Exploring Digital Technology Adoption among Brazilian Evangelicals: A Survey and Research Agenda

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Abstract The influence of faith on users' adoption and use of digital technologies is a relevant aspect explored in the field of Human-Computer Interaction (HCI). In the Brazilian context, a religious segment that has experienced significant growth in recent years is the evangelical community. Understanding how evangelical members have adopted and utilized digital technologies, including their experiences during religious practices such as evangelical services, is of fundamental importance. In this work, we present an exploratory study conducted in Brazil, aiming to characterize the use of digital technologies among evangelicals. We conducted a survey through a questionnaire from 107 participants from all regions of Brazil. The results revealed that digital technologies are crucial in engaging religious services and facilitating Bible reading. However, they also highlighted challenges related to spiritual experiences arising from using these technologies. Furthermore, the research identified a series of questions and promising areas for future investigations in the field of HCI and its intersection with religion. This study contributes to the understanding of the complex interaction between technology and faith and enriches discussions about the use of digital technologies in the evangelical religious context. Additionally, by presenting a detailed research agenda, we identify topics deserving deeper investigation, such as technology-mediated spiritual experiences and the cultural implications of technological adoption in religious settings. The combination of these results and the proposed research agenda provides valuable insights for researchers, HCI professionals, and members of religious communities interested in comprehending and enhancing the intersection between technology and faith.

Keywords: Religion, Church, Techno-spirituality, User Experience

1 Introduction

As digital technologies become ubiquitous and used daily by humans, it is necessary to understand the wide variety of spaces in which they can be used. The third wave of Human-Computer Interaction (HCI) research seeks to address cultural, emotional, and experience aspects due to digital technologies being present in the most varied spaces of human life [Bødker, 2006, 2015], including institutions, communities, and religious practices, because as Bell [2006] states, *"life also happens in the sacred domain"*.

Faith can influence the adoption and use of digital technologies around the world. According to Wyche and Grinter [2012], religion affects some digital technologies' usefulness and adoption. Consequently, adopting and using digital technologies imply new ways of learning and practicing faith [Wyche, 2008]. The search and stimulus for innovation can often contradict the desires and needs of potential users of digital technologies. Humans do not wish to have technological interventions in some aspects of life. An example of this may be religious practices, as reported by the authors.

According to Martins [2012], *"there is no doubt that Brazil is a religious country"*, although the numbers from the 2010 Brazilian demographic census present an increase in the number of people declared to have no religion [IBGE, 2010]. According to the Brazilian Institute of Geography and Statistics (IBGE), the religious segment that grew the most in Brazil was the evangelical one, going from 15.4% of the population to 22.2% [IBGE, 2010].

However, evangelicals' use of digital technologies has only sometimes been regular and allowed by their leaders. Examples of this are the prohibitions of television, internet, movies, or other digital media by the Assemblies of God Church (*Igreja Assembleia de Deus* in Portuguese) [Roiz and Fonseca, 2009; Santana, 2013], which persists in some Brazilian states, such as the Mato Grosso, the God is Love Church (*Igreja Deus é Amor* in Portuguese) [Mendonça, 2009]. On the other hand, some evangelical pastors use digital technologies during their services.

In this context, some questions arise: (i) What are digital technologies used by Brazilian evangelical people in their daily lives? (ii) What are digital technologies used by evangelical people in church services in Brazil? (iii) What are the primary perceptions of these users about digital technologies used during church services? To answer these questions, we conduct an exploratory study using a survey online to characterize the use of digital technologies by evangelical people in Brazil.

Besides providing an overview of the questions that guided this research, this study also contributes to the identification of digital technologies used by evangelicals people; the identification of characteristics related to the use of digital technologies during evangelical services, the presentation of initial scientific evidence about challenges, difficulties, and needs relating to the use of digital technologies during evangelical services in Brazil.

In this paper, we present an exploratory study to fill a gap at the intersection of digital technologies and the growing evangelical community in Brazil. Over the past years, the evangelical segment has emerged as an influential cultural and religious force in the country. However, the interaction between this community and digital technologies remains under explored in the literature. We seek to provide empirical insights into the use of these technologies among evangelicals, with a particular focus on experiences during religious practices, such as evangelical services. Moreover, our research stands out for its interdisciplinary approach, bridging the fields of HCI and religious studies. By bringing these perspectives together, we shed light on the complex dynamics between modernity and conservatism in the evangelical context and the cultural and spiritual implications of adopting digital technologies. This approach offers new opportunities for understanding the interactions between faith and technology in a unique socio-cultural landscape.

This paper is divided into eight more sections. The following section deals with the relationship between HCI and religion; Section 3 presents scientific publications on creating or using digital technologies with religious/spiritual objectives. In Section 4, we introduced the methodological approach conducted in the research. We describe the research results in Section 5, and Section 6 presents a results discussion. Section 7 presents the research's limitations and threats to validity. To conclude this manuscript, Section 8 presents the investigation's final considerations, and Section 9 presents a short research agenda.

2   HCI & Religion

Historically, HCI can be broken down into three waves. The first wave of HCI deals with human factors and ergonomics under the objectivist and dualist perspectives through experimental research methods. In turn, the second wave of HCI concerns cognitive psychology, still under the objectivist and dualist views investigated from experimental methods that seek to identify and explain mental processes during (human-computer) interaction in the work environment. Finally, the third wave of HCI left the work environment and moved to the ubiquity of digital technologies. Subjectivity became the fundamental perspective through research methods that seek to understand reality, focusing on culture, values, emotion, experience, and the body [Bødker, 2006].

In this sense, third wave HCI research brings into existence the everyday perspective of people and the subjectivity surrounding interactions beyond the computer and work. One of these human subjective aspects related to the third wave of HCI is faith [Wyche and Grinter, 2012]. Religion is a vital human characteristic and is at its foundation. From religions, humans create their worldviews, signs, culture, and other subjective aspects, although, in some religions, this may be similar [Rivers, 2006]. According to Wyche and Grinter [2012], religion can affect the (non-)use and modes of human-computer interaction, which implies the need to know this aspect and its influences on the individual and his faith community.

The adoption and appropriation of interactive digital technologies are the research topics related to HCI [ACM, 1992]. Wyche and Grinter [2012] indicate challenges to appropriating digital technologies for spiritual purposes. According to Blythe and Buie [2021], many people use digital technologies in their religious practices, and several specific digital technologies support these practices. Nevertheless, there is little HCI research related to this topic. For the authors, HCI deals a lot with the user experience and aspects provoked by this experience, such as learning and emotions, either good or bad. However, there are a few considerations related to spiritual or transcendental experiences that can be provoked through digital technologies, besides other experiences.

