# Development of a Solution for Identifying Moral Harassment in Ubiquitous Conversational Data


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Abstract: This study presents the development and evaluation of a moral harassment detection system focusing on mobile and pervasive computing, leveraging artificial intelligence, textual similarity analysis, and ubiquitous data generated from recorded audio. Implemented as a mobile application, the system allows users to record audio and identify inappropriate behaviors using models like Mistral AI and Cohere, while integrating a collaborative database that evolves with user contributions. Tests conducted ranged from simple phrases to complex dialogues and colloquial expressions, demonstrating the hybrid approach's effectiveness in capturing cultural and linguistic nuances. By combining advanced technologies and user participation, the system adaptively identifies moral harassment, enhancing detection accuracy and continuous learning. This work underscores the potential of mobile devices and pervasive systems to monitor daily interactions in real-time, contributing to moral harassment prevention, fostering ethical environments, and advancing the innovative use of ubiquitous data for social well-being.


## 1 INTRODUCTION

The constant evolution of connectivity technologies, including remote and wireless connections, has significantly transformed the development and use of ubiquitous devices, such as smart cards, sensors and others. These devices permeate various areas of society, playing fundamental roles in everyday life and in the advancement of innovative technological solutions (Barros, 2008).

Historically, computing has presented three major trends that have shaped the relationship between users and technologies. The first trend, known as mainframe, is characterized by the "one computer, many users" model. Then, the era of personal computers was consolidated with the concept of "one user, one computer". The third trend emerged with the advancement of the Internet, highlighting the "one user, many computers" paradigm. This last trend, which aligns with distributed and mobile computing, is closely connected to the concept of Ubiquitous Computing (Santos, 2014; Greenfield, 2018). In this context, the presence of hundreds of computers in a room, which might initially seem intimidating, tends to become invisible to conscious perception, just like the electrical wires hidden in the walls of a room(Shaheed et al., 2015). Computing ubiquity seeks to achieve this naturalness, integrating technology imperceptibly into everyday human activities (Weiser, 1995).

Ubiquitous computing emphasizes the use of "invisible" tools, that is, devices that perform their functions efficiently without demanding the user's full attention. Examples of this include glasses that, although positioned on the face, do not divert the visual


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focus of the person using them, and audio capture devices that can record conversations in hostile environments for later data analysis (Weiser, 1994).

Although such devices use different media — such as sound, video, text and graphics — their purpose is not to act as "multimedia devices". Unlike traditional multimedia machines, which require the user's direct attention, ubiquitous devices are designed to disappear into the background, allowing users to focus on essential tasks and interacting with the environment (Weiser, 1995).

## 1.1 Problem

The increasing use of ubiquitous devices in everyday environments has expanded the possibilities for monitoring and analyzing human interactions, including those that occur in adverse contexts, such as bullying (Ahmed, 2024). Despite the significant advances provided by ubiquitous computing, there are still important gaps to be explored to improve technologies for detecting abusive behaviors, especially in the field of Human-Computer Interaction (Blackwell et al., 2019; Vranjes et al., 2020). This study seeks to investigate how ubiquitous devices, particularly those based on audio capture and data analysis, can be used to identify harmful practices, such as bullying, during technology-mediated interactions. Moral harassment, characterized by abusive and repetitive behaviors that affect a person's psychological, social and/or physical integrity (DE SOUZA, 2018; Silva Junior et al., 2024), can occur in various social environments, and is especially worrying in the work and educational context, where it compromises the well-being of individuals and destabilizes work and teaching environments.

## 1.2 Objective

This study aims to develop an intelligent system for monitoring and accurately detecting situations of moral harassment in data generated by Human-Computer interaction, specifically by ubiquitous devices in conversational environments. Using pervasive computing and natural language processing (NLP) techniques, the system will analyze interactions, focusing on identifying patterns of behavior that may indicate harassment practices. The proposal involves the development and implementation of user-centered systems, integrated with portable devices, such as smartphones, that efficiently capture conversations, with the aim of providing a personalized monitoring and detection experience.

The analysis will be conducted based on artificial intelligence and machine learning methodologies, allowing the identification, classification and provision of feedback on the collected data, in order to identify moral harassment behaviors in an automated and accurate manner.

