Außertheologische Perspektiven

Manishk Gawande et al.[1]

From SanTO to CelesTE

A Theomorphic Device for Religious Practice

Abstract

A recent development in social robotics involves a new wave of robots with religious connections. One of these robots is SanTO, created in 2017 as the first robot that has Christian Catholicism embedded into its design and functionalities. Insights and critical issues emerged through time, at the same time prompting the potential to use robots of this kind to assist elderly population. This paper introduces CelesTE, a similar device designed to support healthy living among older adults, within the framework of an international project involving the EU and Japan. Shaped like an angel praying, CelesTE aims to engage users of Christian Catholic faith. The paper covers CelesTE's conceptual development, addressing challenges related to religious perception, fallibility and user interaction inherited from SanTO. CelesTE uses a multimodal system for communication, enabling discussions on sensitive topics relevant to older adults. This paper also reports the first qualitative studies involving end users, who provide the feedback containing the insights that will guide the next phases of CelesTE's development.

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1. Introduction

The last few years have witnessed a sudden rise in interest in robots for religious practice. The concept of "theomorphic robots" originated in 2016[2] and was followed by efforts by a niche of researchers all over the world, aimed at providing a theoretical basis as well as practical development in this respect. 'Theomorphic' derives from the Greek word 'theos', meaning 'God', and 'morphe', meaning 'form' or 'shape'. In essence, a theomorphic robot is designed to mimic or embody a divine being. Since then, the field has gained interest and is expanding to other religions[3], and might have profound implications on future research.[4] Some of the robot prototypes developed are called theomorphic as they embed religious symbols with the intent of conveying divinity, while other robots like Pepper and Xian'er, are 'generic' robots which happen to be used within religious contexts. Relatively few studies have been conducted in both cases,[5] and one notable study examines BlessU-2, an anthropomorphic robot used in a Christian Protestant church. This study, led by Löffler et al.,[6] gathered feedback from 1923 forms. Notable comments include negatives, such as "I guess God will throw his hands up in horror when seeing this blessing machine", and positives, like "Although the robot did not talk to me personally, I still felt spoken to and experienced a blessing tailored to my needs". These comments offer valuable insights into such robots' potentially significant design characteristics. The allegedly superhuman nature of theomorphic robots, reinforced by specific design criteria[7], offers several advantages in human–robot interaction regarding acceptance as well as issues related to transparency and explicability.[8]

Ahmed et al.[9] categorised robots in religion into four different roles: robots as teaching agents; robots as counselling agents; robots as religious assistants; and robots as religious companions. We will

2 See *Trovato/Cuellar/Nishimura*: Introducing "theomorphic robots", 1245–1250.
3 See *Şahin/Gültekin*: The Interaction of Religion and Robotics.
4 See *Trovato/Weng/Sgorbissa* et al.: Editorial Introduction.
5 See *Trovato/De Saint Chamas/Nishimura* et al..: Religion and robots.
6 See *Löffler/Hurtienne/Nord*: Blessing Robot.
7 See *Trovato/Lucho/Huerta-Mercado* et al.: Design strategies.
8 See *Trovato/Weng/Du*: "Never complain, never explain".
9 See *Ahmed/La*: Evaluating.

synthesise them in a slightly different way in this paper. "Ritual" corresponds to "religious assistant"; while 'teaching' and 'social care' comprise the other roles when the application is focused on content or conversely is a tool to provide social assistance. Figure 1 shows this division into the three categories.

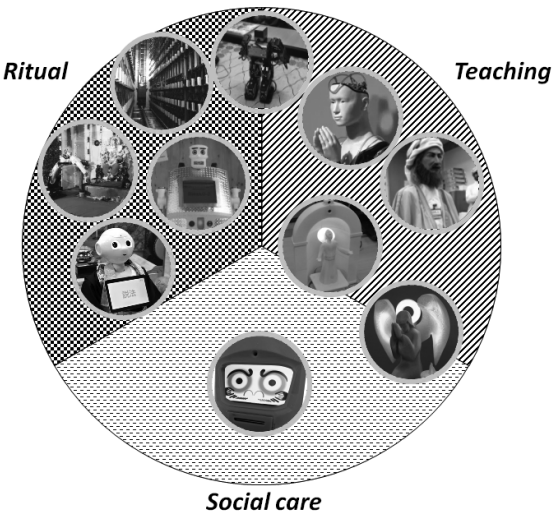

Figure 1. Application of robots within religion

According to this categorisation, SanTO and CelesTE are not only a teaching tool, but can also be applied to a social care scenario.