In this regard, Blythe and Buie [2021] presented the results of research they conducted in 2012 and 2020 in which they found considerable smartphone apps for spiritual purposes. According to the researchers, corroborated by Ahmad *et al*. [2015], apparently, people seek and use digital technologies to support their religious practices. However, more research needs to be done on this topic [Ahmad *et al*., 2015; Blythe and Buie, 2021; Rifat *et al*., 2022].

According to O'Leary *et al*. [2021], faith communities have appropriated digital technologies in various areas. However, the researchers question whether integrating digital technologies in some contexts is innovative, necessary, and progress, as the authors draw attention to the repercussions of the design of digital technologies for the religious environment. Designers often look for situations that are amenable to technological interventions. This desire to imagine new digital technologies for everyday life is valued in the HCI [Wyche and Grinter, 2012]. However, there are aspects of life that humans do not desire intervention, so designers must consider why to create something digital before considering how to make it [Matos, 2008].

3   Related Works

As discussed earlier, little research has dealt with the creation or use of digital technologies for religious purposes. Noteworthy publications on this theme include [Young, 2022; O'Leary *et al*., 2021, 2022; Rosa *et al*., 2020; Wyche and Grinter, 2012; Wyche *et al*., 2009; Banni *et al*., 2020]. We highlight these studies because their focus on the intersection of HCI and religion in the Brazilian and foreign spheres, has been published in relevant scientific journals and conferences and is accessible and contemporary.

Young [2022] designed a virtual pastor to perform pastoral counseling and care using artificial intelligence and augmented reality. However, Young concluded that faith communities must still be ready to adopt this faith automation. In turn, O'Leary *et al*. [2021, 2022] developed an app with the participation of two faith communities with predominantly black people in the United States of America (USA) to support physical, social, and spiritual well-being. The researchers recognize that several works focus on physical and social well-being, but few deal with these themes from a religious community stance, recognizing that physical and social well-being can be intertwined with spiritual well-being.

In the Brazilian context, Rosa *et al*. [2020], at the request of members of an Assemblies of God Church in Salvador

City, created an application to manage the church's music band; however, the researchers used this case as instrumental and did not highlight aspects related to religion and spirituality. Wyche *et al.* [2009]; Wyche and Grinter [2012] proposed digital technologies for Pentecostal evangelicals in São Paulo. However, the researchers identified that, depending on the church, the participants could misinterpret the sacred symbols (because, for some, they were holy symbols, and for others, they symbolized something related to idolatry) and that the technologies created could be misused. Therefore, for the researchers, culture, and values should be considered relevant when creating digital technologies for religious use.

Finally, the study reported by Banni *et al.* [2020] presents an analysis of the use of Twitter and YouTube pre- and intra-pandemic covid-19 by catholics, evangelicals, and spiritualists. According to the researchers, evangelicals became more engaged in using YouTube when comparing the pre- and intra-pandemic periods, while catholics remained stable and spiritualists reduced. The researchers also pointed out that digital technologies can bring faith communities and their faithful closer together; even virtually, there is a concern for the good of others; that technologies can be used for teaching, enlightenment, and prayer.

The researches by Young [2022]; Rosa *et al.* [2020]; Wyche and Grinter [2012]; Wyche *et al.* [2009] demonstrate that digital technologies can be designed to act specifically on religious practices. So too, digital technologies can associate religious aspects with others, as is the case in the research of O'Leary *et al.* [2021, 2022], or be "generic" to the point that they can also be used for religious purposes, as presented by Banni *et al.* [2020]. However, little was investigated in Brazil and the world [Ahmad *et al.*, 2015; Blythe and Buie, 2021; Rifat *et al.*, 2022], reflecting challenges to identifying the (non) use and the need to create digital technologies for religious purposes. Therefore, in this article, we seek to characterize the use of digital technologies in everyday life of evangelicals, and during church services in Brazil.

4   Methodology

To achieve the research objective and answer the research questions, we conducted a survey based on Robson and Mc-Cartan [2016]; Lazar *et al.* [2017]. The survey had as its target audience people of legal age who are part of evangelical churches in Brazil. From this, in this section, we present the methodological approach. So, in the following subsection, we introduce ourselves; in subsection 4.2, we present the survey design. In subsection 4.3, we describe the pilot test; in Subsection 4.4, we explain the survey distribution; in subsection 4.5, we describe the data analysis.

4.1   About the Researchers

Before going into detail about the survey, it is crucial to characterize us, especially concerning religion. We are evangelical Christians, so this becomes a presupposition for our worldview and research. Furthermore, we assume a

Constructivist-Interpretivist position as a research paradigm from Ponterotto [2005] philosophy-of-science perspective.

The first author is adjunct pastor of the Evangelical Church Assemblies of God in Madeira Island. From childhood until 2021, he was a member of the Evangelical Church Assemblies of God Madureira Ministry in São Cristóvão - Sergipe. However, for about six years, due to a change of residence to do his master's and doctorate, he spent time at the Evangelical Church Assemblies of God Madureira Ministry in Salvador - Bahia. In addition, for nine months during the sandwich doctoral internship, he was a member of the Evangelical Church Assemblies of God in Madeira Island. The author conducts research in HCI, Education & Computing, and Requirements Engineering. He holds a Technologist degree in Internet Systems from Tiradentes University, a Master's and Doctor in Computer Science from the Federal University of Bahia, and a Bachelor in Theology from South American Theological Seminary.

The second author is a member of the Evangelical Church Assemblies of God Ministry of Amazonas in Manaus. The author is part of the church band, this being a frequent activity during the services. The author holds a Bachelor's degree in Computer Science from the Federal University of Amazonas University and an Master's and Doctor in Informatics from the same University.

Our religious context motivated the conduction of this research since, in our faith communities, some people widely use digital technologies and are dismissed by others when it comes to their use in worship or spiritual practices. As previously reported, religion is also a human characteristic. It should also be considered in the design and use of digital technologies, either considering specific digital technologies for religious use, associated with other human aspects, or generically that can be appropriate for religious use. Moreover, it is not uncommon to hear that churches or religious people use digital technologies but should not use them, as well as do not use digital technologies but should use them. In this sense, as Christians-evangelical HCI researchers, our worldview permeates our religious composition, which can facilitate communication with other people of the same religion, given that we know expressions, ways, and even terms explicitly used in the Christian-evangelical environment.

