don't have cell service. They can use their phone but they have to be Wi-Fi connected. You will be surprised how many people sit out in front of my office to use my Wi-Fi.* "

During our design workshop at the conference, two participants (P1-1 and P2-18) highlighted the issue of poor internet connectivity on the reservation. They mentioned that in emergency situations, people may not have access to cell service, which can be problematic. P1-1 suggested that some people sit outside his office to connect to his Wi-Fi during such times. However, he also noted that some Indian reservations may lack internet connectivity when power lines go off, making it challenging to adopt chatbots and AI in general. Despite these challenges, the potential benefits of using chatbots in emergency management were widely recognized.

> **P2-9:** "*So it may be instead of asking if it's an emergency maybe ask if Is your life in immediate danger or something like that. Cause then people will like, Oh, if my driveway is flooded, then I would think that would be an emergency, but you are not really in danger. So that way, you can move on and continue to put stuff in the app without people being stopped and like get help.*"

P2-9 recommended a modification for the chatbot's emergency response process. Instead of asking if the situation is an emergency, she suggested that the chatbot could ask a follow-up question to determine if the person's life is in immediate danger. For example, if someone reports a flooded driveway, it may not be an emergency if they are not in danger. P2-9 explained at the conference that the term "emergency" can have various interpretations and that asking a question like *Is your life in immediate danger?* could provide clarity for both the user and emergency managers. This suggestion could aid in prioritizing emergency management resources and help emergency managers assess the situation of people who may be stranded at home or on the streets.

DISCUSSION

In this paper, we conducted a qualitative analysis of a co-design process for an AI chatbot with indigenous communities. The study involved experienced emergency managers and tribal members, and through a two-stage process, we identified three themes related to how the chatbot could improve emergency communication and damage reporting. We also examined the usability and adoption of chatbots in emergency management and discussed the practical implications for tribal emergency members and AI technology. Our study confirms that effective communication and documentation are crucial for obtaining a 25% cost share from FEMA during emergency declarations. We found that chatbots can streamline the declaration process by quickly retrieving relevant documents and facilitating collaborative damage reporting among tribal members. Furthermore, chatbots can aid communication during rushed disaster periods and provide the location and emergency procedure updates. Additionally, voice capabilities can help older members of the tribe. Finally, the chatbot can facilitate communication with those who can assist with disaster declaration paperwork for other state or federal governments, such as FEMA.

Our study's findings support the argument that co-designing an AI-based chatbot can empower tribal members in natural disaster reporting (RQ1). The co-design process took approximately eight weeks to complete, with the first four weeks focused on implementing the generic chatbot and recruiting participants for stage 1. As researchers outside of the realm of tribal emergency management, we aimed to understand better the duties and practices of first-line emergency managers, as well as the difficulties and challenges faced by tribal members during stage 1. This step was crucial in selecting suitable scenarios, interaction mechanisms, and appropriate language for the designated system. The proposed chatbot solution can enhance disaster management and response capability while preserving the sovereignty of the indigenous community. Additionally, the co-design process helped establish a relationship of trust between the designer and the target users.

Our study findings demonstrate the positive user perception and experience of utilizing the proposed AI-based chatbot in indigenous communities (RQ2), as supported by our design workshop. During the workshop, we engaged face-to-face with the tribal members, demonstrating and guiding them on using the proposed chatbot to file a report via their cell phone or laptop, either in a web browser or by calling a Gateway number. Most participants reported positive experiences during the workshop, providing helpful feedback to refine the system design. At the end of the workshop, we asked the participants if they would like to continue the co-design process with the authors, and we received a verbal agreement. Both council members then presented a resolution to their tribes, which was voted on and passed one month after the design workshop. This official support from both tribes indicates strong potential for the success of this participatory study. We argue that this process of engaging with the users can establish a relationship of trust and improve the system design.

Our findings support the argument that new technology can offer fresh opportunities for tribal self-governance and sovereignty. Our study demonstrates how AI can facilitate the collection and recording of critical data necessary to claim resources from other agencies. Including indigenous knowledge systems in discussions concerning AI and society can lead to alternative approaches that tackle the distinctive challenges faced by these communities (Lewis et al. 2020). Our findings highlight the potential of using new technology to empower indigenous communities, which is a labor-intensive and time-consuming task. Our study also emphasized the importance of considering cross-sovereignty systems to ensure transparency and accountability, which have received less attention in previous indigenous co-design projects (Harding et al. 2021; Gonzales et al. 2022). For example, the FEMA disaster declaration procedure may not be feasible for tribal councils to collect and document all receipts and reports simultaneously for submission. Instead, a community-based storytelling approach and in-kind labor cost-share might be more appropriate to acknowledge and honor the on-site efforts in responding to natural disasters.

This article presents essential design considerations for creating a chatbot tailored to indigenous communities, including addressing challenges such as poor internet connectivity during natural disasters. To overcome this issue, the chatbot should be able to accept fragmented responses and function offline or with limited cloud connectivity. Additionally, users should have the flexibility to interact with the chatbot through various mediums, such as an app, web browser, voice call, or text message. The chatbot's conversational design should be personalized to each tribe's specific needs and preferences, and establishing trust with the community is crucial before implementing the system. Our research supports the literature in emphasizing that the technology itself is not the primary objective; rather, the technology should be flexible and serve to benefit the indigenous community and promote community engagement in co-design projects (Kelly and Taffe 2022).

We acknowledge certain limitations to this study. Firstly, our co-design participants were predominantly highly educated, which may not be representative of most tribal communities. Further research is needed to investigate the impact of education on co-design findings. Secondly, we believe that FEMA's current offering of an informational

app could serve as a useful baseline for future studies [5]. Additionally, it is crucial to consider user privacy and data protection measures when deploying the app and connecting it to the actual government system. Thirdly, the co-design process usually requires a longer collaboration to establish mutual trust between designers and stakeholders, but our study period is less than two months. We plan to address these limitations in our future collaboration with the two tribes we worked with.

CONCLUSION

In this study, a disaster management chatbot was created through a participatory design approach involving first-line emergency managers and two indigenous communities. The co-design process was conducted in a culturally sensitive manner, emphasizing the importance of building trust and relationships between researchers and participants. The process involved two stages and an in-person design workshop, which resulted in the development, refinement, and evaluation of the proposed chatbot design, with a focus on flooding damage reporting scenarios. The design received positive feedback from participants, who expressed their willingness to continue the co-design process in the future.

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