### 1.2.1 Specific Objectives

The objective of this work is to develop an intelligent system for detecting moral harassment in data generated by ubiquitous devices, specifically in conversation environments mediated by Human-Computer interaction. The main focus will be on the processing and analysis of the captured audio data, using advanced Artificial Intelligence and machine learning methodologies. To generate the audio, an application will be created that will use the integrated microphone of smartphones. This objective will be broken down into the following goals:

1. Develop a system composed of two REST APIs for the processing and analysis of audio data generated in Human-Computer interactions.
2. Implement a moral harassment detection using artificial intelligence widely available on the market.
3. Create a detection based on SQL queries, using pre-established data stored in the database.
4. Develop a detection method by similarity, comparing new data with information previously stored in the database.
5. Implement a learning system based on user feedback to improve the detection of moral harassment.
6. Analyze the characteristics of data generated by ubiquitous devices, with emphasis on audio interactions, to identify relevant variables in the detection of moral harassment.
7. Develop an application that works as a client for capturing and recording audio files, allowing interaction with the harassment detection system.

## 1.3 Justification

The growing adoption of pervasive computing technologies and the evolution of Human-Computer Interaction practices offer a unique opportunity to use data generated by ubiquitous devices in an intelligent and effective way. This data can be fundamental to creating safer, more inclusive and respectful environments, enabling, for example, the development of user-centric systems capable of identifying harmful behaviors, such as bullying. The implementation of a machine learning-based solution to detect such behaviors is a significant innovation, with the potential to promote a positive impact on society by providing a healthier environment, both in professional and educational contexts.

Bullying, especially in higher education institutions, is a phenomenon that, despite its significant repercussions, still does not receive the attention it deserves in the academic literature. Characterized by abusive and repetitive practices, with the aim of humiliating and psychologically destabilizing the victim, bullying can result in devastating impacts, both in the personal lives of those involved and in the work environment and in the educational context. In the educational context, bullying compromises the well-being of teachers and students, harming organizational dynamics and directly affecting productivity and the quality of teaching. Therefore, it is essential that bullying in educational institutions be discussed in more depth, with the exploration of technological solutions for its detection and prevention (DE SOUZA, 2018).

# 2 METHODOLOGY

The methodology adopted for this research follows a practical and applied approach, with an emphasis on Human-Computer Interaction (HCI) and User-Centered Systems. The main focus is the development of a mobile application aimed at detecting bullying in audio-based interactions generated by ubiquitous devices. The process involves creating a mobile application using TypeScript, React Native and Expo technologies, allowing the recording and sending of audio data for later analysis. The backend system will consist of two REST APIs: one built with TypeScript and Nest.js and another with Python, for processing and analyzing the captured data.

## 2.1 Procedures and Resources

This section details the procedures adopted for the development of the application and the analysis system, as well as the technological resources employed. The process of detecting moral harassment is centered on user-device interactions, with the objective of identifying abusive behaviors through the analysis of audio recordings made by users. The focus is on understanding and interpreting communication patterns that may indicate moral harassment, considering the dynamics of human-computer interaction and how ubiquitous devices can be used in an invisible but effective way to monitor and detect inappropriate behaviors.

### 2.1.1 System Development

The development of the system was designed to handle ubiquitous data in audio format, aligning with the principles of pervasive computing and Human-Computer Interaction (HCI). The application backend consists of two REST APIs, each playing a specific role in data processing and analysis:

1. API 1: Developed in TypeScript using the Nest.js framework, in conjunction with Prisma ORM, ensuring a robust structure for data management and integration with the PostgreSQL database.
2. API 2: Implemented in Python with the FastAPI library, focused on audio processing and more complex analyses, including integration with machine learning models.

The client responsible for data collection, that is, recording conversations that will generate audio for analysis, will be developed as a mobile application using TypeScript, React Native and Expo technologies. The interface of this application will be designed based on the principles of User-Centered Systems, ensuring ease of use and a user-friendly experience during interaction.

# 3 BACKGROUND AND RELATED WORK

## 3.1 Human-Computer Interaction (HCI)

For users to get the most out of a system, interfaces need to be designed to promote efficient and intuitive interaction. This requires that interfaces meet criteria of usability, user experience, accessibility, and communicability (Santos, 2014; Ramirez et al., 2022).