4.2   Survey Design

The survey is a widespread research method in HCI, often used to describe populations, explain behaviors and explore human themes that are still little known [Lazar *et al.*, 2017]. Due to the exploratory character of the study presented in this paper, we chose the survey as a data collection method due to its ability to obtain extensive participation of geographically distributed people quickly, its low cost, and for providing the identification of a portrait of the participants' characteristics [Lazar *et al.*, 2017]. Therefore, a survey was structured through an online questionnaire on the Google Forms platform to achieve the research objective.

We composed the survey into five sets of questions in the Portuguese language. The survey questions are presented in this article's appendix. The first set was aimed at the ethical aspects of the research, where the Informed Consent Form

(ICF) was presented, and participants were asked to accept it. Through the ICF, the participants were informed about the study objectives, relevance, and proposal, how their participation would be, the procedures and risks arising from the study, and that the data obtained in the research would be used only for scientific purposes, that the research was anonymous, and that they would not receive any advantage or remuneration for answering the online questionnaire.

We composed the second set with eight questions: two closed-ended and six open-ended. The questions were about demographic characteristics, the name and city of the church the participant belongs to, the amount of time they have been an evangelical, and what activity they do in the church.

In the third set, we asked if the participant uses digital technologies; how digital technologies support his daily life; what religious practices digital technologies are used in his everyday life, and if they believe that digital technologies can help him in his religious activities, about the goals of using digital technologies in religious practice, and if digital technologies were used during the church services. The third set consisted of eight questions, four open-ended and four closed-ended.

If the participant answered that they used digital technologies during the church services, they were directed to the fourth set of questions; otherwise, they did not answer the fourth set and were directed to the fifth and last set of questions. The fourth set was composed of open-ended questions in which the participants answered which digital technologies they used during the church services, their goals, and how they felt when using them. Finally, the fifth set was composed of open-ended and closed-ended questions. In this set, the participants were asked if they saw the need for any digital technology for religious use that they had yet to find and if they want to leave a contact to participate in future works.

4.3　Survey Pilot Test

After designing the questionnaire, we conducted a pilot test with three participants who were part of the survey's target audience (members of the Adventist Church, the Baptist Church, and the Assemblies of God Church). All three participants used their smartphones to answer the questionnaire. Two participants in the pilot test used an initial version of the questionnaire, in which they could indicate adjustments and improvements to the questions. The third pilot test participant answered the second version of the questionnaire, pointing to no adjustments or enhancements. The pilot test identified that the middle time to answer the survey was fifteen minutes. We discarded the pilot test responses and asked participants not to answer the questionnaire's final version.

4.4　Survey Distribution

The survey was distributed online through the researchers' social networks (Facebook, Twitter, Instagram, and WhatsApp) through an attached link. Participants and interested people were also asked to disseminate the survey on their social networks, thus causing snowballing. In the survey distribution, there was no selection of aspects, groups, communities, or locations of participants. The survey was distributed

and was available for completion from January 28, 2022, to February 6, 2022.

4.5　Data Analysis

After collecting the data through the survey, we began its analysis. We adopted open coding procedures to answer the open-ended questions [Muller, 2014], by which relevant concepts were created through abstractions of the participants' quotes. We also use tag clouds to represent some qualitative data. We chose the tag cloud because of its feature of presenting the dimensions associated with a word within a set. In this sense, the prevalence of a word in the set can be represented by its size. The tag cloud can provide an overview or an overall impression of relevant words in the dataset, making it easier to see the frequency of words in a dataset [Rivadeneira *et al.*, 2007].

Regarding the answers to the closed questions, we conducted a descriptive statistical analysis and two statistical tests to explore the relationships between variables: (i) Fisher's exact test and (ii) the Kruskal-Wallis test [Robson and McCartan, 2016]. We performed the quantitative analysis with the support of Jamovi[1].

Considering the online questionnaire, we have two grouping variables: the use of digital technologies during church services (UDT) and the need for new digital technologies for religious/spiritual use (NDT). Both variables are nominal qualitative, and the UDT variable causes two groups (yes and no), while the NDT variable causes three groups (yes, maybe, and no). In this sense, due to the number of groups formed by these variables, we performed Fischer's exact test for UDT and Kruskal-Wallis's test for NDT. We considered as dependent variables the six demographic data: (i) regions of Brazil, (ii) sex, (iii) age group, (iv) educational level, (v) period attending evangelical churches, and (vi) church.

While the first researcher constructed the tag clouds with the qualitative data and performed the statistical analysis for the quantitative data, which the second researcher reviewed; in turn, the second researcher performed the qualitative data analysis through open coding, which the first researcher reviewed. In case of conflicting perspectives, the researchers discussed the results to build a common denominator.

5　Survey Results

The survey obtained 122 answers, of which 15 were not considered valid due to: (i) open questions not answered as expected (e.g., not indicating the city of the church where they are a member in answer to the appropriate question); (ii) the participant indicated that he/she is not a member of a church in Brazil (there were answers from France and Portugal); or (iii) contradictory answers (e.g., the answer to the closed question indicates that the participant makes use of digital technologies during worship, but in the open question about which the participants use technologies indicates that they do not use them). Therefore, the valid corpus of this research is composed of 107 responses to the survey. We reiterate that

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[1] https://www.jamovi.org/

all the survey questions and answers were in Portuguese, but we translated the results into English to write this paper.

We present the survey results in this section. The first subsection presents the participants' demographic characteristics. In subsection 5.2, we present digital technologies in participants' everyday life. Subsection 5.3 reports on the use of digital technologies in church services, and Subsection 5.4 on the participants' perception of the need for digital technologies during church services.

5.1 Participants' Characterization

As indicated in the methodology section, the survey's second set of questions sought answers about the participants' demographic aspects. Figure 1 presents a graph with the geographical distribution of the survey participants. There were responses from the five regions of Brazil, with the most significant number of responses (61%) coming from the Northeast region. The Southeast region was represented with about 21% of the answers; about 8% came from the South region, and about 5% and 2% came from the North and Center-West regions, respectively.
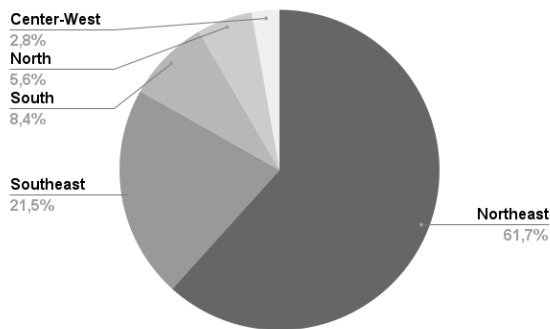

Figure 1. Geographic distribution of participants.