The need for robots for social care in fact originates from the problem of society ageing, which is common to many developed countries. The low fertility rate combined with longer life expectancy have caused the lack of a workforce to support adults in old age. Many of them may experience loneliness in everyday life. The problem becomes exacerbated with age, owing to the elderly people's inability to use technological devices[10] and increasing levels of dementia. Care homes provide assistance, but particularly in larger ones, carers cannot offer companionship at all times, and organised activities are limited. In this context, there is a growing need for socially assistive devices, and

10 See *Hunsaker/Hargittai*: A review of Internet use.

the potential market may reach millions of users. Especially during the pandemic, the health and well-being of older adults appear to have been significantly affected. Many feasible solutions have been proposed to alleviate this social problem, while facilitating a better understanding of the human user. Socially assistive robots are one potential tool that can be utilised to alleviate the loneliness and isolation experienced by older adults as a result of the COVID-19 pandemic.[11] One of the most successful robots used in care homes is the seal robot Paro. Authors Shibata and Wada[12] contend that robot therapy can alleviate stress in a manner similar to animal therapy.

Our research is part of the e-ViTA project, funded under Horizon 2020 EU–Japan, which aims to develop a 'virtual coach' to support healthy living among adults aged 65 to 75.[13] The e-ViTA framework includes a front-end device like a robot or tablet, a network of sensors, a dialogue system and middleware. In fact, not every socially assistive robot is suitable for this purpose. Achieving user acceptance, especially among older generations, can be challenging and can act as a potential bottleneck for this project.

The initial challenge is related to the robot's appearance and concept, requiring careful design to ensure user acceptance, including the avoidance of uncanny aspects.[14] Previous studies have indicated that robot acceptance is influenced by the user's cultural background, in which religion also plays an important role.[15] DarumaTO[16] is one of the robots developed within this application.

Under these premises, the theomorphic device called CelesTE was conceived.

The development of CelesTE was grounded in the principles of participatory design, a methodology that places a strong emphasis on actively involving end users and stakeholders throughout the design process. This approach seeks to thoroughly understand and address the specific needs and preferences of these important parties and then incorporate their feedback into iterative prototypes. The development

11 See *Getson/Nejat*: Socially assistive robots.
12 See *Shibata/Wada*: Robot therapy.
13 See *Jokinen/Homma/Matsumoto* et al.: Integration.
14 See *Carros* et al.: Not that uncanny.
15 See *Trovato/Mavdridis/Huerta-Mercado* et al.: Cross-cultural timeline.
16 See *Shen* et al.: Participatory Design; *Du* et al.: Composite Emotion Recognition.

process unfolds through a series of well-defined steps, each building upon the insights gained from the previous one. Drawing insights[17] from SanTO and the broader e-ViTA initiative, CelesTE was used in interaction with older adults within the project, with the intent of being a primary asset for the future of socially assistive robots in the domain of elderly care. In this paper, we describe its concept and development, which derives from SanTO, in Section 2, its technical overview in Section 3, and user impressions in Section 4.

2. Conceptual development

SanTO, short for Sanctified Theomorphic Operator, is a robot designed to resemble a statue of a Christian Catholic saint in a niche.[18] Its design blends robotics with religious symbols and sacred art, drawing inspiration from neoclassical architecture and the golden ratio. This fusion of innovation in robotics with conservative visual elements from the past is a distinguishing feature of SanTO.

SanTO serves various purposes, such as providing companionship during prayer, teaching catechism, narrating the lives of saints, delivering the Pope's homilies, reciting verses from the Bible and offering prayers. It is primarily intended for elderly practitioners. The perception of its sacredness among Catholic believers was assessed through experiments conducted in a church in Lima, Peru.[19] In 2021, a Polish version, SanTO-PL, was introduced.[20] SanTO-PL, manufactured in Poland and on display at the Copernicus Science Centre in Warsaw, is an upscaled version, approximately one metre tall, with an improved design featuring a control panel with buttons. Its content is available in three languages (English, Polish, Russian), with a particular focus on the words of Pope John Paul II. SanTO-PL has been active at the Science Centre since November 2021 and was previously featured by the BBC.[21]

17 See *Trovato/Weng*: Retrospective Insights.
18 See *Trovato/Lucho/Ramón* et al.: The creation of SanTO.
19 See *Trovato/Pariasca/Ramirez* et al.: Communicating with SanTO.
20 See *Trovato/Pariasca/Purizaga* et al.: SanTO in exhibition.
21 See *BBC News*: God and robots.

