Exploring Geolocation and Emergency Alerts in Public Health Services via TV 3.0 in Brazil

Kellyanne Carvalho Alves,
Michel Adelino da Silva
Giuliano Maia Lins de Castro
Claudio Alexandre Schneider Lavid
Rafael Moura Toscano da Nóbrega
Thayná Rodrigues Lopes Tolentino
Lucas Aversari
Richelieu Ramos de Andrade Costa
Yuri Fernandes Souza Silva
Derzu Omaia
Guido Lemos de Souza Filho

CITE THIS ARTICLE

Kellyanne Carvalho Alves, Michel Adelino da Silva, Giuliano Maia Lins de Castro, Claudio Alexandre Schneider, Rafael Moura Toscano da Nóbrega, Thayná Rodrigues Lopes Tolentino, Lucas Aversari, Richelieu Ramos de Andrade Costa, Yuri Fernandes Souza Silva, Derzu Omaia, Guido Lemos de Souza Filho; 2025. Exploring Geolocation and Emergency Alerts in Public Health Services via TV 3.0 in Brazil. SET INTERNATIONAL JOURNAL OF BROADCAST ENGINEERING. ISSN Print: 2446-9246 ISSN Online: 2446-9432, doi: 10.18580/setijbe.2025.3 web link: https://dx.doi.org/10.18580/setijbe.2025.3

SET INTERNATIONAL JOURNAL OF BROADCAST ENGINEERING – SET IJBE V.11, 2025, Article 3 | 8 p
 | ISSN (Print): 2446-9246 | ISSN (Online): 2446-9432

Exploring Geolocation and Emergency Alerts in Public Health Services via TV 3.0 in Brazil

Kellyanne Carvalho Alves, UFPB, Michel Adelino da Silva, UFPB, Giuliano Maia Lins de Castro, UFPB, Claudio Alexandre Schneider, Lavid/UFPB, Rafael Moura Toscano da Nóbrega, Lavid/UFPB, Thayná Rodrigues Lopes Tolentino, IFPB, Lucas Aversari, Lavid/UFPB, Richelieu Ramos de Andrade Costa, UFPB, Yuri Fernandes Souza Silva, UFPB, Derzu Omaia, UFPB, Guido Lemos de Souza Filho, UFPB.

Abstract— The Brazilian Digital Terrestrial Television System (SBTVD-T), implemented in 2007, is undergoing a major upgrade with the development of its third generation, TV 3.0, coordinated by the Brazilian Forum of Digital Terrestrial TV (SBTVD). TV 3.0 introduces innovations such as the personalization of content based on the viewer's profile, the integration of transmission via broadcast and broadband, geolocation, targeted advertising, emergency alert, accessibility and automatic subtitling, in addition to improving image quality (4k and 8K) and immersive audio. This article presents an interactive application integrated with Meu SUS Digital (My Digital Unified Health System), the official Ministry of Health app and digital gateway to the Unified Health System (SUS), focusing on geolocation and emergency alerts. Developed under the project "TV 3.0: Interactive and Inclusive Applications in Health and Education on Public TV", the solution includes two public health applications: the Meu SUS Digital TV app, for appointment scheduling, telehealth, and locating nearby health centers via the TV 3.0 geolocation API; and the Blue November Campaign app, for targeted public health campaigns. The integration enables location-based services, epidemic emergency alerts, and optimized healthcare management. Therefore, the application demonstrated the potential of TV 3.0 as an innovative technological tool for improving the delivery of public health services and promoting greater effectiveness in the implementation of national health policies. The continuous improvement of this research is essential to ensure that the benefits of Digital TV effectively reach the population.

***Index Terms*— TV 3.0, Geolocation, Interactivity, Connected health, Digital inclusion, Accessibility.**

I. INTRODUCTION

The digital television in Brazil has undergone constant technological advancements, especially since the implementation of the Brazilian Digital Terrestrial Television System (SBTVD-T) in December 2007. Currently, the third generation of the standard (TV 3.0) is imminent in Brazil. As a result, the television industry must prepare for a significant transformation in how content is produced, transmitted, and consumed. Coordinated by the Brazilian Digital Terrestrial TV System Forum (SBTVD Forum), the TV 3.0 Project aims to incorporate innovations such as hybrid transmission (broadcast and broadband), content personalization, targeted advertising, improved accessibility, automatic captioning, support for 4K and 8K resolution, immersive audio, and features focused on geolocation and emergency alerts. The new generation of the Brazilian TV standard is scheduled for implementation starting in late 2026.

Among the possible applications of this new technological generation is the integration of essential public services with the TV 3.0 infrastructure. In this context, the potential for interactive digital television as a strategic tool to strengthen the Unified Health System (SUS) stands out. Using the TV 3.0 geolocation API, it becomes possible to develop solutions that display, in real time, the nearest health centers to the viewer, optimizing care management and reducing the burden on specific units. Furthermore, the same platform can be used to broadcast location-targeted public health campaigns and to issue emergency alerts in critical situations, such as epidemic outbreaks or natural disasters.