Regarding sex, the participants were offered three options: male, female, and "I prefer not to answer". These categories were used due to the conservatism of many evangelicals. As a result, about 46% indicated they were female, and about 53% were male. There were no responses to *"I prefer not to answer"*.

The graph in Figure 2 shows that the age group with the most participants was 21 to 24 years old. Still, it was identified that there was participation from the most varied age groups (18-60+), despite the low frequency in the higher age groups.

Still, the participants' educational level was questioned. Of the 107 participants, 46.7% had higher education complete, and about 30% and 15% stated that they had higher education incomplete and secondary education complete, respectively. Only 2.8% of the participants had incomplete secondary education. Finally, elementary education complete and incomplete had 1.8% each. This data can be visualized in the graph in Figure 3.

The period the participant attended evangelical churches and which evangelical church s/he belonged to at the time of participation were also treated as demographic aspects. Regarding the time the participant has been attending evangelical churches, from the graph in Figure 4, we identified a
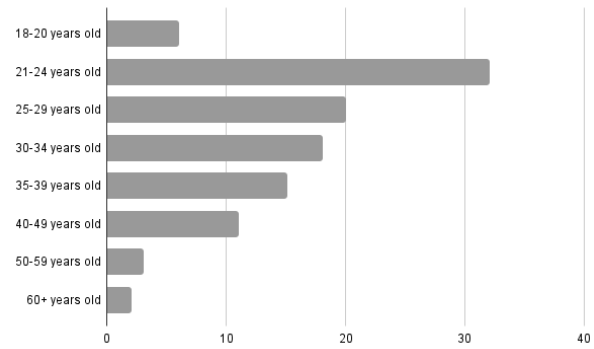

Figure 2. Age group of participants.
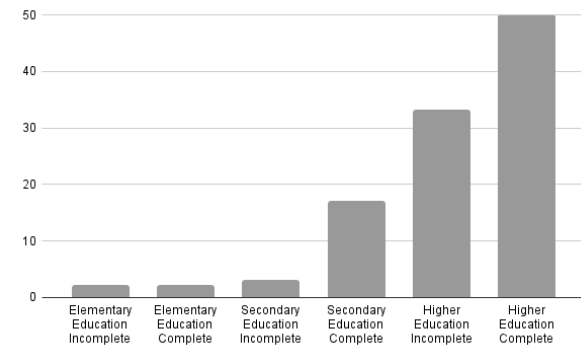
Figure 3. Educational Level of Participants.
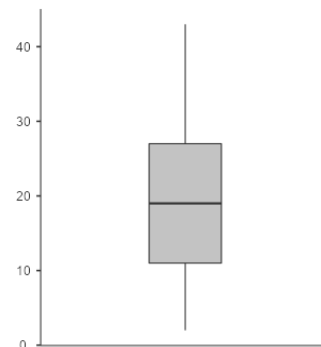
Figure 4. The period in which the participant attends evangelical churches.

mean of 19.6 years, with the minimum time specified being two years and the maximum time being 43 years.

Regarding the evangelical church to which the participant belonged, we identified many church names, and they were grouped according to their primary name; for example, the *Igreja Assembleia de Deus Ministério Madureira* and the *Igreja Assembleia de Deus Ministério Missão* were grouped as *Igreja Assembleia de Deus* – Assemblies of God Church in English; the *Igreja Batista de Alto José do Pinho*, and the *Igreja Batista da Lagoinha* were grouped as *Igreja Batista* – Baptist Church in English. We present the names[2] of the churches and the quantities in Table 1. It is identified that the *Igreja Assembleia de Deus* has greater representativeness among the survey participants, followed by the *Igreja Batista* and the *Igreja Presbiteriana* – Presbyterian Church in English –, sequentially.

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[2]The names of the churches were put in Portuguese because not all have official translations.

Table 1. Names and quantities of churches of the research participants.

	Name	Qty.
1	Igreja Assembleia de Deus	47
2	Igreja Batista	20
3	Igreja Presbiteriana	12
4	Igreja Evangélica de Confissão Luterana no Brasil	3
5	Igreja Adventista	2
6	Igreja do Nazareno	2
7	Igreja Evangélica Quadrangular	2
8	Igreja Nova Vida	2
9	Igreja Evangélica Casa do Oleiro	2
10	Igreja Metodista	1
11	Igreja Cristã Evangélica da Amazônia	1
12	Igreja Esperança	1
13	Paz Church	1
14	Igreja Chuva Serôdia	1
15	Primeira Igreja da Penha	1
16	Igreja Vidas no Altar	1
17	Catedral do Avivamento Internacional	1
18	Bola de Neve	1
19	Igreja Cristã Evangélica do Brasil	1
20	Comunidade Cristã Videira	1
21	Nova Aliança	1
22	Congregação Cristã no Brasil	1
23	Igreja Comunidade Cristã Casa do Oleiro	1
24	Comunidade da Vila	1
	Total	107

5.2 Use of Digital Technologies in Daily Life

The use of digital technologies during church services was the topic of questions set three and four of the survey. However, different questions were asked to draw a parallel between the everyday use of digital technologies and specific use during church services.

It is pertinent to point out that only one participant, out of 107, signaled that the survey uses digital technologies in her daily life. This participant indicated that she is part of the Christian Congregation in Brazil church, is between 30 and 34 years old, has completed high school, and lives in the Northeast.

Since 106 participants signaled that they use digital technologies in their daily lives, the tagcloud presented in Figure 5 was constructed to represent how technologies support their daily lives.

Analyzing the tagcloud in Figure 5, we identified that the most cited uses of digital technologies are for work (36x) and study (25x). However, one also identifies their use for communication, research, entertainment, and leisure, whether through the computer, smartphone, notebook, TV, kindle, or tablet. Some participants also listed some software they use: Google Calendar, WhatsApp, Telegram, Instagram, HabitNow, Twitter, Google Meet, YouTube, Spotify, and, with specifically religious purposes, "Apps of the Bible", and Glorify app.