Usability refers to the ease with which users learn to use the system and perform their tasks. It is a set of factors that measures the quality of the user's interaction with the system. These factors include: ease of learning, memorization, efficiency, safety during use, and user satisfaction when completing their activities (Santos, 2014).

User experience focuses on the emotions and sensations generated by the interaction with the system. Although often associated with user satisfaction, it goes beyond that, considering how the system impacts the perception and comfort of those who use it (Jun et al., 2008; Santos, 2014; Alhirabi et al., 2021).

Accessibility, in turn, concerns the system's ability to remove barriers that limit use by people with different abilities. By ensuring accessibility, it becomes possible to expand the reach of the software to more diverse audiences. A clear example is the use of screen readers, which help people with visual impairments to interact efficiently (Santos, 2014).

Finally, communicability addresses how the system's design communicates its operating logic to users. When the user understands the logic behind an interface, they are more likely to use it creatively and effectively. An example of this is the application of visual analogies that refer to objects in the physical world, facilitating familiarity with the system (Santos, 2014).

#### 3.1.1 HCI in Ubiquitous Systems

Ubiquitous computing represents a natural evolution of computing, where the interaction between users and technological devices occurs in an integrated and continuous manner. This approach seeks to create environments full of intelligent devices that focus on improving the human experience, often without the need for explicit user intervention (Stefanidi et al., 2023).

Interaction in ubiquitous systems goes beyond traditional interfaces and includes implicit interaction methods. This means that systems can capture user input data automatically and naturally, without requiring direct attention. A classic example is that of automatic doors that detect the presence of a person and open. Although implicit, this interaction is the result of a system that interprets data from the environment and responds to human behavior (Vallejo-Correa et al., 2021).

To ensure an effective experience, ubiquitous systems must adopt more natural interfaces that simplify interaction. Technologies such as voice commands, gestures and touch screens are examples of solutions that replace or complement traditional graphical interaction elements. These technologies also help to subtly integrate computational elements with the physical environment, creating a homogeneous and natural experience for the user (Santos, 2014).

However, the development of ubiquitous systems brings significant challenges. Among them are:

- The complexity of implementing and evaluating systems in real scenarios.
- The need to collect and store continuous interaction data without compromising the user experience.
- The difficulty of dealing with tasks that can be paused, resumed or shared between users.
- The challenge of accurately identifying the user's context, given its unpredictability and environmental variables.

These challenges are even more evident in systems such as the one proposed in this work, which seeks to detect moral harassment. The idea of maintaining discreet audio sensors, handling multiple participants, and interpreting conversations in real time requires innovative solutions. Furthermore, determining the intent or context of a conversation represents a significant technical and ethical hurdle.

Ubiquitous computing radically transforms the relationship between humans and machines. By spreading computational services across all aspects of daily life, it expands the possibilities for interaction. However, the success of this transformation depends on projects that prioritize HCI principles, ensuring that applications are intuitive, accessible, and effective for their users (Santos, 2014).

### 3.2 Moral Harassment

Moral harassment is characterized as any abusive, repetitive and systematic behavior that affects a person's psychological, social or physical integrity, compromising their dignity, threatening their employment relationship and disrupting the work environment. This type of behavior is generally manifested by superiors in relation to their subordinates, using their position of power to commit such abuse. Harassment can be explicit or implicit.

In the implicit form, the harasser resorts to nonverbal behavior, such as indifference or irony, which are more difficult to prove. This approach allows the aggressor to deny his intentions if confronted, masking the abusive behavior. In the explicit form, the actions become evident not only to the victim, but also to third parties. Examples include excluding the victim from activities or groups without justification, exposing them to embarrassing situations in front of colleagues, or publicly belittling their work. This type of practice, which is more serious, highlights the perversity of the harasser (DE SOUZA, 2018).

The harasser's main objective is to subjugate the victim, shaking their self-esteem and exerting control over them, often in a callous and destructive way. Men, for example, may be attacked in relation to their virility, while women often face intimidation that reinforces stereotypes of submission. This perverse practice reflects the aggressor's unlimited need to assert his power, regardless of the consequences for the victim (DE SOUZA, 2018).

The victim, in turn, often chooses to remain silent, fearing reprisals or the loss of their job. This tolerant behavior, although understandable, contributes to the perpetuation of the cycle of abuse. Continuous humiliation can have serious impacts on the identity, dignity and emotional health of the person being harassed, compromising both their personal and professional life. In addition, it directly affects their work capacity and general well-being (DE SOUZA, 2018).