This article proposes an interactive application integrated with the Meu SUS Digital service, exploring the functionalities of TV 3.0 with a focus on geolocation and emergency alerts. The interactive application for TV 3.0 in health was developed by researchers from the research project "TV 3.0 PROJECT: Interactive and Inclusive Applications in Health and Education on Public Television." This project leverages technological advances designed for the TV 3.0 standard to create innovative solutions for health services and media education on Brazilian public television through interactive and inclusive applications. Two applications were implemented: the Meu SUS Digital TV app, which offers a solution for health services through appointment scheduling and telehealth services, and the Blue November Campaign app, which is a solution for developing targeted advertising aimed at public health campaigns on television.

The initiative seeks to demonstrate how this technological convergence can contribute to a more effective response to health crises, in addition to representing a step forward in the democratization of access to information and health services. By highlighting the benefits of this integration, the aim is to reinforce the role of TV 3.0 as an instrument of social innovation and strengthening public policies in Brazil.

II. EVOLUTION OF DIGITAL TELEVISION IN BRAZIL

The Brazilian Digital Terrestrial Television System (SBTVD-T) is ten years old. Since its creation in 2006 and its first broadcast in December 2007, its main function has been to establish guidelines for the migration from analog to digital signals, enabling the public to receive programming with better image and sound quality, without interference such as static or ghosting. [1]. The main feature that distinguishes the Digital TV platform from the analog one is the processing of the audiovisual signal using digital techniques (coding, compression and transmission). Due to this digital processing of television content, robust reception

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.1 Web Link: https://dx.doi.org/10.18580/setijbe.2025.3

is noticeable to the user, with an improvement in the quality of television signal reception [2].

Since 2020, the SBTVD Forum, responsible for the standardization and technological evolution of the system, has initiated studies and public calls for proposals for the development of TV 3.0. This new digital television paradigm focuses on personalizing the user experience, integrating traditional broadcasting and the internet (broadband), and incorporating emerging technologies such as artificial intelligence, geolocation, and cloud computing [3].

TV 3.0 represents a technological breakthrough that expands the role of television as a communication medium to an interactive and personalized service platform. The new guidelines propose the use of high-efficiency coding (VVC), 4K and 8K resolutions, immersive audio, and mechanisms that allow the content displayed to be adapted in real time to the viewer's profile and location.[4] This means that television is no longer just an entertainment channel, becoming a strategic tool for digital inclusion and public service delivery.

Geolocation functionality, for example, can be used to display hyperlocal content, such as community news, safety alerts, and targeted public health campaigns. Emergency alert systems will be able to send visual and audio messages in situations of collective risk, utilizing the broadcast infrastructure, which has broad national reach, especially in regions with limited internet access [5].

III. GEOLOCATION AND EMERGENCY ALERT IN PUBLIC SERVICES

Geotechnologies have been used in risk and disaster management by different fields of knowledge. In disaster risk prevention, different fields of knowledge have contributed with diverse applications through risk mapping. [6]. In the context of natural disasters, epidemics, or health emergencies, location-based systems enable faster and more targeted responses, with less waste of resources and greater population reach.

Emergency Alert Systems (EAS) have been widely studied in international contexts, particularly in countries such as Japan and the United States, which use television and radio as their primary means of disseminating alerts. The adoption of these systems in digital environments allows for greater flexibility in the way information is displayed and enables customization based on location and user profile [7].

TV 3.0 has a Webservice module that allows local and non-local applications (on companion devices) to access various information and content from the TV, including emergency alerts. This allows applications to access alerts and also display them on the TV itself [15].

Emergency alerts may reference external applications, such as the Meu Sus Digital TV app, for health alert situations. To do this, the alert must be configured so that one of its media channels is the Meu Sus Digital TV app [15].

Health emergency alert situations, such as infectious disease epidemics, are already covered by the Brazilian Disaster Classification and Coding (COBRADE) [14] and can be indicated in the TV 3.0 emergency alert configuration.

IV. DIGITAL TECHNOLOGIES IN THE UNIFIED HEALTH SYSTEM

Digital transformation in the Unified Health System (SUS) is one of the pillars of Brazil's public administration modernization strategy. Initiatives such as Conecte SUS and Meu SUS Digital aim to bring citizens closer to health services through accessible and interoperable platforms. These tools have the potential to improve coverage of vaccination campaigns, appointment scheduling, medication distribution, and preventative health guidance.

However, without internet access, televisions will have content already made available by open channels and broadcast via free open signal. [8].

V. METHODOLOGY

The research adopts an applied development research approach based on the Design Science methodology [9], using Design Science Research (DSR) as its method. This methodology, known as "design science," works based on artifacts. In other words, an artifact is the object of study. To generate knowledge, it is necessary to articulate three elements: the objective, the artifact's character, and the external environment in which it is inserted [9].

Based on this perspective, the methodological process consists of design as an artifact that aims to solve relevant problems through rigorous evaluation in order to produce scientific and technological knowledge [10, 11, 12]. The DSR method consists of processes that range from identifying the problem and research objective, through development, demonstration, and evaluation, to the dissemination of results through communication and dissemination of the knowledge generated. The DSR method offers valuable guidelines for the development of applications developed by the research project, as it considers the understanding of the users' reality from the search for viable solutions based on the well-defined objective to the evaluation considering the specificities and dimensions present in the real context.