The reception of SanTO has been polarised.[22] While some researchers have advocated the establishment of a cultural robotics subfield dedicated to religion, some of the scientific community have reportedly criticised the project as 'antithetical to science'. Globally, the public has displayed significant interest in the potential of SanTO. Although not universally accepted, SanTO-PL has been seen as a tool that could bring believers closer to God, with the validity of the messages, typically quotes or prayers, remaining unquestioned.[23]

Since its first release in 2017, one common misconception was whether SanTO was considered an idol. To avoid any suggestion of blasphemy and to make clear that the robot is not supposed to be the target of prayers but is designed to pray together with users, the subtitle 'prayer companion' was added to the introductory words spoken by SanTO. The original intention was never to replace human priests, but the idea of an AI or robot taking on religious duties attracted media attention. The Holy See, through its spokesman, emphasised that SanTO is a useful technological tool as long as it provides content without interpreting sacred texts, as machines cannot offer significant advice to believers.[24]

A further problem arose on the theoretical level of the theomorphic concept. As SanTO is a robot, it is just as fallible as any other robot. However, as it represents a sacred object, it is supposed to be infallible at the same time. This theoretical contradiction can have a negative impact on the interaction experience on a practical level.[25]

Moreover, during early tests, SanTO provided biased answers, some of which could even be considered sexist by today's standards. These responses were drawn from the Bible, which can contain contradictory messages. The primary criticism revolved around the AI's method of response, particularly regarding the influence of randomness in its algorithms. To illustrate, sensitive questions such as "Should I marry?" involve personal context. In the absence of complete understanding, machines should not provide advice, neither should they be asked.

22 See ibid.
23 See ibid.
24 See ibid.
25 See *Trovato/De Saint Chamas/Nishimura* et al.: Religion and robots.

The observation of visitors' differing interactions with SanTO-PL was also noteworthy, in particular in a church setting compared to the science centre where it is currently displayed. In the church, users posed faith-related questions, while at the science centre, a relevant number of interactions involved insults directed at the robot.[26] This variation may be attributed to the environment or the diverse audience in these locations. The concept of a 'sacred space' needs to be further investigated to determine how a robot's setting can influence user perceptions and interactions.[27]

These challenges and such feedback significantly influenced the development of the new design for CelesTE *(Celestial Theomorphic devicE)*. Addressing the misconception of the robot being an idol, the design was altered by making the figure bent on one knee in an act of prayer. Moreover, its appearance moved away from the "sanctity" of a saint and adopted a more intercultural and slightly interreligious angelic look. This reduced characterisation supposedly associates the robots less with a sacred sphere, which may compensate for the aforementioned problem of fallibility.

Figure 2. A statue of an angel in a church in Helsinki (left) and CelesTE (right)

26 See *BBC News*: God and robots.

27 See *Moor*: The Nature.

The issue of bias was addressed with the development of SanTO (and therefore the improvements were imported into CelesTE) through adjustments in how the dialogue system manages user intent. For instance, keywords such as "Talk to me about..." are associated with informative responses, while inquiries resembling requests for advice, like "Should I...?" receive a clear response from the robot that it cannot provide advice but can share relevant knowledge on the topic. Different datasets (about less sacred topics, more on the well-being side) were integrated as the device was connected with the e-ViTA system. It is important to note that all this happened before the recent (2023) boom of generative language models.

3. Overview of CelesTE

Unlike SanTO, CelesTE is technically not a robot. In the form of an angel atop an ionic column, it lacks any motor function. It is perhaps more accurate to classify it as a 'device' rather than a robot, depending on the definition we give. However, it shares the capability of communicating through lights with SanTO, as the angel's wings can be illuminated and change colour. The final shape is a result of matching form with functionality and hiding the figure's robotic appearance.

Being specifically built for e-VITA, the intended main function of CelesTE is to be a 'guardian angel', especially with older adults in mind. It can maintain a short conversation, in which the user may ask and receive an answer about a sensitive topic (such as happiness, death, faith, etc.). Furthermore, it can print out a selection of short texts.