When asked if they believed digital technologies could help their religious practices, about 94% of the participants answered yes, 4% answered maybe, and only 1 participant answered no. The participant adont who answered that she did not believe that digital technologies could not assist her in her religious practices attends the Assemblies of God Church. She is 40 to 49 years old, has completed elementary school, and lives in the Northern region. However, the participant indicated that she uses digital technologies during church services.

In turn, the tagcloud of Figure 6 presents a set of words representing the religious practices the participants usually do in their daily lives. Considering the tagcloud, we observed that the five most performed religious practices are, in descending order: prayer (73x), Biblical reading (64x), worship (30x), devotional (20x), and Bible studies (20x).

Still, on the use of technologies in religious practices in everyday life, the participants' answers were organized into 13 different categories, with the support of open coding [Muller, 2014], representing the participants' perceptions. Some of these categories are described below.

Bible reading: P2 - *"I use the smartphone to record which book of the Bible I am reading, I have the Bible app for when I cannot take the Bible with me"*; P3 - *"With the cell phone I always have a Bible at hand through applications"*; P14 - *"Reading the Bible with the Bible app and devotionals with the Glorify app"*.

Devotional: P43 - *"Access free devotionals on apps, access preaching, ask questions about some topic..."*; P59 - *"I use the online devotional and Bible on mobile"*; P81 - *"It helps a lot in the devotional"*.

Communication: P31 - *"I connect with brothers who live in other cities and consume Christian content like videos, texts, and courses"*; P36 - *"Provide points of contact with church members, serve as a channel for evangelization"*;

Study: P71 - *"Bible apps make it easy to study everywhere"*; P86 - *"Organizing reading, research, and deepening"*; P98 - *"I watch videos of ministrations and Bible studies. I use it sometimes as a visual resource for the children to assimilate the content"*; P102 - *"Verify opinions and studies of various national and international authors, deepen my knowledge of the Bible, speed up the learning process, besides further enriching my biblical knowledge"*.

Online services and seminars: P20 - *"And when, for some reason, I cannot be at the face-to-face church services, I can follow along through live streaming"*; P25 - *"In the context of the pandemic, for example, these technologies were beneficial especially with the temporary closure of churches"*; P35 - *"Participating in seminary and theological courses among another possibility that the internet offers in communication"*; P88 - *"I can participate in studies, meetings, and prayers with other members of my Church in different cities and states"*.

The above categories reflect part of the tagcloud presented in Figure 6. In addition to these, we observed that the use of technologies as support for users who have difficulty reading the printed Bible (*"use to read the Bible because I cannot see the printed Bible"* - P32); and technologies used in religious practice could cause distraction (*"help to keep the routine, especially with Alexa. However, they can be a cause of distraction, too"* - P17).

5.3 Use of Digital Technologies in Church Services

Regarding the use of digital technologies during church services, the participants were first asked whether digital technologies are used during their church services. About 92% of

Figure 5. How technologies support the participants' daily lives.

Figure 6. Everyday religious practices.

the participants answered yes to the question, 4% answered no, and just under 3% answered maybe. When answering whether they use digital technologies during church services, about 67% of participants indicated yes, and about 32% indicated no.

With this data, we explored whether there are associations between the outcomes of digital technology use during church services and the demographic variables (presented in subsection 5.1). We analyzed the association using Fisher's exact test [Robson and McCartan, 2016]. The results are presented in Table 2. From this statistical analysis, we identified that considering the research corpus. There is no significant association between the variables tested, considering $p < 0.05$ as the default metric.

By indicating whether or not they use digital technologies during church services, the participants were redirected to a different set of questions, as reported in Section 4.2. Therefore, the remaining answers presented in this section were from those participants who answered positively to the ques-

Table 2. *P-value* results from Fisher's exact test of association between dependent variables and UDT.

Variables	P-values
Regions of Brazil	0.435
Sex	0.307
Age Group	0.713
Educational Level	0.954
Period Attending Evangelical Churches	0.071
Church	0.681

tion and, thus, were redirected to the fourth set of questions. We have identified 12 categories, some of which are presented below:

Use of smartphone for Bible reading: P1 - *"I use the digital Bible when I forget the physical one"*; P3 - *"I use the digital bible to keep up with Bible reading..."*; P36 - *"I access digital Bible and research on preaching topic..."*.

Technologies for streaming worship online: P38 - *"Transmit lives and content to church network."*; P65 - *"Transmission of live worship service to someone could not*

be present!"; P68 - *"Technologies provide live worship for people who cannot be present in the church"*;

Technologies for interaction with the audience: P44 - *"The use of the large video display makes it easy for the brethren to read the Bible and accompany us in the congregational songs"*; P90 - *"The use of the large video display facilitates and helps those present to have access to the songs of the various musical groups"*; P99 - *"The use of the large video display provides more convenience for the people in the services, making it possible to follow the lyrics of the songs"*;

Technologies to support singing: P12 - *"I use the smartphone is to put playback"*; P13 - *"Help with the music part and with the instruments, tuner, and playback"*; P43 - *"Access music chords..."*.

With this, these participants perceived different purposes regarding the use of technologies during church services. Such answers indicated that technologies could contribute to church services. However, there is no uniformity in this opinion regarding the use of the digital Bible over the printed one, and a specific category was created for such technology, which reports a variance for such a phenomenon:

Digital Bible X Printed Bible: P44 - *"I do not feel comfortable using a smartphone or tablet in place of the physical Bible, it does not seem to "match""*; P2 - *"I feel that some brethren do not like it very much, but I think it involves more prejudice than anything else. Many people believe that the Bible has to be on paper"*; P26 - *"Tranquil regarding using the Bible on the cell phone. Many people use it, too, and our leadership has never said anything contrary or favorable"*.

5.4 Participants' Perceptions of the Use of Digital Technologies during Services

From the participants' answers about technologies during church services, we perceive their experiences concerning their use. Some stated that the use of technology promotes a more attractive church service, providing videos related to the theme addressed and the projection of music and images. About the positive experiences, we noted that technologies could support the singing from the musicians and band side and the people attending the service, supporting the reading of the Bible during the services, either through the digital app or the presentation of slides. Below are some categories that characterize positive experiences.