VII. RESULTS AND DISCUSSION

A. Interaction Design Development

The design development of the Meu SUS Digital TV and Blue November Campaign apps was guided by the fundamental principles of interaction design, based on a multidisciplinary team that considered Interaction Design [13] based on well-defined activities, applying a process that has the following steps: 1) identifying needs and establishing requirements; 2) developing designs that meet the requirements; 3) creating interactive versions of the designs for team review; and 4) continuously evaluating the development process by the design and development teams [13].

During this process, the team sought to achieve two main Interaction Design goals: usability goals and user experience goals. The usability goals are effectiveness, efficiency, safety, usefulness, learnability (easy to learn), and memorability (easy to remember how to use). Regarding the user experience, the application is developed based on the

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.1 Web Link: https://dx.doi.org/10.18580/setijbe.2025.3

 | ISSN (Print): 2446-9246 | ISSN (Online): 2446-9432

goals of making the system pleasant, satisfying, interesting, useful, motivating, fun, aesthetically pleasing, rewarding, emotionally appropriate, and creative [13].

B. Geolocation and Healthcare Network Information

Regarding geolocation, the application displays a catalog of healthcare facilities with relevant information, including name, specialties, location data, and distance. The interface uses geolocation data provided by the TV 3.0 API, thus displaying the healthcare facilities closest to the user. Filters by healthcare facility type, such as UBS and Hospital, were implemented to refine the televiewer's search. These results indicate that TV 3.0, by providing the location of the receiver linked to Meu SUS Digital, will allow the application to effectively assist in care management, directing citizens to the most appropriate and closest service.

Accessibility and Telehealth

The telehealth functionality of the Meu SUS Digital TV application significantly improves accessibility to public health services. Through this tool, we offer audiovisual interaction between patients and healthcare professionals. For the general public, this also overcomes geographic barriers, benefiting residents of remote areas or those with limited access to specialized centers.

Telehealth also reduces direct and indirect costs for patients, such as transportation expenses and lost workdays, making it especially beneficial for individuals with reduced mobility. This also helps minimize traffic flow in in-person healthcare facilities and generates greater access to the Unified Health System.

C. Implementation of an Alert and Notification System

A visual and audio notification system was developed and tested. For queue management, the system includes progress indicators, pop-ups, and audio alerts that capture attention and guide televiewers through the queue waiting process for Meu SUS Digital TV telehealth services. In parallel, a similar notification mechanism is used to issue emergency alerts. Its application on TV allows for the rapid dissemination of impactful visual and audible warnings, which are crucial for responding to public health crises such as epidemics and natural disasters.

The robustness of these notification mechanisms on TV demonstrates the technical potential for managing service flows, such as telehealth services, and for effectively disseminating critical alerts. The Meu SUS Digital TV app design includes geolocation, emergency alerts, and telehealth features, which were tested during the project. Figure 1 presents the application's home screen, offering access to healthcare services and informational content. As shown on Figure 2, the geolocation functionality enables televiewers to search for nearby health units based on their current location.

The telehealth module (Figures 3-8) provides a complete flow for remote medical consultations. Initially, viewers can schedule an appointment by entering their *Cadastro de Pessoas Físicas* (CPF), the Individual Taxpayer Registry maintained by the Brazilian Federal Revenue Service (Figure 3). This service is integrated with the API of the *João Pessoa na Palma da Mão* application. If preferred, televiewers may scan a QR code displayed on the TV to join a consultation queue instantly (Figure 4).

Fig. 1. Home of the service Meu Sus Digital TV, offering health services and health content options.

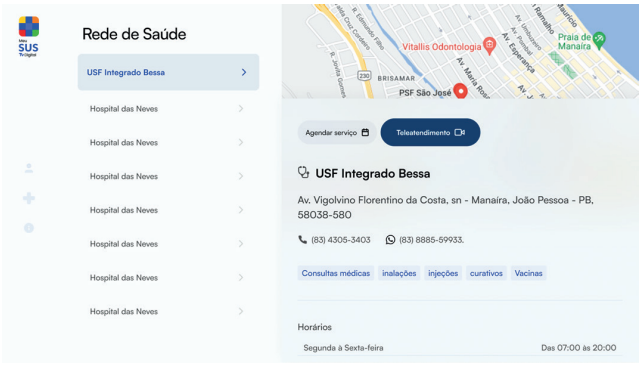


Fig 2. It showcases the search of nearby units for health service based on geolocalization.