Moral harassment in the academic environment, especially in higher education institutions, presents specific nuances. Although it is a relevant problem, it still lacks in-depth discussion in the literature. In these institutions, harassment can occur both between professors and students and between colleagues, generating negative consequences for the well-being of those involved, the quality of teaching and the organizational dynamics. In some cases, students can also act as agents of harassment, adopting disrespectful attitudes towards professors, who often choose not to report such incidents to avoid conflicts or harm to their careers (Da Silva Franqueira et al., 2024).

Ubiquitous computing emerges as a potential ally in detecting moral harassment, regardless of the environment in which it occurs. Since many of these practices involve verbal interactions or behaviors, smart devices can be used to monitor and record these events. For example, audio sensors attached to corporate or academic environments could capture suspicious conversations and send them to systems that assess the possibility of bullying. Similarly, devices that capture videos or other forms of interaction could provide concrete evidence for the analysis of inappropriate behavior.

Companies equipped with ubiquitous technology and monitored classrooms can not only prevent incidents of harassment, but also ensure greater safety and justice by providing reliable data that corroborates or refutes complaints. These innovations have the potential to transform the way harassment cases are identified, reported and treated, contributing to healthier and more equitable environments.

### 3.3 Moral Harassment Detection

Moral harassment detection is a challenge that requires the integration of several technologies, such as artificial intelligence, natural language processing and ubiquitous computing, to create a system capable of identifying patterns of abusive behavior. This project proposes an innovative solution that uses audio recordings as input for a system composed of interconnected APIs, artificial intelligence models, and textual analysis techniques. The goal is to offer a practical and efficient tool to identify and classify possible occurrences of moral harassment in different contexts.

## 4 DEVELOPMENT

### 4.1 Architecture

The system architecture is based on APIs that communicate to detect moral harassment from received audios. The mobile application, developed with a focus on system testing, uses the cell phone's microphone to capture conversations. The general flow of the system is described below.

The application's database was filled with several phrases considered examples of moral harassment. In a real scenario, this table could contain a much larger volume of records, which would justify a later analysis to optimize this approach.

Initially, the application records a conversation between the participants using the cell phone's microphone. The audio is then sent to the detection system, with communication between the application and the backend being carried out through an API developed in Nest.js. The backend stores the audio in the file system and uses an executable program in Python, with the Whisper library, to convert the audio into text. From the generated text, the system performs four analysis steps:

1. Database query: The Nest.js API performs an SQL query to compare the generated text with phrases previously entered in the database.
2. Similarity analysis: The generated text is sent to a Python API, which performs a similarity search in the database, returning the result to the Nest.js API.
3. Mistral Detection: The text is analyzed by an API that uses the Mistral artificial intelligence model, returning a detailed analysis to the Nest.js API.
4. Cohere Detection: Similar to the previous step, but using the Cohere model, the analysis is returned to the Nest.js API.

After these analyses, the results are stored in the database and sent to the application, allowing the user to view the detailed data. The complete architecture of the flow is presented in Figure 1.

In the case of detection based on a database without similarity, the identification of moral harassment is attributed as a decision by the "Administrator", without implying a definitive or punitive nature. If the database does not detect harassment, users can vote on whether or not they consider the text to be moral harassment. The votes generate a result that can be positive, negative or undetermined, depending on the consensus or tie between the votes. This process allows the system to evolve by incorporating the collective perception of users.

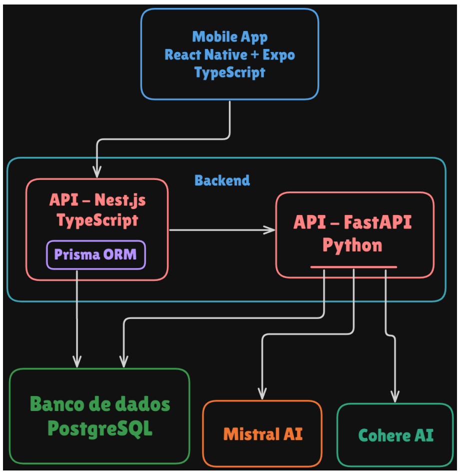


Figure 1: Project architecture mind map.