Facilitates the singing: P13 - *"A great aid for those who play alone is the pad when I do not know the chords or lyrics of some song, I put on apps that help with that"*; P39 - *"I do not have the physical hymnal, so using a smartphone to accompany, even though there is usually a big screen in the temple reproducing the lyrics, is something I consider good..."*; P56 - *"facilitated the ministry of praise by preventing me from getting the lyrics wrong..."*; P66 - *"When you do not have a musician, you can sing with a playback with practicality"*.

Practicality in Bible reading: P4 - *"Quickness to find the book when someone calls at worship time"*; P10 - *"Easy to access the Bible"*; P55 - *"It is possible to check the verses quoted in the preaching by mobile phone"*; P84 - *"The good experience is the practicality of having many things at hand, like notepad and the Bible"*;

Attractive worship: P19 - *"The use of large video display provides the projection of images and music to the community"*; P35 - *"I believe it makes preaching or worship more attractive"*; P55 - *"The positive thing is to present a YouTube video that adds knowledge added with the sermon"*; P107 - *"It is possible to broadcast videos in a quick search on the subject covered"*.

In addition to interacting with the presential public in the services, we observed that the technologies promoted positive experiences for remotely interacting with the public. This is through social networks, podcasts, and broadcasting of the service, as shown in the following quotes:

P12 - *"Recording the messages and posting as a podcast has been rewarding because the message has reached those who cannot attend the services"*; P38 - *"Not long ago, we had one of the church members bedridden by accident, she always accompanied the lives, and with that, we created the habit of doing, and precisely in the period of the pandemic, because of the isolation"*; P105 - *"I record videos and take pictures, so people on social networks know that communities like mine exist"*.

Regarding negative experiences, we identified that some participants faced problems with technologies used during the services, such as the lack of internet, notebooks with low batteries, lack of power, and problems with social networks. We also perceived discomfort with using online videos because of advertisements and the lack of attention of some by not leaving their cell phones on silent. Some participants stated that using smartphones during services could cause distraction. The categories below highlight the aspects of negative experiences.

Problems with the use of technologies: P9 - *"A bad experience can be caused because of the internet connection"*; P26 - *"I once took a laptop to use during preaching, and it unloaded at a point I had not memorized! It was suffocating"*; P98 - *"I was doing YouTube's live worship for the pastor and having problems on social networks and interrupting the recording"*; P99 - *"Because of the convenience, people become dependent on the benefit of the large video display. It is impossible to sing as easily as the projected lyrics when the light goes away"*.

Discomfort because of advertisements: P43 - *"When accessing a finished website, the advertisement starts playing, and the cell phone is at high volume"*; P66 - *"The bad thing is that by YouTube we cannot control what comes from there and sometimes secular music is played in the advertisements, before starting what was searched for"*.

External interruption while using technology: P10 - *"Forgetting to put the cell phone on silent"*; P56 - *"Forgot to put the cell phone on silent and notified message at the time of worship, disrupting the celebration"*.

Use of smartphones can cause distraction during church services: P31 - *"A negative experience is getting distracted and wanting to check social media during worship"*; P47 - *"I notice some people inattentive to worship, which saddens me a lot, but I try not to focus on others, since worship is individual"*; P52 - *"It needs discipline and maturity not to be distracted and lose the explanation of the preaching content"*.

About the need for new digital technologies for religious

purposes (NDT), in the fifth set of the survey, we identified that about 75% of the participants indicated that they did not envision a need for some digital technology for religious/spiritual use that they have not yet encountered. In contrast, about 13% indicated yes, and about 11% indicated that maybe. We performed the Kruskal-Wallis test [Robson and McCartan, 2016] to explore comparisons between this and demographic variables (see Table 3). Analyzing the result of the Kruskal-Wallis test, we identified no statistically significant difference between the variables, considering $p < 0.05$ as the default metric.

Table 3. *P-value* results from the Kruskal-Wallis test of comparisons between the dependent variables and NDT.

Variables	P-values
Regions of Brazil	0.689
Sex	0.109
Age Group	0.092
Educational Level	0.574
Period Attending Evangelical Churches	0.304
Church	0.765

6 Discussion

Through the analysis of the data produced by the survey presented in this paper, we obtain indications of how religion can influence the adoption of digital technologies in services performed in Brazil. Such results could answer the questions raised in this paper's introduction.

About the results of demographic data, we observed that there was the participation of evangelicals from all regions of Brazil, with emphasis on the Northeast region. Most participants are male, between 21 and 24 years old, with different levels of education, attending evangelical churches for approximately 19 years, on average. We also noted that most participants are from the Assemblies of God Church. Almost all participants use digital technologies in their daily lives, such as the use of applications in smartphones, tablets, and notebooks.

Considering this sample and viewing the question (i) "What are digital technologies used by Brazilian evangelical people in their daily lives?", we identified that only one participant indicated that she does not use digital technologies in her daily life. The other participants said they use digital technologies for study and work. Although these are the primary purposes in the results (cf. Figure 5), we observed that the Bible was also something in evidence as a digital technology used every day. This goes back to the religious practices reported by the participants (cf. Figure 6), of which Bible reading, devotional, and teaching are distinguished as practices that make use of the Holy Bible, whether it is printed or digital. The use of the Holy Bible is, in fact, a characteristic of Brazilian evangelicals, as also evidenced by Wyche *et al.* [2009].

We understand that these technologies are useful, helping them to stay connected to their faith or to live the lifestyle established by the Holy Bible (e.g., prayer, devotional, fasting, evangelization), considering the result presented in Subsection 5.2. In this sense, using digital technologies is possible

to carry out individual or collective, synchronous or asynchronous religious activities, such as using YouTube for biblical study or establishing relationships among the faithful, as was also described by Banni *et al.* [2020].

Moreover, technologies can make it easier for religious people to access biblical study or even the Holy Bible itself because, through the digital Bible, it is possible to increase the size of the letters, as participant P32 describes. However, some people consider that digital technologies can cause distraction. Wyche and Grinter [2012] also found similar results in their research. For the researchers, evangelicals feared being distracted in avoiding or fighting evil, and digital technologies could cause this distraction, according to the survey participants. Therefore, the researchers indicate that technological interventions are not always desirable.

About question (ii) "What are digital technologies used by evangelical people in church services in Brazil?", we observed that not all participants use these technologies during church services. Even so, the results of this study showed that the participants used applications for Bible reading and study, smartphones and notebooks to transmit the church service online, and large video display in conjunction with other technologies to project Bible texts, song lyrics, videos, and notices like reported by Wyche *et al.* [2009]. In addition, technologies support the songs concerning the use of playback such as using smartphones for such purposes and apps to support the musicians in the band, such as the one produced by Rosa *et al.* [2020].