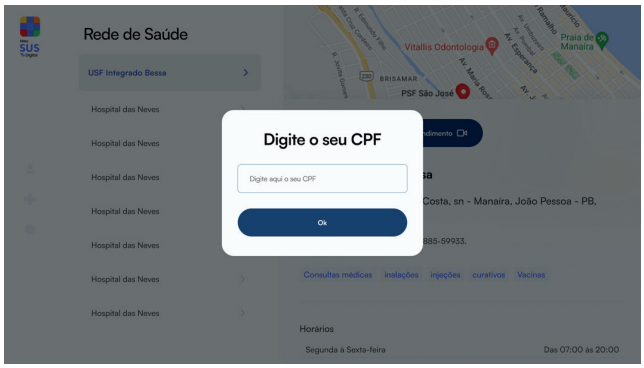


Fig 3. The viewer has the option to schedule a medical consultation by entering his Individual Taxpayer Registry number.

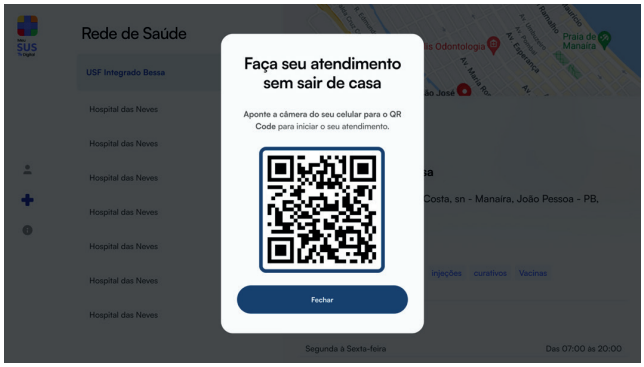


Fig 4. If the viewer wants to seek medical consultation, they can scan a QR Code on the TV and will immediately enter a queue for the service.

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.1 Web Link: https://dx.doi.org/10.18580/setijbe.2025.3

 | ISSN (Print): 2446-9246 | ISSN (Online): 2446-9432

While waiting, viewers can return to their TV program, with a small on-screen card showing their queue position (Figures 5-6). As they approach the front of the queue, the system notifies them when only one person remains (Figure 7) and then alerts them with both a popup and an audible notification when it is their turn to enter the virtual consultation room (Figure 8).

Fig 5. After the viewer is on the queue he has the option to come back to the channel in order to watch while waiting his turn to enter the medical consultation room.

Fig 6. Once the viewer has accepted to watch while wait for his turn on the queue, there's a tiny card on the top left showing the number of people on the queue to get his turn.

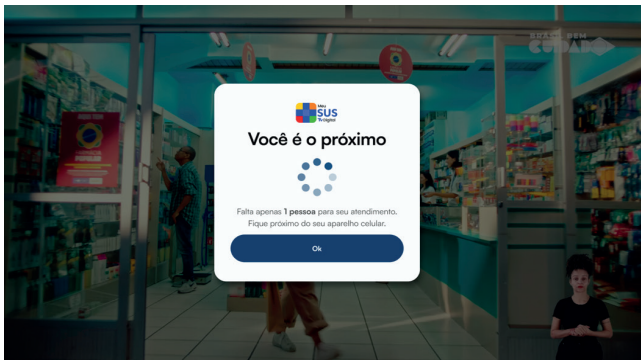


Fig 7. When there's just 1 person left on the queue, it says to the televiewer and he's the next person to get on the virtual room.

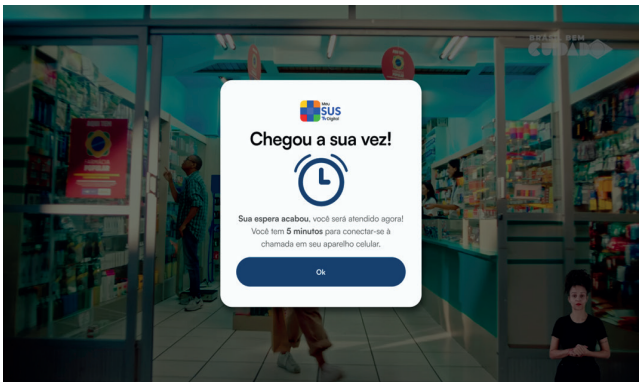


Fig 8. By getting on his turn, the viewer can see a popup saying it's his turn and can hear a notification sound.

The implementation of the Blue November campaign on the TV 3.0 application yielded promising results in the context of health promotion and prostate cancer prevention, particularly through tools accessible directly via digital television. The proposal consisted of creating a specific module focused on screening for possible symptoms, based on a simple and straightforward questionnaire, to encourage users to seek medical evaluation.

At the end of the test, the system analyzed the responses provided and, if it identified relevant signs, offered the user the option to schedule a preventive appointment, integrating with the municipal public health João Pessoa na Palma da Mão app. This app is currently operational and serves as a tool for citizens to access municipal public services, such as scheduling public health appointments. This functionality, which integrated the TV app with João Pessoa na Palma da Mão, further reinforces the role of TV 3.0, which is not only a vehicle for information but also an active means of connecting citizens with public health services.

The visual interface for this campaign was designed with a focus on accessibility and user experience. Navigation was structured to be fluid, clear, and intuitive, following readability and contrast guidelines recommended for television screens (Figures 9-11). The layout employs well-defined information blocks, moderate use of corporate colors (dark blue and white), and prominent action buttons to facilitate remote control interaction (Figures 9 and 10).