The detections performed by the Mistral and Cohere AI models are immutable by users, since the models are trained and maintained by specialized companies. Similarity detection, in turn, uses the same database as the detection without similarity, being updated jointly, which eliminates the need for a separate voting system for this stage.

In this way, the proposed solution combines traditional and advanced textual analysis techniques, taking advantage of both collective intelligence and the precision of modern artificial intelligence models.

#### 4.1.1 Application

The mobile application developed for this project plays an essential role in allowing the user to interact with the moral harassment detection system. It was designed to be intuitive and functional, offering a practical experience for recording audio and consulting analysis results. The application has an interface organized into different screens, each with specific functionalities to meet the system flow.

#### 4.1.2 Home Screen

The application's home screen (Figure 2) is the starting point for the user. It presents the application's objective through a clean and straightforward interface, with a link that leads to the main functionality, which is present on the recording screen.

#### 4.1.3 Recording and Detection Screen

The recording and detection screen (Figure 3) is where the user's main interaction with the system occurs. Here, the user can start or stop recording audio using a centralized button. After recording, the audio

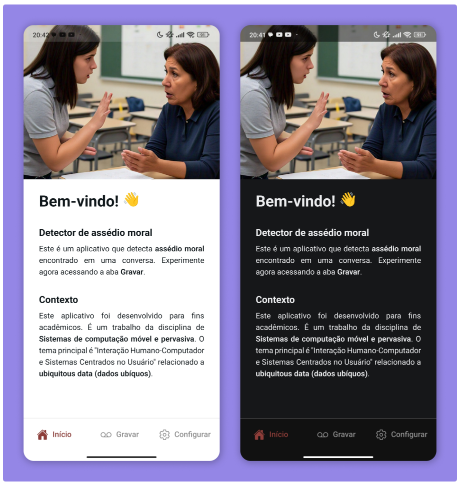


Figure 2: Application Home Screen.

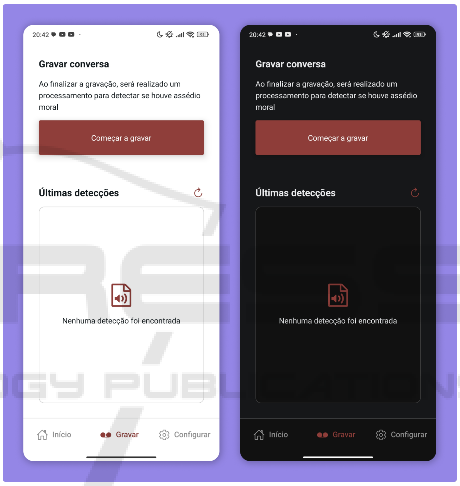


Figure 3: Recording and detection screen.

is automatically sent to the detection system for analysis. During the process, the screen displays a processing indicator to inform the user that the analysis is in progress. In addition, the analysis results can be presented directly on this screen, allowing for quick and efficient viewing.

#### 4.1.4 Settings Screen

The settings screen (Figure 4) offers options to customize how the application works. On this screen, the user can adjust only the application's theme, switching between light, dark or system-based mode.

### 4.2 Using the Detection System

The bullying detection system was subjected to a series of tests that explored different scenarios, from simple sentences to more complex interactions. The

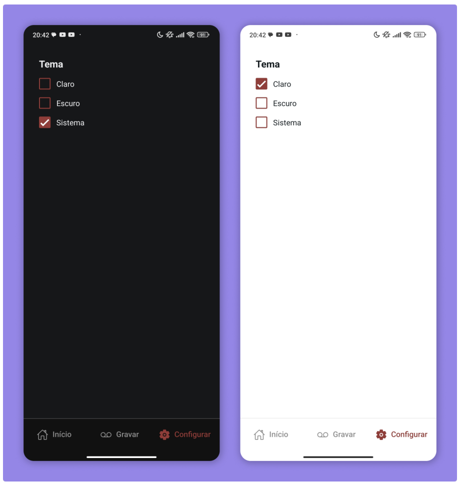

Figure 4: Settings screen.

objective of these tests was to evaluate the effectiveness of the system in identifying bullying and its ability to learn and adapt based on user interactions.

Initially, a simple and offensive sentence, "You are useless", was recorded and analyzed. The result revealed that all four evaluators involved considered the sentence to be bullying, as shown in Figure 5. This result demonstrates that, even using short sentences previously recorded in the database, the system is capable of accurately identifying harassment situations. Figure 6 shows the results generated by the system for this test.