In Figure 3, the relocation of the peripherals that compose CelesTE is shown in contrast to SanTO. The main differences are the removal of the motors and the camera (for privacy reasons), and the addition of a printer and of a USB drive hidden in the candle. The capacitive touch-sensing ability of SanTO was replaced by a distance sensor, which not only acts as a button for activation, but also regulates the luminance of the wings depending on the user's position.

The version of CelesTE we are presenting here is the second (R2). The first, R1, featured slightly different proportions. The shape and the features vary accordingly with the iterative nature of participatory design. This methodology allows for continuous refinement and

enhancement so that the robot aligns optimally with the expectations and requirements of the end users (involved in the trials reported in the next section) and stakeholders. Further revisions (R3 and more) will follow in the coming years thanks to the feedback collected.

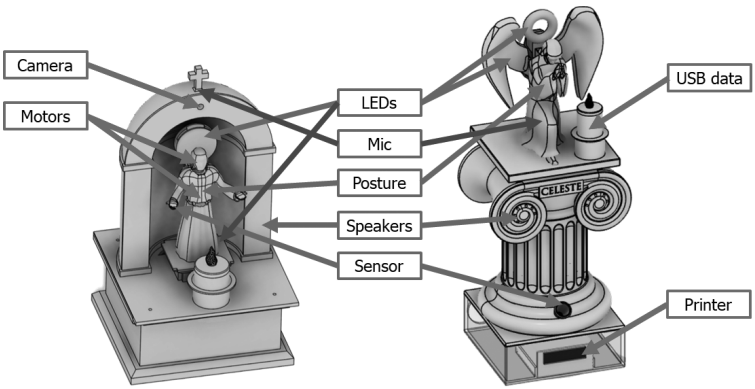

Figure 3. Components of SanTO and CelesTE: a diagram highlighting both the parts they have in common and their differences.

Communication takes place in alternating multimodal interaction through the use of lights and voice. When the device is activated with the finger, it is possible to record vocal input. CelesTE will listen for nine seconds. The conversation between CelesTE and the user is regulated by visual feedback. When the device is recording, its halo is illuminated with a rotating green light and it produces a sound; for the rest of the time, the halo is yellow, while the wings change colour according to the content being spoken. The speech is then processed and converted into text. If the device is connected to the e-ViTA cloud, the text is sent to it and analysed for matching keywords, and an answer is selected. If not, the answer will be determined locally. Finally, CelesTE speaks in its artificial voice, then returns to standby and can be activated anytime. Vocal input works in English, German, Italian and French.

When the answer is processed locally, a selection of topics is available. The content for an answer is searched for in a shortlist that contains more than 500 IDs of certified parts of text. These texts were certified by religious authorities for their relevance to

certain keywords or topics and are broken down into sentences and assigned an emotional valence (positive or negative) which can affect the look of the colour of CelesTE's wings. The texts are extracted from a variety of sources, here classified as: the Bible, prayers, quotes from saints or popes, and stories of the lives of saints.

In addition to this content selection, the story of the saint of the day is always available and can be listened to through activation by a specific keyword.

As an alternative to the shortlist, a deeper search into the sources is also possible. Various forms of extraction with machine learning and text mining are being attempted; however, given the inconsistency of the quality of the results, this mode is only enabled as a "debug mode" for developers to troubleshoot issues and is never activated in front of the users.

A specific keyword is also configured to trigger the use of the printer. There are two cases: When CelesTE is configured for a private user, one can ask: "Do you have any message for me?". CelesTE will then print a short motivating sentence extracted from the Bible. When CelesTE is configured for more than one user, the trigger keyword is simply "My name is …". That will be more appropriate for visitors who approach it for the first time. The content of the tickets printed is the same. For elderly users, these printed messages offer cognitive reinforcement and a reminder of their spiritual practice, addressing potential memory challenges while providing comfort through physical artifacts of faith that persist beyond the immediate interaction.

A final aspect worth mentioning is the handling of failures. When the speech recogniser cannot detect any sound, CelesTE will switch to standby after two attempts. When some words are detected but not understood, one more attempt to repeat the voice input is given. If the second time also fails, it will switch to "praying mode". CelesTE is capable of generating a prayer based on chunks of existing prayers, in the same way as SanTO-PL. This application of Procedural Content Generation (PCG) has also been validated in collaboration with members of the clergy, who verified the consistency of the output text of the new prayer.