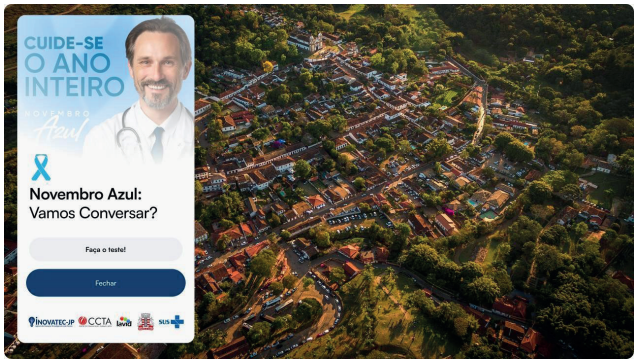


Fig 9. The Blue November App campaign features a user-friendly interface that easily attracts the public, with few options to improve its usability.

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.1 Web Link: https://dx.doi.org/10.18580/setijbe.2025.3

 | ISSN (Print): 2446-9246 | ISSN (Online): 2446-9432

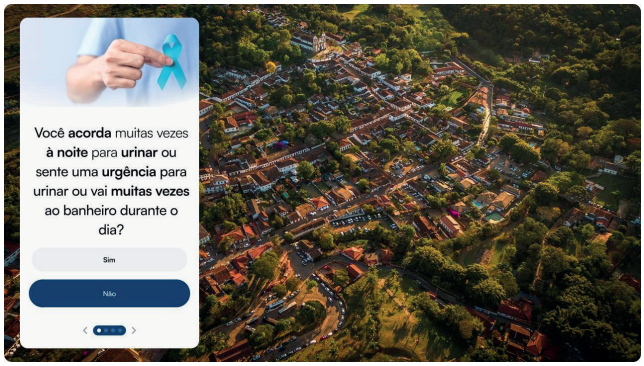


Fig 10. When starting with the first interactive question the viewer can choose between yes or no.

The screening test was completed smoothly, and it was clear that each question clearly indicated the next step at the end of the questionnaire. This means that a QR code is used to direct you to the medical waiting list, facilitating the transition between devices by eliminating bureaucratic steps and providing immediate access to the healthcare system through the João Pessoa app in the Palm of Your Hand.

Fig 11. When you finish answering the quiz questions, the results of your symptoms are shown and you can be directed to schedule an appointment.

Therefore, the use of TV 3.0 as an engagement platform in campaigns like Blue November has proven particularly effective for audiences who, due to digital limitations or educational backgrounds, don't frequently use smartphones or computers. Television, a medium traditionally present in Brazilian homes, has proven ideal for this strategy, making the service more inclusive.

VIII. ARCHITECTURE AND IMPLEMENTATION

The software architecture designed for the Meu SUS Digital TV and Blue November Campaign applications was structured modularly, aiming for scalability, interoperability with public health systems, and adherence to the technical specifications of the TV 3.0 standard. The adopted architectural model follows the distributed client-server paradigm with hybrid broadcast/broadband integration, allowing functionality to be executed both locally, on the TV receiver, and remotely, on application servers and institutional databases.

A. Presentation and Interactivity Layer

Located in the Ginga middleware adapted for TV 3.0, this layer is responsible for the graphical interface and user interactions via the remote control. It includes:

Geolocation Module: Obtains coordinates via the TV 3.0 native API and triggers queries to remote services for feedback from nearby healthcare facilities.

Teleconsult Module: Manages the audiovisual connection between patients and healthcare professionals, ensuring secure and stable teleconsultations. The module integrates directly with the Meu SUS Digital APIs, allowing access to essential information and efficient service recording.

Notifications and Alerts Module: Displays pop-ups, banners, and audio alerts based on events received by the TV 3.0 Emergency Alert System.

Interactive Campaign Interface: In the case of Blue November, it collects user responses to questionnaires and directs scheduling flows.

B. Business Logic Layer

Hosted on secure web servers, this layer implements the core rules and functional workflows of the proposed applications: Location and Routing Service, Campaign Management Service, Teleconsultation Management Service, Public Systems Integration Service.

Location and Routing Service: Processes geographic coordinates received from the TV, queries the National Registry of Healthcare Establishments (CNES) database, and applies filters according to the type of healthcare unit.

Campaign Management Service: Configures dynamic content, defines geographic segmentation, and collects user responses.

Teleconsultation Management Service: Manages the scheduling, authentication, and mediation of teleconsultation sessions.

Public Systems Integration Service: Ensures interoperability with external platforms, such as João Pessoa na Palma da Mão and Meu SUS Digital, through RESTful APIs.

C. Integration and Data Layer

REST APIs and Web Services manage communication between the TV application and the server (backend). These technologies are essential to ensure the TV can send requests and receive data, such as user information, video catalogs, and playback status, efficiently and securely.

A relational database (PostgreSQL) securely stores interaction records, call center history, and usage metrics. This choice ensures data integrity and facilitates the analysis of information essential for system operation and improvement.