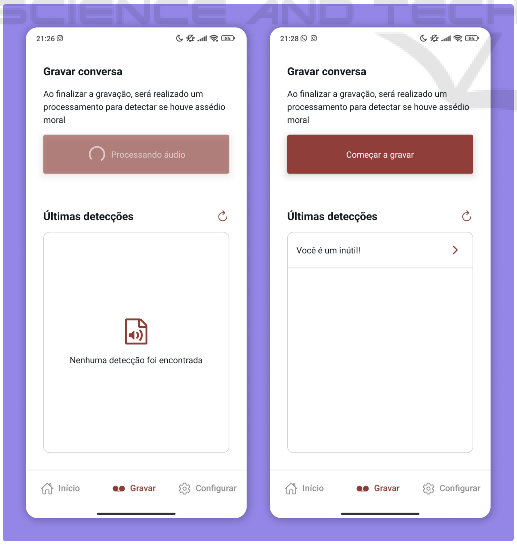

Figure 5: First Recording.

In the second test, a common phrase containing compliments without any aggressive connotation was used. The evaluators did not consider the phrase as moral harassment, which confirms the system's

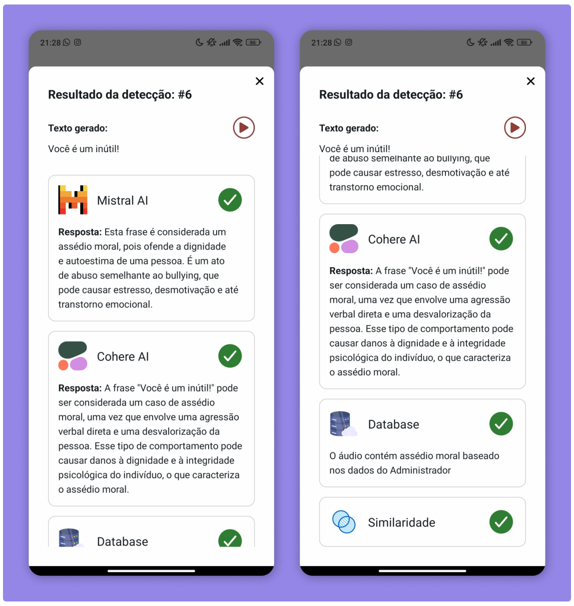

Figure 6: Results of the first recording.

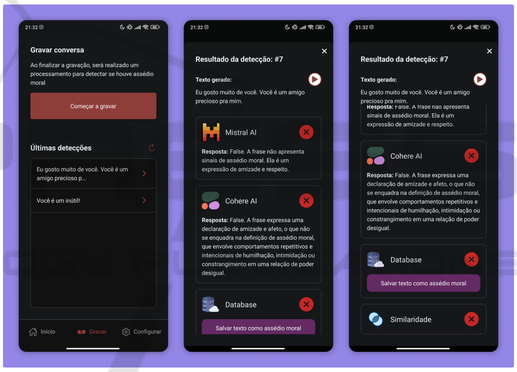

Figure 7: Second Recording.

ability to differentiate harmless interactions from potentially abusive situations. Figure 7 illustrates the recording process and the results of this test.

In the third test, two participants simulated a professional conversation in which a superior employee delegated tasks to a subordinate. The analysis revealed that the Mistral AI model considered the interaction to be bullying (Figure 8). However, the Cohere model did not classify the conversation as bullying, although it did identify unethical behavior and possible violations of labor laws (Figure 9). Furthermore, database queries and similarity methods also did not detect bullying in this scenario, highlighting the nuances involved in interpreting complex interactions.

The fourth and final test explored the user voting functionality. A sentence with regional characteristics and slang was submitted to the system. Although the artificial intelligence detected moral harassment,

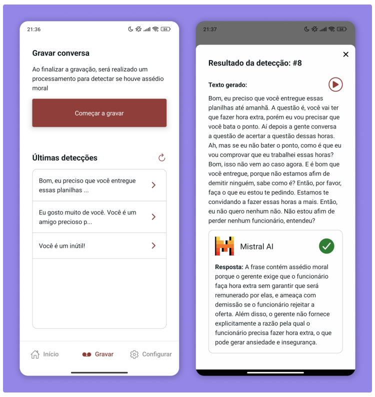

Figure 8: Third Recording and Results.