4. Qualitative studies

CelesTE was developed for the Horizon 2020 e-ViTA project and underwent initial tests in three different countries (Germany, France and Italy) with a total of ten participants, as shown in detail in Table 1. The range of the participants' ages was from sixty to eighty-seven years old, with a median age of sixty-five.

Table 1 Participants' information and experimental setting.

ID	Age	Sex	Religious attitude	Experimental setting
IT01	60	M	Christian Catholic, non-practising	Living Lab
IT02	62	F	Christian Catholic, non-practising	Living Lab
IT03	65	M	Atheist	Living Lab
IT04	64	F	Christian Catholic, practising	Living Lab
FR01	87	F	Atheist	Home
FR02	82	F	Christian Catholic, practising	Living Lab
FR03	81	M	Christian Catholic, non-practising	Living Lab
GE01	60	F	Christian Catholic, practising	Church
GE02	65	F	Christian Catholic, practising	Church
GE03	70	F	Christian Catholic, practising	Church
GE04	75	F	Christian Catholic, practising	Church

The interactive session typically lasted five to ten minutes. After an introduction to the device, we let the participant repeat the trials they wanted. An interview followed, aiming to go in-depth and focus on more concrete feedback regarding specific aspects of the device's design and usability. Within this interview, some quantitative data was also collected, but to include it here would go beyond the scope of this paper.

One of our biggest concerns was whether it would cause any discomfort. CelesTE was judged to be not uncanny overall: on a scale of one to five points, only two participants rated it two out of five, while the rest judged it to be completely not uncanny (one out of five). No participant felt unsafe.

Regarding the interviews, here is a list of the most insightful comments.

- "The quality of the bibliography and its pertinence to the context should be improved" (IT03)
- "The finger as an activation method could be improved" (IT02)
- "Should be possible to ask for additional clarifications on a certain topic" (FR03)
- "Too Catholic" (FR03)
- "It would be good for my mother, who is 83 years old" (GE01)
- "Too slow, makes too many pauses" (GE04)
- "Would be good for someone who lives alone and has nobody to speak to" (GE04)
- "Could reproduce some music" (GE04)
- "Please add a way to regulate the volume" (FR02, FR03)

As robot developers, we believe that not all comments must necessarily be addressed. Each user may want something different according to their personal preferences, and some may not want or need such a robot. GE04 offers three comments which demonstrate the variety of opinions and the different weighting that the roboticist should attach to them. Specifically, the comment about the ideal user, someone who lives alone, confirms the target users we had in mind for this robot concept. At the same time, it clarifies that GE04 is not such a user profile. If we see things in this light, the comment about music may be seen as just a personal preference expressed by someone who would not use the robot anyway. We believe that, at best, music would be an interesting functionality, but should not be included in the core value provided by the object. Finally, the comment about CelesTE being too slow is purely technical, and effort should be made to resolve the issue.

Additionally, very valuable insights actually came from observing the interaction during the experiments. From previous studies, we know that the timing of vocal communication (i.e. when the user can or cannot speak, corresponding to the device's recording time win-

dow) is critical for successful communication. When not performed correctly, the communication fails. In the present series of experiments, we confirmed that it took a few trials for the participants to get used to the correct usage of the device. The redundancy of signals (coloured light and sound) seems to be useful as well, as the user may concentrate on hearing and thus miss out on some of the visual signals.

Another critical detail was the need to recharge the printer battery or for the user to replace its paper. With the current (R2) design of the base, that is not easy. A redesign of the lower box is therefore needed in order to extract the printer easily and safely.

5. Conclusion

In this paper, we have introduced some critical points regarding the SanTO Catholic robot and the concept and development of CelesTE, a device that embodies an angel praying, on the top of an ionic pillar. CelesTE was designed to be employed in the Horizon 2020 project called e-ViTA, in which older adults are offered cognitive support for healthy living. Through a participatory design that involved end users, the concept and shape of CelesTE took place.

For the early findings shown in this paper, we witnessed a positive response from the users. Some improvements are needed on the interaction method, and some contents need to be refined in terms of their relevance and accessibility to our target audience. The most important insight refers to the target audience, which seemed to be more appropriate for an older generation (over 80 years of age) than the currently targeted range of 65- to 75-year-olds. For future work, we may need to distinguish between different user profiles for CelesTE. On one hand, the oldest generation is the ideal target, and CelesTE should be specifically designed to overcome any kind of impairments they may have. On the other hand, we plan to revise the concept and functionalities in order to better meet the needs of a younger audience (65–75 years old).

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