Query Caching and Optimization were implemented to reduce latency and ensure near-real-time responses to requests from the TV application. This component temporarily stores the results of frequent queries in high-performance volatile memory, minimizing the number of accesses to the relational database. Furthermore, indexing, query planning, and join adjustment techniques were applied to improve the efficiency of read operations, ensuring that

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.1 Web Link: https://dx.doi.org/10.18580/setijbe.2025.3

critical information, such as healthcare facility listings or telehealth status, is retrieved quickly and stably, even under high simultaneous user demand.

D. Communications Infrastructure

Broadcast channel to deliver the application and its basic interface content directly to TVs. This method ensures the platform is available efficiently and accessibly, even in areas with limited connectivity.

Broadband (Internet) channel for dynamic services, such as real-time geolocation, teleconsultations, and campaign updates.

Gateway to send alerts reliably and in compliance with ABNT NBR 25607. This standard establishes the requirements for alert systems, ensuring that messages are delivered securely and efficiently, especially in critical situations. 5. Validation and Testing

The implementation underwent functional, performance, and usability testing:

Telecare Testing: Detailed assessments of video and audio stability under various bandwidth conditions, ensuring communication quality during teleconsultations and other remote interactions.

Alert Testing: Simulation of health emergency messages to validate the visual and audio impact of alerts, ensuring they are effective and easily perceived by users.

Usability Assessment: Analysis with real users to measure the readability, navigation, and response time of the interface, optimizing the user experience and accessibility of the platform.

This architecture, already validated in a real environment, demonstrated technical robustness and operational feasibility, fully exploiting the capabilities of TV 3.0 for the integration of public health services. The combined use of geolocation, interactivity, and hybrid communication highlights the platform's potential to expand the reach and efficiency of public health policies in Brazil.

IX. CONCLUSION

The third generation of the Brazilian Digital Terrestrial TV System, conceived by the TV 3.0 Project of the Brazilian Digital Terrestrial TV Forum (SBTVD), represents a revolution in the way we consume television content, offering a variety of innovative features and functionalities. TV 3.0 promises to provide a more immersive and interactive viewing experience by allowing viewers greater personalization and control over the content they watch.

In this context, TV 3.0 becomes a powerful tool for public communication, allowing broadcasters to expand their engagement with the public. One of the enhanced features is the broadcaster's ability to map their audience's consumption and suggest content segmented by region or neighborhood, which includes geolocation and targeted advertising features. It also includes emergency alert functionality for natural disasters, as well as epidemics and health emergencies.

With geolocation, emergency alert, and targeted advertising features in mind, the interactive apps Meu SUS Digital TV and Blue November Campaign bring relevant contributions to the field of research into the development of interactive interactions for television by proposing solutions that seek to improve public health policies based on television communication strategies, especially within the scope of public broadcasters.

ACKNOWLEDGMENT

The project is supported by Inovatec-JP through a funding call launched by the city of João Pessoa, the Municipal Secretariat for Science and Technology (SECITEC), the Municipal Secretariat for Communication (SECOM), the Municipal Secretariat for Economic Development and Work (SEDEC), and TV Cidade João Pessoa. The research also had the partnership of the João Pessoa Municipal Health Department and the Secretariat of Information and Digital Health (SEIDIGI) of the Brazilian Ministry of Health.

REFERENCES

[1] SET – Sociedade Brasileira de Engenharia de Televisão, “Sistema Brasileiro de Televisão Digital Terrestre completa dez anos,” SET News, Aug. 30, 2016. [Online]. Available: https://set.org.br/set-news/sistema-brasileiro-de-televisao-digital-terrestre-completa-dez-anos/. [Accessed: Aug. 1, 2025].

[2] R. S. de Figueiredo, “A definição do padrão de TV digital no Brasil: um estudo sobre a construção social de um padrão tecnológico,” M.S. thesis, Escola de Administração de Empresas de São Paulo, Fundação Getulio Vargas, São Paulo, Brazil, 2009. [Online]. Available: https://repositorio.fgv.br/server/api/core/bitstreams/14856253-46d1-400d-a432-ae7861bf699b/content. [Accessed: Aug. 1, 2025].

[3] Fórum SBTVD – Fórum do Sistema Brasileiro de TV Digital Terrestre. Available: https://www.forumsbtvd.org.br/tv3_0/. [Accessed: May 10, 2025].

[4] A. Boquimpani, “DTV Play - A nova plataforma de interatividade na TV Digital 2.5 e como ela vai evoluir para a TV 3.0,” Revista SET, no. 203, 2022. Online]. Available: https://set.org.br/wp-content/uploads/2018/01/REVISTASET_203_GT-TV-3.0.pdf. [Accessed: Dezl. 18, 2023].

[5] R. R. A. Costa, D. Omaia, T. M. U. Araújo, J. O. Pereira, M. P. S. Cruz, M. M. Barbosa, R. Toscano, and G. L. S. Filho, “Suporte a alertas de emergência na TV 3.0 brasileira,” in Proc. Workshop Futuro da TV Digital Interativa – Simpósio Brasileiro de Sistemas Multimídia e Web (WebMedia), 30th ed., Juiz de Fora, Brazil, 2024, pp. 303–308. doi: 10.5753/webmedia_estendido.2024.244412.