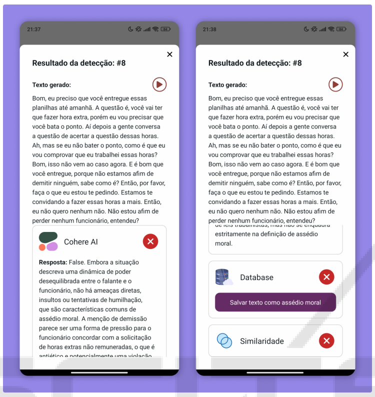

Figure 9: Third recording and more results.

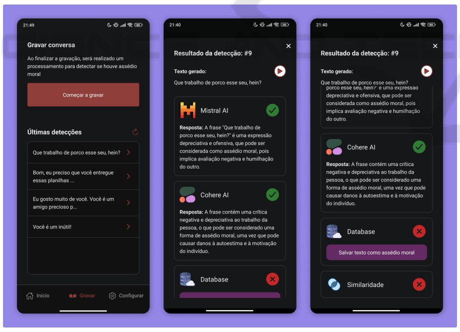

Figure 10: Fourth recording and results.

database queries and similarity methods were not effective. Figure 10 illustrates the recording process and the initial test results.

It is possible to observe in Figure 10 that the database evaluation did not detect moral harassment, but it is possible to save the text if the user considers it to be moral harassment, when doing so a screen to save is displayed, which is represented by Figure 11.

An audio in which moral harassment was not detected by the administrator (database) allows the user to save this detection as moral harassment if they consider it, this opens a vote where the application users can leave their vote on whether that conversation contains moral harassment or not. This can be seen in Figure 12, where the first screen shows the harassment detection by the user and the second screen shows how the vote for that text is going.

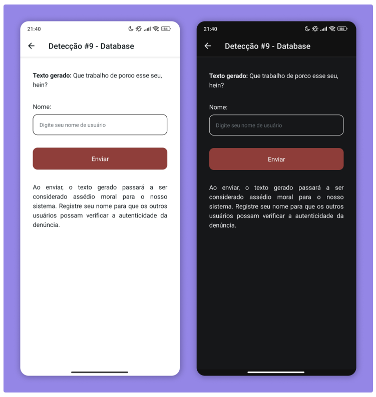

Figure 11: Fourth recording and more results.

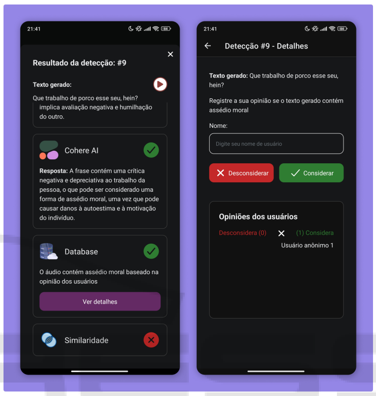

Figure 12: Voting for fourth recording.

As seen in Figure 12, users can vote on whether or not moral harassment exists in the sentence. In cases of a tie, the detection result is considered undetermined (Figure 13). When the majority of votes do not consider the interaction as moral harassment, the system alerts that no moral harassment was identified, as shown in Figure 14.

A final possible case is the vote where the majority of users do not consider the text as moral harassment, this causes the detection results to alert that it was not considered moral harassment based on the users' opinion. Figure 14 shows the vote where the majority does not consider moral harassment and how this is displayed on the screen.

The fourth test shows how the system can learn from users. In addition to being able to detect using highly intelligent services such as two artificial intelligences, it is also possible to improve the basis of the moral harassment detection system itself.

This system can be integrated with other devices that are considered more pervasive and thus detect ir-

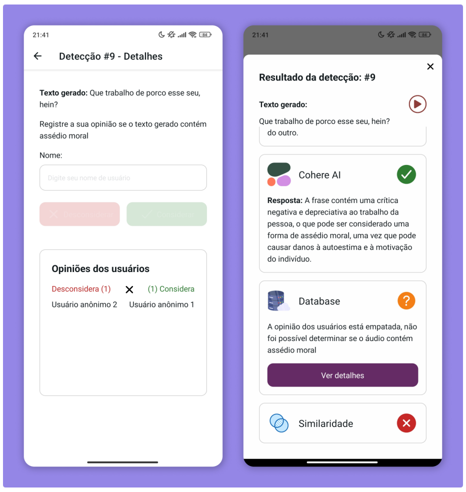


Figure 13: Tie of a vote.