It is valid to relate this analysis results to the use of digital technologies in daily life and church services. While only one person informed that he or she does not use technologies in daily life, 32.7% of the participants informed that they do not use technologies during services. Considering the related work, we conceive some hypotheses for this increase in the number of participants who do not use digital technologies during church services.

Although the research presented by O'Leary *et al.* [2021, 2022] was carried out in the USA context, the hypothesis that the non-use of technologies during worship may be due to: (i) the conservatism of the churches (leaders and members); (ii) the preservation of the liturgy of the church service; (iii) the need for a public demonstration of familiarity with the printed Bible, which, according to the researchers, is something valued. Another hypothesis can be conceived by relating the results presented in Subsection 5.3 of this paper to the results of the research presented by Wyche and Grinter [2012] in the context of evangelical Pentecostal churches in the city of São Paulo. From this perspective, the non-use of technologies during worship may be due to the distraction that digital technologies can cause during church services, making it easier for evil to enter a person's life. These hypotheses, if investigated, could clarify the motivations for the prohibition of the use of digital technologies in some Brazilian churches, for example, the Assemblies of God Church and the God is Love Church, cited by Mendonça [2009]; Roiz and Fonseca [2009]; Santana [2013].

In turn, concerning question (iii) "What are the primary perceptions of these users about digital technologies used during church services?", we noted that the participants presented both positive and negative experiences. According to

the data analysis, digital technologies can facilitate singing during the services, make Bible reading more practical, and make the church service more attractive. O'Leary *et al.* [2022] also identified these results in their research in two USA evangelical churches. For the researchers, using digital technologies in church services can increase engagement and attract younger audiences. However, our paper and O'Leary et al.'s paper did not investigate digital technologies' spiritual or transcendent experiences.

Nevertheless, the use of digital technologies needs to be pondered, especially when considering the core purpose of the church. Some churches seek to preserve their traditions, historical significance, legacy, and temple architecture, which may inhibit the integration of digital technologies and religious practices. Moreover, technologies can cause inconveniences, such as those reported in Subsection 5.4. In this sense, it is necessary to clarify that churches that seek to modernize their practices may go through some bad or unwanted experiences.

Indeed, this study's practical and theoretical implications have significant and promising implications. On a practical level, this study's evidence offers a rich and insightful perspective for religious leaders, enabling them to make informed decisions about the adoption and integration of digital technologies in evangelical services and practices. Understanding how believers use and interact with these technologies provides a solid foundation for shaping strategies that facilitate enriching and authentic spiritual experiences. Moreover, these findings can stimulate productive discussions about balancing deep traditions with technological innovation's benefits while avoiding negative impacts on religious practices.

Theoretically, this study enriches the HCI field by exploring the complex intersections of faith, culture, and technology. By investigating evangelicals' perceptions of digital technologies, a unique perspective is provided to understand the underlying motivations for adopting these technologies and the cultural and religious challenges that may arise. This deep understanding contributes to building a more solid conceptual foundation for future research and debates at the intersection of technology and religion. Furthermore, the theoretical implications extend to the broader fields of cultural and sociological studies, as this study highlights ongoing transformations in religious practices and technology-mediated interpersonal relationships.

In essence, this study's practical and theoretical implications underscore the importance of carefully considering the multidimensional aspects of the interaction between faith and technology. By providing valuable insights for religious leaders, scholars, and practitioners in the field, this study not only broadens our understanding of how digital technologies are being incorporated in the evangelical context but also catalyzes deeper and more enriching discussions on how technology can be meaningfully and culturally sensitively used in contemporary religious practices.

7   Threats to Validity and Limitations

In the research presented, some threats can influence validity. Some of these have been mitigated where possible. The following are some threats to external, construct, and conclusion validity that were identified and some actions to mitigate them:

Internal Validity: some words or expressions could be ambiguous or unfamiliar to some participants in the questionnaire. To mitigate this threat, we conducted a pilot test with three participants, whereby suggestions for improving the questionnaire were received. In addition, every time the expression "digital technologies" was used, the following examples were cited in parentheses: computers, smartphones, smartTV, and tablets. These examples could influence the participants' answers by being limited to these technologies or serve as an initial idea to be supplemented by them.

External Validity: the questionnaire received only 107 valid answers, which one can consider the sample as small, considering that in Brazil. This threat prevents the results from being generalized. More than forty-two million Brazilian people declare themselves evangelicals, according to the IBGE [2010].

In addition, in this study, about 61% of the participants are from the Northeast region, where the first author resides, and most of the participants attend the Assemblies of God Church, the church attended by the research authors. These two occurrences may have happened due to the distribution mode of the survey, and we already expected a more significant number of participants who are members of the Assemblies of God Church. Assemblies of God is the evangelical church with the most significant number of members in Brazil, according to the IBGE [2010].

Concerning the qualitative analysis performed in this research, a possible threat would be the expectation of the researcher who performed the coding. Another researcher reviewed the categories obtained from the participants' quotes to mitigate this threat.

Validity of Conclusion: one might consider the most prominent threat related to conclusion validity to be the small sample size (N = 107) versus the multitude of evangelicals in the country. Therefore, it is not possible to treat the results of this study as conclusive and general but as initial evidence for further and deeper research.

As previously reported, we classified this study as exploratory, thus seeking to know some phenomena and identify new research questions and hypotheses. This reflects that it is not necessary to obtain absolute answers to the research questions but to build a corpus of sufficient evidence to justify further studies. Herefore, this study meets its objectives despite the threats.

8   Final Considerations

This paper has presented findings from a study aimed at characterizing the use of digital technologies among Brazilian evangelicals, both in their everyday lives and during religious services. The results obtained underscore the existence of significant challenges associated with the (non-

)adoption of digital technologies within the Brazilian evangelical community. These challenges warrant attention from both researchers and HCI practitioners, particularly given the intricate interplay between modernity and conservatism. The resulting tension necessitates a reevaluation of the current goals, focus, and aspirations of the church, culminating in various questions discussed throughout this paper and prompting pivotal inquiries: (i) Is the integration of digital technologies a progressive step for churches? (ii) How and under what circumstances should digital technologies be introduced into ecclesiastical settings? (iii) What spiritual and transcendent experiences can digital technologies evoke during religious services?