[6] V. Marchezzini, A. Y. Iwama, M. R. M. de Andrade, R. Trajber, I. Rocha, and D. Olivato, “Geotecnologias para prevenção de riscos de desastres: usos e potencialidades dos mapeamentos participativos,” Revista Brasileira de Cartografia, vol. 69, no. 1, 2017. doi: 10.14393/rbcv69n1-44035. [Online]. Available: https://seer.ufu.br/index.php/revistabrasileiracartografia/article/view/44035. [Accessed: Jul. 28, 2025].

[7] D. Bonaretti and D. Fischer-Preßler, “From digital public warning systems to emergency warning ecosystems,” in Disaster Management and Information Technology, Public Administration and Information Technology, vol. 40, Cham, Switzerland: Springer, 2023, pp. 381-391. doi: 10.1007/978-3-031-20939-0_17.

[8] BRASIL, Ministério das Comunicações, "Ministério das Comunicações responde às principais dúvidas sobre a TV 3.0," Gov.br, Apr. 10, 2024. [Online]. Available: https://www.gov.br/mcom/pt-br/

preliminary version.noticias/2024/abril/ministerio-das-comunicacoes-responde-as-principais-duvidas-sobre-a-tv-3.0. [Accessed: Aug. 1, 2025].

[9] H. A. Simon, The Sciences of the Artificial, 3rd ed. Cambridge, MA, USA: MIT Press, 1996.

[10] A. Dresch, D. P. Lacerda, and J. A. V. J. Antunes, Design Science Research: Método de Pesquisa para Avanço da Ciência e Tecnologia. Porto Alegre, Brazil: Bookman, 2015.

[11] K. Peffers, T. Tuunanen, M. A. Rothenberger, and S. Chatterjee, "A design science research methodology for information systems research," Journal of Management Information Systems, vol. 24, no. 3, pp. 45-77, 2007.

[12] V. Vaishnavi and B. Kuechler, Design Science Research in Information Systems: Overview of Design Science Research. AIS, 2004.

[13] J. Preece, Y. Rogers, and H. Sharp, Interaction Design: Beyond Human-Computer Interaction, 6th ed. New York, NY, USA: John Wiley & Sons, 2023.

[14] COBRADE, Classificação Brasileira de Desastres, 2016. [Online]. Available: https://educacao.cemaden.gov.br/midiateca/classificacao-e-codificacao-brasileira-de-desastres-cobrade/. [Accessed: Aug. 1, 2025].

[15] ABNT, NBR 25607 - TV 3.0 - Emergency Warning System

Michel Adelino da Silva, researcher at the Center for Research and Extension in Digital Video Applications (LAVID) of the Federal University of Paraíba. Computer Science student at Federal University of Paraíba (UFPB). IEEE member since 2022, sub-editor of Enlaces Magazine of region 9 (Latin America) Student Activities Committee in 2025. Works in research and software engineering with an emphasis on Digital TV.

Giuliano Maia Lins de Castro is a Computer Science specialist with experience in Interactive Digital TV, the Ginga middleware, and systems architecture. He holds degrees in Computer Science and Telematics, an MBA from PUCRS, and is currently a Master's student in Informatics at UFPB, where he researches datacasting solutions for Digital TV. He contributed to the development of Brazilian Digital TV standards through the FLEXTV project and participated in technical working groups of the SBTVD Forum for TV 3.0, including activities related to requirements elicitation for TV 3.0 applications aimed at public broadcasters, in partnership with EAD. He also took part in the development of the first Brazilian Digital TV multiplexer, as well as in projects such as MP-SeAC (real-time monitoring of more than 200 pay-TV channels) and LabTVDi, in collaboration with RNP, focused on validating interactive applications. He is a director at MoPA, a company responsible for implementing the Ginga middleware in millions of set-top boxes and television sets in Brazil, contributing directly to the large-scale deployment of interactivity within the SBTVD. His work bridges research, standardization, and practical implementation of key technologies for Brazilian Digital TV.

Kellyanne Carvalho Alves has been a Professor at the Department of Communication at the Federal University of Paraíba (UFPB) at the Tourism, Communication and Arts Center since 2023. She is currently the vice-coordinator of the Post-Graduate Program in Journalism – Professional Master's Degree at UFPB. She holds a PhD in Communication from the Federal University of Pernambuco (UFPE) with a doctoral internship at Pompeu Fabra University, in Barcelona, Spain. Researcher at the Center for Research and Extension in Digital Video Applications (LAVID), at the UFPB Computer Science Center since 2006. Researcher at GP Television and Televisual Studies at Intercom. She holds a master's degree in Digital Television at State University of São Paulo Júlio de Mesquita Filho, studying in the line of Information and Communication Management for Digital TV. She holds a bachelor's degree in Radio and TV and Journalism at UFPB. Author of the book Active Sources: collaboration of active audiences on television news in Brazil and Spain.