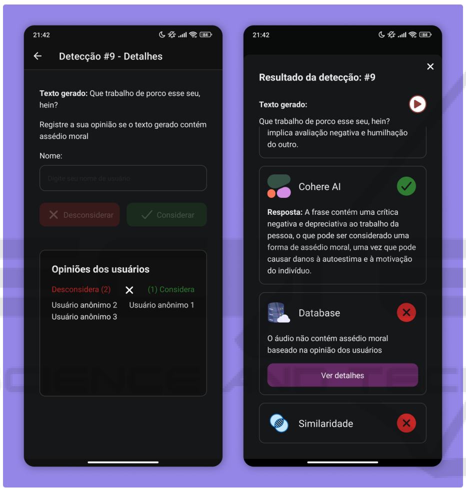


Figure 14: They disregard the presence of moral harassment.

regularities in everyday conversations. The application developed was designed mainly to test this system and provide the possibility for users of the application to improve the system based on their opinions.

## 5 CONCLUSIONS

The presented bullying detection system demonstrated significant potential in identifying inappropriate behaviors in work and everyday contexts. Using a hybrid approach that combines artificial intelligence, textual similarity analysis, database and collaborative user voting, the system proved to be an adaptable tool with continuous learning capacity. The tests performed demonstrated the effectiveness of the system in dealing with different scenarios, from simple sentences to more complex dialogues, and highlighted its versatility in integrating various detection methods, such as the Mistral AI and Cohere models.

Despite the contributions, challenges were identified that can be explored in future work. Firstly, the analysis of long and complex conversations revealed limitations in processing, especially due to the delay associated with converting audio to text and the large number of words analyzed by the database. In addition, the system depends on explicit user interaction to start and end recordings, which limits its pervasiveness. Ubiquitous devices equipped with sensors that automatically capture conversations could make the system more integrated into the environment, but they raise ethical issues and technical challenges related to real-time data detection and storage.

Another relevant limitation is the database used for text comparison. In a real scenario, a significantly larger and more diverse database would be required, which would generate new challenges, such as validating the authenticity of the inserted sentences and managing the impact of the increase in data on the system's performance.

In summary, this work validates the technical feasibility of a system for detecting moral harassment and highlights the potential of mobile and pervasive computing technologies in promoting more ethical and respectful social and work environments. At the same time, it points out ways to develop more robust and integrated solutions, reinforcing the importance of approaching the topic from an interdisciplinary perspective that unites technology, ethics and social well-being.

## 6 FUTURE WORKS

Recommendations for Future Works:

- **Ethics in Ubiquitous Devices.** Investigate the ethical and social implications of devices that capture conversations continuously, considering the privacy and consent of individuals.
- **Development of Ubiquitous Systems.** Design a pervasive device that uses systems similar to the one developed, capable of operating autonomously and effectively in different environments, minimizing the need for direct user interaction.
- **Optimization and Scalability.** Implement optimization techniques for processing long audio files and managing large volumes of data based on phrases, ensuring greater speed and efficiency in detection.

### 6.1 Ethical and Privacy Considerations

The implementation of a system for detecting moral harassment in ubiquitous conversations raises significant challenges in terms of privacy and ethics. To address the ethical and privacy challenges associated with this paper, several measures should be implemented in future works:

- **Informed Consent.** The system should not record audio without the user's explicit consent. Before any recording, a clear notice should be displayed explaining the purpose of audio capture and requesting permission. Additionally, users should be able to stop the recording at any time.
- **Anonymization and Data Protection.** All captured audio should be automatically converted into text before processing, and any identified sensitive information should be anonymized or removed through automatic filters.
- **Responsible Use of Artificial Intelligence.** The system's detections should be used only as an indicative and should not have punitive implications, always requiring human review to prevent false accusations.
- **Right to Be Forgotten and User Control.** The system should allow users to request the deletion of their recorded interactions. Moreover, stored data should be encrypted and accessible only to authorized users, preventing misuse by third parties.

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