Moreover, deciding to include or exclude digital technologies in worship services requires a comprehensive understanding of the social factors involved, which can either promote inclusion or result in exclusion. Furthermore, introducing or restricting digital technologies in religious practices, as evidenced by O'Leary *et al.* [2021], presents its challenges. In this regard, we find resonance with Matos [2008], who proposes that an exploration of the "why" behind the creation of digital technologies should precede investigations into the "how", as not all faith communities, as emphasized by Young [2022], are equally prepared to embrace digital technologies in their religious observances.

In concluding this research, the intricate interplay between faith and technology that has been illuminated calls for deeper investigations and ongoing explorations. Such investigations are crucial to addressing the complexities arising from the coexistence of tradition and modernity, spirituality and digitization, inclusion and exclusion in the evangelical context. The insights gleaned from this study are poised to guide future research endeavors that delve into the intertwined spiritual, social, and technological dimensions of the Brazilian evangelical experience. By embarking on this research agenda, we can further enhance our understanding of the multifaceted relationship between digital technologies and religious practices, propelling discourse and addressing this domain's multifarious nuances. This endeavor signifies a continuation of our commitment to unraveling the intricate fabric that binds faith and technology within the evangelical community.

9　Research Agenda

The research presented in this study lays the foundation for a broader and more in-depth research agenda at the intersection of digital technology and religious contexts. Based on the obtained results and discussions, several promising research directions emerge that could significantly contribute to understanding the complexities involved in adopting and using digital technologies by religious communities, particularly among Evangelicals in Brazil.

First and foremost, delving deeper into the spiritual experiences resulting from incorporating (or lack thereof) digital technologies in religious settings is essential. Through more comprehensive qualitative studies, such as in-depth interviews and focus groups, researchers can explore the spiritual and emotional dimensions that faithful individuals experience when using technologies during religious services or in their daily lives.

Furthermore, a longitudinal study could be conducted to examine how the adoption of digital technologies impacts liturgical practices over time. This would allow for a more profound analysis of changes in church dynamics as technology becomes more integrated, considering aspects such as congregant participation and the evolution of religious rituals.

Another crucial aspect to investigate is the role of digital technologies in social inclusion and exclusion within religious congregations. A thorough analysis of the social dynamics that arise with technology adoption can provide valuable insights into how these tools can create barriers or opportunities for different groups of worshippers.

Developing practical guidelines for integrating technologies into religious practices is a clear necessity. These guidelines assist religious leaders in making informed decisions about when and how to incorporate technology sensitively and effectively while maintaining the integrity of religious practices and fostering a positive experience for the faithful.

Moreover, exploring specific technologies such as mobile applications, social media, and virtual reality could offer a deeper understanding of how each technology affects religious experience and congregant engagement. This could lead to insights into the specific features of these technologies that best align with religious objectives.

A comparative study involving other religious denominations is also a promising research area, enabling the identification of similar or distinct patterns in attitudes toward digital technology. This broader perspective could shed light on how different religious groups respond to the increasing influence of technology on their practices.

Additionally, analyzing the influence of cultural and generational factors on attitudes toward digital technology could further enrich the understanding of variations in perceptions within religious congregations. Understanding how these factors shape attitudes toward technology can help develop more effective implementation strategies.

Finally, long-term studies tracking changes in religious practices, beliefs, and values as digital technology evolves and becomes more integrated into society are crucial. This would enable an in-depth analysis of social and spiritual transformations over time as religious communities continue to adapt to technological innovations.

In summary, this research agenda outlines a series of interconnected topics that can enhance understanding of the implications of digital technology in religious contexts, particularly among Evangelical congregations in Brazil. Each of these research directions promises to contribute to a more holistic view of the complex interactions between the digital and the spiritual, enabling a deeper and more informed analysis of ongoing socio-cultural changes.

Declarations

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Competing interests

The authors declare that they have the following competing interests.

Authors' Contributions

J. C. S. Rosa contributions: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing.

A. L. Damian contributions: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing.

Appendix

Survey Questions

Second set[3]

1. What is your name (feel free not to answer; this question is not mandatory)?
2. How old are you?
3. What is your sex?
4. What is your education level?
5. What is the name of the church you attend?
6. In which city is the church you attend?
7. How long have you been an evangelical?
8. Do you have any activity in the church? What is it?

Third set

1. Do you use digital technologies (e.g., computers, smartphones, smartTV, tablet) daily?
2. If you answered yes to the previous question, please comment on how these technologies support your daily life.
3. What religious practices do you usually do in your daily life?
4. Do you believe digital technologies (e.g., computers, smartphones, smartTV, tablet) can help you in your religious activities?
5. Can you comment on the purposes of using digital technology (e.g., computers, smartphones, smartTV, tablet) in your religious practice?
6. During the services in your church, are digital technologies used (e.g., computers, smartphones, smartTV, tablet)?
7. If you answered yes or maybe to the previous question, what digital technologies are used in your church?
8. Do you use digital technologies (e.g., computers, smartphones, smartTV, tablet) during church services?

Fourth set

1. What digital technologies (e.g., computers, smartphones, smartTV, tablet) do you use during church services?
2. Comment on your goals for using digital technology (e.g., computers, smartphones, smartTV, tablet) during worship services.
3. How do you feel using digital technologies (e.g., Computers, Smartphones, SmartTV) during church services?

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[3]We presented the survey's questions in English but executed the survey in Portugues Language. As explained in the methodology, the first section was for accepting the Informed Consent Form. Therefore, we present the questions from the second set of questions.

4. Report at least two experiences, one good and one bad, of using digital technology (e.g., computers, smartphones, smartTV, tablet) during church services.

Fifth set

1. What do you think about the digital technologies (e.g., computers, smartphones, smartTV, tablet) used during church services?
2. Do you see other people using digital technologies (e.g., computers, smartphones, smartTV, tablet) during church services?
3. Is there encouragement or discouragement of using digital technologies (e.g., computers, smartphones, smartTV, tablet) during church services?
4. What reason(s) led you to the answer to the previous question?
5. Do you see a need for some digital technology for religious use that you have not yet found?
6. If you answered yes or maybe to the previous question, what digital technology do you see the need or desire for religious use that you have not yet encountered?
7. We thank you for your participation. If you wish to participate in other stages of this research, please leave your contact information (email or phone).

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