Claudio Alexandre Schneider is a technical lead at MoPA Embedded Systems, where he has worked since 2010. He holds a master's degree in Electrical and Computer Engineering and a bachelor's degree in Computer Science from the Federal University of Rio Grande do Norte. A member of the technical committee of the Brazilian Digital TV Forum, he has contributed to the enhancement of the Ginga-NCL, Ginga-HTML5, and NCLua specifications used in the Brazilian Digital TV System. He is currently involved in developing the technical standards for TV 3.0.

Rafael Moura Toscano da Nóbrega is a designer and researcher in the area of media and interaction. Researcher at the Center for Research and Extension in Digital Video Applications (LAVID) of the Federal University of Paraíba. He holds a master's degree in Computer Science, Communication and Arts and bachelor's degree in Digital Media Communication from the Federal University of Paraíba (UFPB).

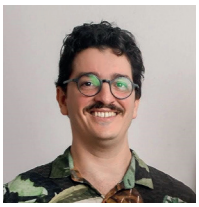
Thayná Rodrigues Lopes Tolentino is an undergraduate student in Internet Systems at Federal Institute of Paraíba (IFPB), with strong skills in graphic design, image editing, and web development. My main academic and professional focus is UX/UI Design, where I seek to combine creativity and technical expertise to create functional, accessible, and user-centered interfaces. I also have practical experience in Front-End Development, applying usability principles and visual design techniques to build intuitive and visually appealing user interfaces. Throughout my academic and professional journey, I have actively participated in projects related to UX/UI Design and Web Development, which has strengthened my organization, delivery capabilities, and technical skills.

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.1 Web Link: https://dx.doi.org/10.18580/setijbe.2025.3

 | ISSN (Print): 2446-9246 | ISSN (Online): 2446-9432

Lucas Aversari has been a researcher at the Digital Video Applications Laboratory (LAVID) since 2015. He holds a degree in Computer Science from the Federal University of Paraíba (UFPB) and a master's degree in distributed systems from the same university. He is the co-founder and CTO of Wisecare Tecnologia, a company specialized in secure videoconferencing solutions for healthcare, since 2020, and is the product manager at MoPA Embedded Systems since 2022. He works in research and development of synchronous, secure, and distributed video solutions, digital TV, and embedded systems. He also has experience in information systems security and artificial intelligence.

Richelieu Ramos de Andrade Costa, Project Advisor at the Information Technology Center of the Federal University of Paraíba. Computer Engineer at the Federal University of Paraíba (UFPB) since 2019, Master in Computer Science from the Graduate Program in Computer Science (PPGI-UFPB), researcher at the Center for Research and Extension in Digital Video Applications (LAVID). He was one of the authors of the TV 3.0 technical standards projects: ABNT NBR 25606, 25607, and 25608 (Sign Language, Emergency Alerts, and Application Encoding). He works in research and development in the field of Computer Science, with an emphasis on Digital TV and Accessibility.



Derzu Omaia holds a PhD in Computer Science from the Federal University of Pernambuco (UFPE). He also holds a Master's degree in Computer Science from the Federal University of Paraíba (UFPB). He has been a professor at the UFPB Computer Science Center since 2012 and a researcher at the Center for Research and Extension in Digital Video Applications (LAVID) at the same university since 2006. He is a researcher at VLibras (vlibras.gov.br) - an open platform for automatic translation into LIBRAS for the Web, Digital TV, Cinema, and mobile devices, installed on more than 120,000 websites, including those of the Federal Government, Federal Chamber of Deputies, and Federal Senate. He was also one of the authors of the TV 3.0 technical standards projects: ABNT NBR 25606, 25607, and 25608 (Sign Language, Emergency Alerts, and Application Encoding). He worked on the development of the Ginga middleware and multiplexer for TV 2.0, adopted as the standard in the Brazilian Digital Television System and several other Latin American countries. He works in the field of Computer Science, with an emphasis on Digital TV, Accessibility, Machine Learning, Virtual Reality, and Augmented Reality.

Guido Lemos de Souza Filho, Secretary of Science and Technology of João Pessoa; Full Professor at the UFPB Computer Science Center and PhD in Computer Science from PUC-RIO. Founder of LAVID (Center for Research and Extension in Digital Video Applications) and one of the creators of the VLibras software (www, Portuguese to Libras translator, used at www.brasil.gov.br, câmara.leg.br, etc.). He worked on the development of the Ginga middleware, published as ITU-T and ITU-R recommendations, and adopted as a standard in the Brazilian Digital Television System. He is one of the mentors of the 6Bios project (6bios.com), which uses satellite image processing and blockchain contracts in a scalable payment solution for environmental services.

Yuri Fernandes Souza Silva is a Computer Engineering graduate from the Federal University of Paraiba (UFPB). He is currently a researcher at the Center for Research and Extension in Digital Video Applications (LAVID) and a Software Engineer at MoPA Embedded Systems. In both roles, his work is dedicated to the research and development of application tools and technologies for the TV 3.0 standard. Additionally, he possesses technical expertise in Computer Vision and Artificial Intelligence.

Received in 2025-07-06 | Approved in 2025-08-04

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.1 Web Link: https://dx.doi.org/10.18580/setijbe.2025.3